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The Vertiginous Thrill of Exactitude: Life, Literature and the Physical Sciences in Post-
Enlightenment Paris (1780-1840)

By

Travis Benjamin Wilds

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

French

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Michael Lucey, Chair

Professor Susan Maslan

Professor Carla Hesse

Fall 2015

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by Travis Benjamin Wilds

Abstract

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The Vertiginous Thrill of Exactitude investigates the conditions of intellectual production about life, living things and Nature in general prior to the emergence of literature as an autonomous cultural form. Through readings of texts by late Enlightenment and Romantic-era writers and savants, the dissertation tells the story of how literature and science became distinct entities, with distinct objects and distinct ends, by the latter half of the nineteenth century. Literary writers with natural philosophic ambitions react, I show, to the rise of Newtonian mathematical physics as an epistemic ideal among the elite mathematical physicists of the *Académie des sciences*, answering the growing prestige of precise quantification in the sciences with anti-mathematical rhetoric and alternative modes of quantification. The rhetoric of “exactitude” generated by the Parisian mathematical physicists and the savants who depended on their patronage corresponded, I show, to a push for cultural autonomy in scientific production, and ultimately to the emergence of a distinct scientific “field.”

Countering this trend toward specialization on the one hand, and classicist notions of letters on the other, texts by writers like Bernardin de Saint-Pierre and Balzac strive to adapt the Enlightenment ideal of a cohesive republic of “letters” to the social and epistemic conditions of post-Revolutionary France. In reaction to the pro-Newtonian developments in the sciences, Bernardin de Saint-Pierre articulates an anti-Newtonian position assembled from early modern natural theology, the rhetoric of “spectacular” representation and a sentimental appreciation of Nature. In contrast, Balzac and other writers and thinkers in the eighteen-thirties and -forties opt for a kind of hyper-Newtonianism oriented toward the mathematization of phenomena like volition or vitality, disavowed by the institutional sciences. In opting to investigate living things in terms of their “physico-chemical” elements rather than as subjects of vitality, the emerging life sciences of nineteenth-century Paris incited a notion of life *per se* as scientific representation’s constitutive other. Literary thinkers of Balzac’s time opposed this move in favor of prophesying the direct representation of life itself, critiquing the sciences of their day for their narrow

specialization while seeking to conjure the conditions for a “total” science. By the mid-nineteenth century, the notion of life itself thus becomes one of the prime justifications for the dissolution of scientific autonomy.

In Chapter One, “Bernardin de Saint-Pierre and the Virtues of *Admiration*: Sentiment, Spectacle and the “Science to Come” in the *Études de la nature* (1784),” I show how Bernardin forged Rousseauvian sentimentality, early eighteenth-century natural theology, Buffonian natural history and his own expertise as a naval engineer into a new form of natural philosophy. The emphasis on the value of marveling that we find in Bernardin’s “*science à venir*” occurs as an attempt to update, I contend, notions about the study of Nature formerly prevalent among early eighteenth-century savants and generalists. The imperative to admire Nature, I show, becomes an “epistemic virtue” (Lorraine Daston and Peter Galison) which maximizes knowledge about some aspects of Nature while minimizing others. Espousing the virtues of “admiration,” Bernardin’s work helps gauge the discursive grounds on which it was possible to dispute scientific values at the turn of the nineteenth century in France, while also compelling us to reintegrate wonder into the repertoire of Enlightenment-era scientific affects.

In Chapter Two, “The Virtues of *Exactitude*: Alessandro Volta and the Emergence of Scientific Autonomy in Napoleonic Paris,” I examine the construction of a rhetoric of “exactitude” among the élite mathematical physicists of the Paris *Académie des sciences*. Like the imperative to admire espoused by Bernardin de Saint-Pierre, “exactitude,” I show, can be construed as an epistemic virtue that maximizes knowledge about some aspects of Nature while minimizing others. The chapter examines the construction of “exactitude” as an epistemic ideal through an account of the strategies pursued by the Italian natural philosopher Alessandro Volta as he introduced his work on animal electricity to his Parisian counterparts in 1801. Volta’s eventual integration into the Parisian scientific élite was attributable, I argue, to his efforts to adapt his experimental idiom to the rhetoric of exactitude, as well as to the intervention of the First Consul himself, and to his success in showing that electricity in animals could be described by purely physical laws. By demonstrating the physical nature of animal electricity, he gave rise to new ways of making animal bodies amenable to quantification, while sidelining opponents who argued that vitality itself should constitute an object of the sciences. Situating Volta’s experimental work in a European context, I show that the changes advocated by the *Académie* élite provoked disagreement not only among home-grown writers of fiction and natural philosophy, but also among savants at home and abroad.

In Chapter Three, “Balzac, Geoffroy Saint-Hilaire and the Virtues of Synthesis,” I show how Balzac’s innovations in novel form were shaped by the impulse to reverse the increasing autonomy of the sciences in the interest of creating a total intellectual space. Along with other writers, philosophers and savants of the mid-nineteenth century, I maintain, Balzac articulated a rhetoric of “synthesis” predicated on the poetic and scientific possibilities of vital materialism. Though critics from the mid-nineteenth century onward have dismissed Balzac’s own scientific ideas and his criticisms of the sciences of his day, we cannot read Balzac fully, I argue, without understanding his novel-writing practice as an attempt to intervene seriously in the study of

“life.” Through a sustained reading of the novel *La peau du chagrin* (1831), along with analysis of the “Avant-propos” to the *Comédie humaine*, *Louis Lambert* (1833) and other novels, I show how Balzac’s innovations in novel form wed popular entertainment to ideas about life and volition. Surprisingly, Balzac’s notion of synthesis does not deny science but envisages outdoing it on its own terms: along with Geoffroy Saint-Hilaire, Saint-Simon, Comte and other contemporaries, he criticizes his savant contemporaries for applying exact methods to material bodies alone, while prophesying the mathematization of vital phenomena like will and thought.

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route to happiness in this day and age, your unconditional support throughout my life, from Valrico, to Snead Island to here, has made this moment possible.

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INTRODUCTION

“La création du monde n’a pas eu lieu au début, elle a lieu tous les jours.”
Marcel Proust, *Albertine disparue*¹

I. Exactitude at Large

In an article entitled “De l’influence des idées exactes dans les ouvrages littéraires,” published in the *Nouveau Mercure* in 1809, the physicist and mathematician Jean-Baptiste Biot momentarily set aside his celebrated work on electricity, magnetism and gases to try his hand at literary criticism. Biot’s historiography of the relationship between letters and the sciences reaches all the way back to Homer and Virgil, Pythagoras and Plato, but the sweep of his argument scarcely conceals a more immediate polemical motive. “Exact ideas” were regrettably absent from the literature of his day, in the famous savant’s view, and the writers Chateaubriand and Bernardin de Saint-Pierre in particular erred on the side of exactitude’s counter-party, “imagination.” Though fiction- and poetry-writing might require the use of imagination, Biot allows, these two writers’ immoderation inspired what he viewed as their wayward handling of the French language, as well as the implausible ideas they espoused about Nature. Given the breadth of their readership, moreover, Biot feared they were contributing to the corruption of literary taste in France more generally. “*En citant ces passages d’un auteur qui a reçu tant d’éloges,*” Biot writes of the Chateaubriand of the *Génie du christianisme*, “*dont les ouvrages sont entre les mains de tout le monde, et qui jouit aujourd’hui d’un si grande célébrité, je n’ai eu qu’un seul but: c’est de montrer par des exemples saillants et palpables, que le style le plus brillant, le plus harmonieux, ne saurait avoir de beautés réelles sans la vérité.*”² For Biot, there could only be one truth for both letters and sciences, and “exactitude” appears in his essay as the style or spirit of this truth. A more exact spirit, he believes, would bring fiction, poetry and theater closer to the standard of truth espoused by the sciences, and curb imagination’s potentially pernicious influence on the century ahead. “*Les progrès des connaissances exactes,*” he affirms, “*loin d’être nuisible aux lettres, leur sont plutôt favorables, soit en donnant plus de vérité à leurs tableaux,*

¹ Marcel Proust, *Albertine disparue* (Paris: Gallimard, 1992), 249.

² Jean-Baptiste Biot, “De l’influence des idées exactes dans les ouvrages littéraires,” *Mélanges scientifiques et littéraires*, vol. 2 (Paris: Lévy Frères, 1858), 17.

soit en offrant de nouveaux aliments à la pensée, lorsque l'âme n'a plus de nouvelles passions à ressentir ou à peindre."³

Biot did not invent this notion of exactitude from whole cloth. As Christian Licoppe has shown, the discourse of exactitude takes on special meaning in the sciences of this period, where it begins to characterize altogether new modes of measurement and experimentation. While "exactitude" generally designated the veracity and comprehensiveness of a given description through the eighteenth century,⁴ experimental natural philosophers like Biot, and Lavoisier, Laplace or Coulomb before him, greatly multiplied the ramifications of the term at the dawn of the nineteenth. In their hands, "exactitude" came to typify not only verbal and visual modes of description but also elements of experimental practice and thought, including the precision of a given measurement, the rigor of the mathematical reasoning that sought to link experimental measurements together, and even the veracity of the resulting law. In one experimental report, Licoppe notes, Lavoisier celebrates the fact that an "exact" correspondence between the experimental quantities predicted and those measured gives "*une confirmation frappante de l'exactitude de la théorie,*" a formulation that touches on each of these three acceptations in swift succession.⁵ But even though Lavoisier and others prided themselves on practicing "exact" science and embraced the rhetoric of exactitude, they did not themselves discriminate among these meanings. For them, exactitude was an ideal, not a doctrine.

If exactitude designates certain aspects of experimentation and reasoning, what influence could it possibly exert over "literary works?" In his essay, Biot never really tells us what makes an "idea," as opposed to a description, measurement or mathematical formula, exact, and over the course of the article the ideal of exactitude proves as ambiguous and protean in the literary domain as in the scientific. Exact ideas are the particular facts about Nature produced by the exact sciences, it seems, and works of fiction, poetry or theater can be "exact" insofar as they make

³ Ibid. Biot's notion of the exhaustion of the soul is a commonplace predicated on the parallel between societies and individuals. In a culture like Greece, Rome or France, "*il devient bein difficile de trouver de nouveaux sentiments, de nouvelles passions qui leur aient échappé,*" and a period of literary decadence inevitably arises (2). Though Biot is a royalist, this topos also permeates liberal cultural theory. "*Peut-être avous-nous passé l'âge des plus brillans travaux d'imagination,*" speculates Pierre Jean Georges Cabanis in the *Rapports du physique et du moral de l'homme*, in favor of a period in which, "*toutes les connoissances et toutes les idées applicables à la satisfaction des besoins de la vie, à l'augmentation des jouissances sociales, au perfectionnement des esprits, à la propagation des lumières, semblent être aujourd'hui devenues partout, le but commun de tous les efforts.*" *Rapports du physique et du moral de l'homme* (Paris: Crapelet, 1802), xxiii-xxiv. For Germaine de Staël the fact that poetic impression had become difficult to access in a positive new age was mitigated by the fact that it was essentially timeless. "*On peut marquer un terme aux progrès des arts,*" she affirms in *De la littérature*, "*il n'en est point aux découvertes de la pensée.*" *De la littérature considérée dans ses rapports avec les institutions sociales* (Paris: Flammarion, 1991), 91.

⁴ For instance, a *Chorographie ou description exacte des plus remarquables lieux tant villes, bourgades que villages es environs de la cité de Genève*, 1591, engraving, <http://gallica.bnf.fr/ark:/12148/btv1b55002409x>. Or a *Histoire naturelle et civile de la Californie, contenant une description exacte de ce pays, de son Sol, de ses Montagnes, Lacs, Rivières & Mers, de ses Animaux, Végétaux, Minéraux, & de sa fameuse Pêcherie des Perles; les Moeurs de ses Habitans, leur Religion, leur Gouvernement, & leur façon de vivre avant leur conversion au Christianisme; un détail des différens Voyages, & Tentatives qu'on a faites pour s'y établir, & reconnoître son Golfe & la Côte de la Mer du Sud*, 3 vols.(Paris: Durand, 1767).

⁵ Christian Licoppe, *La Formation de la pratique scientifique: le discours de l'expérience en France et en Angleterre* (Paris: La Découverte, 1996), 256.

factually correct claims about Nature, or at least eschew factually incorrect ones. Moreover, exactitude is associated with economy and precision of expression, as in the case of epithets—“*la verte Zacynthe, l’âpre Ithaque, et la sablonneuse Pylos*”—which reduce a person or place to a single, apt descriptor.⁶ But exactitude further applies to representations of moral phenomena which, like Dido’s despair, can be said to be “*de tous les siècles et de tous les pays*.”⁷ Pertaining to the factual content of literary works, to style, and to the evocation of universal human emotions in literary composition, exactitude additionally designates “*un esprit d’examen et de doute*” appropriate to literary criticism, a sensibility capable of distinguishing the effects of “poetry” or “imagination” from those of exactitude in literary compositions.⁸ From this alloy, it is the job of criticism to extract the “pure gold” of exactitude, a trait associated now with “*l’ordre, la convenance, la sagesse*” and depictions of “*la nature idéale*.”⁹ For even if a modicum of “poetry” inevitably slips into the fabrication of some kinds of literary works (a Racine play, for instance), it subsists there only as a regrettably necessary supplement to the basic substance of exactitude.¹⁰

The notion that a scientific principle should directly define the means and ends of literary composition might well seem implausible today, and the ambiguity of the principle in question does little to bolster Biot’s case. But Biot’s intentions become more legible in the context of a bigger story about the changes agitating lettered culture at the end of the Enlightenment. In subsequent decades, letters were to become “literature” and the sciences were to become “science.” But at the time of Biot’s writing, neither letters nor the sciences enjoyed the kind of autonomy that Pierre Bourdieu would identify as characteristic of cultural production by the time of Baudelaire. Instead, they occupied a single, highly contested space rent by tensions among differing assumptions about what the goals of intellectual production should be. The modern distinction between letters and sciences melts away in Biot’s article in favor of a more fundamental distinction between “imagination” and “exactitude.” The physicist strives for a definition of intellectual culture capacious enough to accommodate both the natural sciences and *belles-lettres* but unified enough to be governed by a principle forged in the exact sciences. As the tendentious quality of his article suggests, efforts to build a consensus around the goals and relative value of different kinds of intellectual production were bound to be controversial in their time, and also foreign in many ways to our own. To we moderns, the notion that some single overarching intellectual principle could productively unite experiments on gases and the writing of verses, the mathematization of the cosmos and the conception of a play might well seem quixotic. Yet meta-discursive commentary on what might be called “total” epistemic ideals was so prevalent during this

⁶ “De l’influence des idées exactes,” 3.

⁷ *Ibid.*, 4.

⁸ *Ibid.*, 3.

⁹ *Ibid.*, 4-5.

¹⁰ Biot softens his attitude toward imagination somewhat in future writings. In a “Discours sur l’esprit d’invention dans les sciences” (1814), he defines the sciences as a mode of research characterized by “*une attention scrupuleusement exacte et minutieuse en apparence, mais guidée par l’invention et l’imagination*.” *Mélanges scientifiques et littéraires*, vol. 2 (Paris: Michel Lévy Frères, 1858), 89.

age that the array of autonomous symbolic forms that came to characterize cultural production in modernity itself comes to seem historically contingent.¹¹

Given the widespread presumption that cultural production could and even should be understood as a totality, perhaps it is no surprise that Biot's targets espoused a totalizing principle of their own. Bernardin de Saint-Pierre and Chateaubriand clamor against what they view as the wrong-headed approach of the exact sciences, while substituting their own total visions of cultural production. These writers object to the exact sciences on the grounds that they replaces a direct, sentimental relationship with Nature with a conventional, instrumental one, disrupting the fundamental unity of the natural and moral orders and therefore conflicting with their own natural philosophical ideals. While Biot asserted a fundamental opposition between exactitude and imagination, Bernardin de Saint-Pierre, Chateaubriand and other like-minded figures responded not by affirming the superiority of imagination against exactitude, but by expressing this sense of disruption in altogether different terms. They opposed the wonder, or *admiration*, that the spectacle of Nature ought by rights to inspire in observers to the disenchantment of Nature operated by the exact sciences. In the *Génie du christianisme*, Chateaubriand proclaims, quoting Gibbon, that "*les sciences exactes nous ont accoutumé à dédaigner l'évidence morale, si féconde en belles sensations, et qui est faite pour déterminer les opinions et les actions de notre vie,*" and he goes so far as to affirm that "*la science entre les mains de l'homme dessèche le coeur, désenchanté la nature, mène les esprits foibles à l'athéisme et de l'athéisme au crime.*"¹² If Chateaubriand responds by laying the groundwork for a new "Histoire Naturelle Religieuse," Bernardin, for his part, similarly defends the prerogatives of wonder in natural philosophy.¹³ In the *Études de la nature* (1784), he hailed the advent of a "*science à venir*" that would triumph over the exact sciences by finding new applications for the sentimental natural sciences.¹⁴

Given these parties' disagreement over the very terms of the debate, perhaps the most they shared in common was the conviction that cultural production could and should be ordered *in toto* by a single principle. Biot's article registers the relative power of these two positions, though ambivalently so. The very existence of a literary essay by a distinguished physicist attests to the persistence of "letters" as a cultural category, enacting the unity of cultural production which the essay seeks to guarantee on new grounds. We sense that his article performs the exact sciences' authoritativeness, its appearance suggesting that for some readers at least the "exactitude" of mathematical physics could plausibly order the means and ends of literary production as well. On the other hand, the article may bespeak a certain instability in the position of the sciences at this moment, such that a physicist like Biot might feel compelled to mount a public de-

¹¹ For more on the problem of "letters" as a category at this juncture, see Louis Bonald "Sur la guerre des sciences et des lettres," *Oeuvres complètes*, vol. 11 (Geneva: Slatkine, 1982), 158-162; or a wide-ranging article by Georges Cuvier in the *Moniteur universel*, 3 November, 1807. For an overview of this problem see also Stéphane Zékian, "Siècle des lettres contre siècle des sciences: décisions mémorielles et choix épistémologiques au début du XIXe siècle," *Fabula* 8 (2011), <http://www.fabula.org/lht/8/zekian.html>.

¹² *Génie du christianisme, ou Beautés de la Religion Chrétienne*, vol. 3 (Paris: Migneret, 1803), 47.

¹³ *Génie du christianisme*, vol. 1 (Paris: Migneret, 1803), 231-32.

¹⁴ *Études de la nature* (Saint-Etienne: Publications de l'Université de Saint-Étienne, 2007), 382.

fense of the Newtonian cosmology of the exact sciences against Bernardin's or Chateaubriand's natural philosophy of wonder. If the impulse to critique these writers effectively (though incidentally) acknowledges them as rivals to the authority of the exact sciences, Biot's essay hints at the degree to which such cosmologies may have continued to hold sway among the public. It becomes difficult to tell whether the article is motivated more by the glee of schooling literary writers on their home territory, or by the pressure to defend the prerogatives of the exact sciences against them. Or, the article might be oriented to a different audience altogether; in the decade since 18 brumaire, Napoleon had become perhaps the most important audience for any scientific producer, with a direct hand in advancing or frustrating the careers of elite figures like Biot. Well-known to despise "imaginative" cosmologies like those of Bernardin de Saint-Pierre and Chateaubriand, personally and politically embroiled, moreover, with the latter, Napoleon might reasonably have been expected to acquiesce in Biot's judgments on the powers of "exact ideas."

These tensions would not be resolved until long after Biot retired from active scientific life and Bernardin de Saint-Pierre and Chateaubriand had both been laid to rest. We know how the story ends: "literature" and "science" became autonomous forms of cultural production, such that a novelist would no longer see fit to critique a work of physics, still less to publish one in his own right, and a physicist would be unable to integrate literary criticism or recognition as poet or novelist into his professional identity. This state of "autonomy" implies that each form of cultural production had achieved a high degree of both self-determination and mutual differentiation: in modernity, each would be substantially free of political, religious and economic domination, and would additionally be defined in opposition to one another. Literature would become the province of the poet or the novelist, not the natural philosopher. As Baudelaire indicates in an article on *Madame Bovary*, the literary writer would henceforth pursue his way "*sans autre excitation que celle de l'amour du Beau et de la Justice*," and perhaps, in light of Flaubert's notorious attention to style, the love of language, as well.¹⁵ Whether we think of literature as "*contre discours*" or as "*contre-pouvoir*"—as the one space, that is, where language use cedes to language thematization, or rather as a force for the invention and defense of "universal" values—it no longer serves as a bona fide source of knowledge about the world.¹⁶ The *savoirs* of literature, the kinds of knowing that literary composition presupposes and that it can in turn make possible, are no longer readily recognized as "knowledge" as such, in spite of Bernardin and Chateaubriand.

For their part, the positive sciences would become synonymous with legitimate knowledge production, over the objections of transcendentalists, illuminists, mesmerists and Romantics of all sorts. In the flowering of the sciences, the physics of figures like Biot had a particularly prominent role to play, both in France and beyond. The physicists' new attention to precision measurement and rigorous mathematization transformed the study of material Nature, adapting the techniques that Newton had applied to the cosmos to the minutiae of the sub-microscopic world. With this transformation, quantification as such achieved a level of prestige that it had

¹⁵ Charles Baudelaire, "Madame Bovary, par Gustave Flaubert" (1857), *Oeuvres complètes* (Paris: Gallimard, 1961), 647.

¹⁶ Michael Foucault, *Les mots et les choses: une archéologie des sciences humaines* (Paris: Gallimard, 1966), 59; Pierre Bourdieu, *Les règles de l'art: genèse et structure du champ littéraire* (Paris: Éditions du seuil, 1998), 545.

never previously enjoyed. The “exactitude” of Biot and his immediate predecessors set the terms for the development of countless fields in both the natural and human sciences, eventually altering the practice of physical science in England, Germany and beyond and shaping the formation of disciplines as far afield as anthropology and ethnology.¹⁷ Indeed, the degree to which quantification, mathematization or the rhetoric of exactitude could be integrated into a discipline has often determined the degree to which it can be taken seriously as a “science” at all. Though mediated by local contingency, French mathematical physicists like Biot provided the initial impetus for processes of disciplinary formation that turned out to be characteristic of modernity, as well as for a valorization of “values” that persists to this day.

These processes were anything but inevitable. However precious the literary production, however enlightening the scientific production in modernity, the achievement of the cultural formations in which they took shape was never a transhistorical reality, or a pre-destined goal. As the literary critic Paul Bénichou has written, the object that critics “*pensent isoler comme essentiellement littéraire n’existe nulle part seul,*” but was itself a doctrine produced by the writers of the Post-Enlightenment, the period in which, writes Bénichou, “*a commencé à poindre la notion d’une littérature séparée du reste: notion, et théorie, abondamment professées en prose et en vers.*”¹⁸ Much the same thing could be said about the sciences, as well: the notion that “science” exists as a transhistorical entity bound together by common objects or methods, say, can largely be attributed to nineteenth- and twentieth-century historians.¹⁹ Tracing the realization of “literature” and “science” as concepts and as cultural forces over the course of the Post-Enlightenment, this dissertation recounts how the Enlightenment ideal of a cohesive Republic of Letters eventually gave way to the more fragmented regime of modern cultural autonomy. As we shall see, the epistemic conflicts that traversed Revolutionary France laid the groundwork for a dispensation that is perhaps only now beginning to change.

II. Action at a Distance

In *Les mots et les choses*, Foucault construes literature as a counter-weight to the positive sciences, a site of resistance to the order of “representation” that emerges during the seventeenth and eighteenth centuries and continues through the present day. Literature accomplishes this resistance, in Foucault’s view, by abandoning the regime of representation altogether, embracing in

¹⁷ See, for instance, Thomas Kuhn, “Mathematical versus Experimental Traditions in the Development of Physical Science,” *The Essential Tension: Selected Studies in Scientific Tradition and Change* (Chicago: University of Chicago Press, 1977); Iwan Rhys Morus, *When Physics Became King* (Chicago: University of Chicago Press, 2005); and Vincent Debaene, *L’Adieu au voyage: l’ethnologie française entre science et littérature* (Paris: Gallimard, 2010).

¹⁸ Paul Bénichou, “Réflexions sur le romantisme français,” *Romantismes français*, vol. 2, *L’École du désenchantement* (Paris: Gallimard, 2004), 1997.

¹⁹ See for instance, Richard Yeo, *Defining Science: William Whewell, Natural Knowledge and Public Debate in Victorian Britain* (Cambridge: Cambridge University Press, 2003); as well as the “Bibliographic Essay” in Steven Shapin’s *The Scientific Revolution*, especially the section “The ‘Great Tradition’ in the History of Science” (Chicago: University of Chicago, 1996), 168-170.

its stead an earlier linguistic order in which language was not yet a conventional system, split into word and thing, but appeared in the world as word and thing at once. In this early modern “hermeneutic regime,” the world is a sensuous language and language is a world of symbolic things. “*Tout au long du XIXe siècle et jusqu’à nous encore,*” writes Foucault, “—de Hölderlin à Mallarmé, à Antonin Artaud—, la littérature n’a existé dans son autonomie, elle ne s’est détachée de tout autre langage par une coupure profonde qu’en formant une sorte de “contre-discours” et en remontant ainsi de la fonction représentative ou signifiante du langage à cet être brut oublié depuis le XVI^e siècle.”²⁰ With this move, literature gives up both its place in the regime of representation and any pretension to the production of what the nineteenth century would view as legitimate knowledge about the world. Cultivating the knowledge associated with poetic intuition and electing to operate on language itself, literature could no longer really be said to “know.”

Yet the persistence of a natural philosophy of wonder in the writings of Chateaubriand or Bernardin de Saint-Pierre suggests that if literature resisted the regime of representation, it did not initially forfeit its “scientific” prerogatives as well. In these writers, the hermeneutic regime, that is, co-exists with an ambition to produce real knowledge. Chateaubriand and Bernardin de Saint-Pierre arouse the ire of Biot not just because they offend his literary tastes but also because they aspire to produce a certain kind of positive knowledge—“*connaissance*” but also “*savoirs*”—which conflicts in mode as well as in detail with the *savoirs* of the exact sciences. Rather than resurrecting an obsolete natural philosophical language, in the terms according to which Foucault imagines Romantic literature constituted itself, these writers update what they conceive as a continuous hermeneutic tradition, adapting the old regime to overcome the new challenge posed by the exact sciences. They not only condemn the exact sciences, they also elaborate their own sciences in response: Chateaubriand begins construction of his religious natural history with observations drawn from his New World travels, and Bernardin makes good on what he affirms as his “*droit naturel et acquis de raisonner sur la cause des marées,*” among other natural phenomena.²¹

If Chateaubriand and Bernardin eventually succumb to their exacting rivals, leaving the field clear for the rise of positive science, the story of how literature became literature and science science does not end with their defeat. The entrenchment of the modern positive sciences continued to inspire resistance, and broad opposition emerged once again in the eighteen-thirties and -forties, in the work of Honoré de Balzac, Geoffroy Saint-Hilaire and others who objected to what they saw as the strict materialism of the positive sciences. Like their predecessors, these figures advocated a “total” point of view on cultural production, grounded in what they saw as the inherent unity of poetry and science. The totality of this position is conveyed, in the words of Paul Bénichou, by the “*désir d’établir pour la poésie un statut de connaissance au niveau le plus haut,*” an ambition which positioned it as “*rivale, émule ou haute auxiliaire de la religion,*” on

²⁰ *Les mots et les choses*, 58-59. Hölderlin seems a placeholder for the complex French literary scene of the period, given that the other writers cited in this passage (and indeed the slant of the book as a whole) are conspicuously gallic in nature.

²¹ “Préambule,” *Études de la nature*, xv.

the one hand, and as “*ennemie de la science moderne*,” on the other.²² But rather than embracing the hermeneutic tradition of Chateaubriand or Bernardin de Saint-Pierre, these figures articulated a literary science with roots in the representational scheme of the modern physical sciences. What Bénichou writes about the rupture between the generation of 1830 and that of Baudelaire could equally be applied to the rupture between the generation of 1800 and that of 1830. “*L’extraordinaire révolution des formes, du style, des genres et des sujets*,” he writes, “*ce bouleversement, en quelques années, de tous les principes et habitudes littéraires consacrés en France et imités en Europe, ne fut que l’instrument nécessaire d’une révolution plus profonde, qui mettait en jeu non seulement les modalités de la littérature, mais son statut et la forme du pouvoir spirituel au sein de la société.*”²³

While Bénichou emphasizes the form of spiritual power at literature’s disposal in this passage, the spirituality implied in the work of Balzac and his cohort went hand in hand with their efforts to renovate the forms of scientific power, just as it had in that of Chateaubriand and his. And as with the literature of 1800, that of 1830 can only be regarded as an “enemy” of modern science insofar as we recognize that, far from eschewing the production of positive knowledge, it wished to produce it on its own terms. If the literature of 1800 opposed the positive sciences and the positive sciences opposed the literature of 1800, the literature of 1830 would define itself in opposition to both. As the threat posed by Balzac, Geoffroy Saint-Hilaire and others subsided, something like the modern regime of cultural autonomy took shape. So pervasive and convincing has this arrangement been, that it may seem odd even today to characterize Balzac as something other than the initiator of literary realism. Yet as we will see, the vision of a “*nouvelle science*”²⁴ that Balzac continuously affirmed, from his early journalistic works to the capstone “*Avant-propos*” to the *Comédie humaine*, was more than a novelist’s extravagance. The reform of the sciences not only formed one of the leitmotifs of his career but also allied him to a broad and diffuse collection of like-minded cultural figures working at the dawn of the July Monarchy.

As an effort to sequence these entanglements, this dissertation shares in a broader cultural-historical turn toward the study of science and literature together. If works like Bénichou’s collected *Romantismes* or Robert Darnton’s *Mesmerism and the End of the Enlightenment in France* set a standard for the subject long ago, a great deal of additional critical attention has been devoted in recent years to the intersections of these cultural forms, in and beyond the France of the turn of the nineteenth century. By and large, cultural studies of the relationship between science and literature have sought to elicit the common elements of what would subsequently be distinguished as discrete cultural forms. In a variety of contexts, these studies have shown that the antecedents of modes of cultural production that are now recognized as fundamentally distinct once shared previously unsuspected elements in common, whether those elements be objects, affects, rhetorics, values, modes of perception, institutions, etc. Such work has the virtue of effacing anachronistic cultural boundaries, and sometimes of positively describing

²² “Réflexions sur le romantisme français,” *L’école du désenchantement*, 2012.

²³ *Ibid.*, 1999-2000.

²⁴ “Lettre à Nodier,” *Oeuvres diverses*, vol. 1 (Paris: Gallimard, 1990) 1214.

where they should be drawn instead. And because the heterogeneity of the past so often asks us to transcend our own scholarly backgrounds it has redounded to efface or redraw (to some degree, at least) disciplinary boundaries in academic scholarship, as well.

In a representative vein, Noah Heringman's *Romantic Rocks, Aesthetic Geology* teaches us that proto-geological discourse and a certain kind of English poetry shared a set of perceptual and aesthetic expectations in common, a "landscape aesthetics" that grounds the modes of observation and philosophical orientations of each. In this work, the presence of the rhetoric of the sublime in the poetry of Wordsworth, Blake or Erasmus Darwin, as well as in the geology of Lyell, bears witness to the actuality of a set of shared "cultural practices" during the years 1770-1820. Heringman shows that poetry and the prose study of the earth each gravitated toward a common object—"rugged, mountainous landscapes"—and realized themselves through a common perceptual scheme—the appreciation of the sublime. These shared elements establish a chiasm typical of this interdisciplinary mode of cultural history in general. If "changing attitudes toward the earth's material and toward materiality itself," writes Heringman, underpin these discourses, "the result is not only a body of poetry obsessed with mountains, but also a geology steeped in aesthetics."²⁵ In this chiasm, the critic shows that a category we moderns assume to be exclusive to one mode of cultural production actually inheres in the other, and vice versa; aesthetic categories structure geology, in this case, while geological formations pervade poetry. In any such account, the space designated by these crossings becomes the space of cultural production in the period in question, relevant to the genres or traditions under review. Heringman's study goes one step further in suggesting the fault lines along which this shared space would eventually disintegrate, even if we do not get the benefit of a detailed history of the rupture. Heringman promises "a [paradigm] for the divergence of arts and sciences and the formation of modern disciplines,"²⁶ but we do not discover in his work just how the fault lines were actualized, how certain forms of authority grew in stature while other forms declined, or the *degree* to which some cultural agents triumphed and others lost out.

In this study, I want to attempt something similar to but perhaps more fundamental than the cultural history of shared elements. As in the story of "divergence" evoked by Heringman, the story of cultural differentiation in post-Enlightenment France not only requires a portrayal of states of indifferenciation but also an account of fluctuations in the relative power of rival points of view on cultural production.²⁷ Telling the story of differentiation presupposes a vocabulary that enables us to register zones of conflict or non-contact among modes of cultural production, as well as zones of contiguity or non-distinction. The story of cultural differentiation is often a story of action-at-a-distance, that is, of power dynamics that order cultural formations even when these formations do not obviously overlap. With the exception of an essay like Biot's, for instance, the partisans of the exact sciences remained studiously silent in response to the complaints of their writerly opponents. In the drama of differentiation enacted by the letters and the

²⁵ Noah Heringman, *Romantic Rocks, Aesthetic Geology* (Cornell: Cornell University Press, 2004), xiv.

²⁶ *Ibid.*, xiii.

²⁷ "Differentiation" being slightly preferable than "divergence" to the extent that it suggests the emergence of the things diverging.

sciences in Post-Enlightenment France, this silence is a prime example of how moments of non-contact count in cultural history. The refusal to respond can itself become a strategy in the accumulation of cultural authority, in this instance employed by the more powerful party as a means of quelling debate on the grounds of its authority. Read alongside Bernardin de Saint-Pierre or Chateaubriand's vociferous critiques of the exact sciences, this silence helps diagnose the relative cultural authority of the parties' respective positions.

This economy of recognition reminds us that histories of shared cultural production require more than an account of the positive relationships among cultural actors or their productions. They may also call for an account of the relationship among discrete "points of view" on cultural production, even when no obvious interchange takes place among these positions. In periods of relative stability, a single view of cultural production may well predominate unchallenged; since the inception of the regime of autonomy in modernity, for instance, most cultural actors have accepted that literature and science are fundamentally distinct, and writers like Flaubert or Villiers de l'Isle-Adam mocked positive science but did not do so in hopes of usurping its authority for their own. A naïve reading of Biot's essay might likewise interpret the contents of the conflict without asking what the incidence of the conflict itself tells us. It might treat the polemic as inevitable, rather than ask what the conditions of possibility of each entry in the polemic might have been. The description of a process of cultural differentiation requires that we delineate a sequence of shifts in the relative authority of alternative points of view on cultural production. For instance, Biot and Bernardin de Saint-Pierre each advocated a scenario of "totality," in which forms of authority freely circulate among activities as distinct as experimentation and poetry-writing. But their respective notions of totality are antithetic to one another; rather than constituting two halves of the same pie as in the case of Villiers de l'Isle-Adam and the positive sciences of his time, the conflict between "exactitude" and wayward "imagination" discerned by Biot is transvalued in Bernardin's view as a conflict between "wonder" and disenchanting "quantification." An exclusive focus on one formation of totality in preference to another (or still worse, the confusion of distinct visions of totality) would yield an incomplete, even distorted view of cultural production in this moment. We would learn *that* a shared space was conceivable, but we would learn nothing about how alternative views of shared space differed. Without this essential counterpoint among points of view, moreover, we would learn nothing about the *conditions of possibility* for affirming a given vision of totality, the risks or benefits a given cultural agent stood to incur or to accrue in doing so.

The advantages and risks of the mode of "connectivity" in writing the cultural history of this period are both apparent in John Tresch's *The Romantic Machine: Utopian Science and Technology after Napoleon*, a fascinating account of the interchanges that took place among savants, engineers, philosophers, artists, musicians and others in post-Enlightenment Paris. Like Biot and Bernardin de Saint-Pierre in an earlier era, the cultural actors Tresch tracks each develop a more or less totalizing view of cultural production, this time in a "utopian" register, Tresch argues, that bypasses the "stalemate between hopeless romanticism and soulless mechanism" in a way that makes "technology and science into instruments of inspiration and even salvation."²⁸As

²⁸ John Tresch, *The Romantic Machine: Utopian Science and Technology after Napoleon* (Chicago: University of Chicago Press, 2012), 26.

in the book's account of the astronomer and politician François Arago's ties to "the worlds of romantic arts, literature, and stage craft, as well as [of] politics and the press," Tresch details links among producers in what might otherwise be presumed to be quite distinct fields of cultural production.²⁹ Yet proximity is not identity, and the conflation of Arago's position with that of figures as different from him as Ampère or Balzac reduces a multitude of points of view on cultural production to a single techno-scientific spiritualism. (This same impulse is equally present in the book's conflation of the composer Giacomo Meyerbeer's point of view with that of a figure as different, even hostile, as Hector Berlioz). If the book's focus on connections among what might today look like heterogeneous cultural productions helpfully elicits these projects' total scope, it reduces the rivalry among points of view to an undifferentiated mêlée of pre-disciplinary or cross-disciplinary creation. In the absence of a vocabulary for making difference and non-contact count in the writing of cultural history, it can only register contemporaneity or proximity as agreement.

This limitation is particularly salient in the book's portrayal of the relationship between Arago and Balzac. Along with Biot, Arago rose to a position as one of the chief protégés of Pierre-Simon Laplace, the figure who more than any other imposed mathematical physics as a paradigm in the sciences. Tresch rightly points out that Arago's assumption of the leadership of the sciences shortly after the death of Laplace marked a change in the tenor of the official sciences; as perpetual secretary of the *Académie des sciences*, Arago's warmth and popular spirit displaced what Tresch characterizes as an "approach to knowledge . . . ruled by rarity, arbitrary authority, and enclosure."³⁰ But it is less convincing to assert that because Arago rejected certain aspects of Laplacian physics and took more interest in the applied sciences than he, he ought to be classified as something other than the "rational physicists whose key exemplars were Laplace and Lagrange."³¹ However eager we may be to celebrate Arago's "[ties] to romantic artists and republican activists," engineers or industrialists, we must acknowledge that these ties did not imply free collaboration, but were rather conditioned by the prerogatives Arago helped to maintain as de facto leader of the sciences in France. As perpetual secretary of the *Académie des sciences*, Arago stood at the pinnacle of the scientific establishment; whereas Balzac, known initially as a journalist and author of fantastic tales, enjoyed almost no scientific recognition. Arago and Balzac may well have frequented the same salons; Balzac may even have maintained particularly friendly relations with Arago's brother;³² but only the most naïve reading of cultural history would thereby conclude that these personalities fundamentally agreed with one another on scien-

²⁹ Ibid., 91.

³⁰ Ibid., 105.

³¹ Ibid., 95.

³² Ibid., xiii.

tific questions.³³ The leveling of powerful and non-powerful positions and the assimilation of quite distinct projects to a common vision of “totality” risks masking crucial differences among the political and social effects these projects are meant to exercise. At worst, such an approach mystifies the effects of power in the constitution of assemblages, construing as the willy-nilly embrace of heterogeneous elements by a given cultural agent what ought really to be attributed to the hegemony exercised by one or more epistemic criteria or practical modes.

If Tresch is right to allude to the scientific prerogative asserted by post-Enlightenment writers like Balzac, Foucault’s insight about literature as a site of opposition to the positive sciences nevertheless still obtains. In post-Enlightenment France, literature is *both* a site of scientific thought *and* a site of opposition to the mainstream sciences. (Not all literature, of course: many writers simply ignore the question altogether, even as the nature of their authority as writers is affected, however minimally or indirectly, by the skirmishes over the nature of literary authority fought by Bernardin de Saint-Pierre and others.) In Foucault’s archaeology, a radical rupture marks the passage from Enlightenment letters to Romantic literature. But in staging the appearance of “literature” and “science” as such as the result of competition among rival points of view, I am aiming to replace the fermata of rupture entailed by the archaeological mode with a legato of transition implied by the processes of cultural differentiation. To that end I have sought to describe the fundamental changes in literary and scientific production that appeared during this period as effects of the acts of collective and sometimes even individual cultural agents, rather than as effects of impersonal archaeological change. If Foucault’s notion of “rupture” captures the gravity of the changes agitating revolutionary France, Pierre Bourdieu’s science of cultural works helps us see how such changes emerge through the everyday dynamics of the “field,” enmeshing Foucault’s epochal succession of epistemes in social, political, literary and scientific histories. The realization of a distinct field of cultural production corresponds, as Bourdieu writes, with the institution of a “point of view” on the world.³⁴ In that light, we can see the promotion of points of view undertaken respectively by Biot, by Bernardin de Saint-Pierre, and later by Balzac as efforts to achieve general recognition of a corresponding field. Prior to the realization of distinct fields, these battles over the priority accorded to alternative points of view mark the competition over cultural authority characteristic of the process of differentiation.

The notion of the field has sometimes been miscast as a primarily synchronic tool, fit only to describe a given state of a given kind of cultural production and therefore ill-suited to narratives of cultural change. Yet Bourdieu himself successfully describes diachronic changes in the distribution of the field on many occasions, and clearly conceives of the concept as a means of charting the “emergence” of forms of cultural production. In *Les règles de l’art*, for instance, Bourdieu depicts Flaubert and Baudelaire as something more than writers among writers; in-

³³ Theresa Levitt’s chapter “A Vital Matter: Light and Life” spells out the degree to which Arago opposed the kind of vital materialist assumptions that characterize Balzac’s science. When pressed, Arago declined to acknowledge the reality of apparently occult phenomena, even though he also declined to dismiss them out of hand. Moreover, he staked out the general position that such cases, if confirmed, might be explained via purely physical means, not vital materialist ones. Levitt additionally shows that as Arago summed up his work in later years, this passive open-mindedness ceded to a firm rejection of animal electricity and other vital materialist phenomena.

³⁴ Pierre Bourdieu, *Méditations pascaliennes* (Paris: Seuil, 1997), 119-20.

stead, they each contribute to setting the conditions for the emergence of the “writer” as such, each in his own way *auctor auctorum*, “*écrivain qui a inventé l’écrivain*.”³⁵ Likewise, in *Manet, une révolution symbolique*, Bourdieu shows how the painter radically alters the possibilities of artistic production in general.³⁶ In such “symbolic revolutions” the distribution of positions available to the would-be agents of a given field shifts, as formerly marginal or altogether new positions attain positions of symbolic authority, and dominant positions suffer losses in prestige. Such revolutions mark only the most dramatic renegotiations of the identity of the field, of the modes of production it implies and the kinds of agents barred from or assimilated to it. In reality, though, the dialectic of positions which constitute the field continually put the identity of the field in play. The values of a field remain stable over a given period only when the dominant figures in the field succeed in maintaining their position, fending off the challenges of less powerful or newly entered agents while renewing the recognition of audiences beyond the field. These values change when newer or less powerful members of the field succeed in attracting more recognition for their efforts than do the more powerful members, whether among other members of the field or among the forces external to it, or both.

This sort of reversal is evident in the trajectory of Baudelaire, who articulates an entirely new notion of what literature can be or do. Baudelaire’s originality can be difficult to discern for readers like us, inured to his innovations precisely because of how generalized they ultimately became. As with Baudelaire, the authors of symbolic revolutions often disappear into the patterns of interpretation they are responsible for effecting. Transformed into norms, these patterns camouflage not only the struggles undertaken by the authors of successful symbolic revolutions, but may also overlay our perceptions of the work of their rivals and of actors in anterior state of the field, proponents of alternative patterns. For Bourdieu, recovering the originality of agents of successful symbolic revolutions requires that we train a critical eye on our own expectations as readers. “*Baudelaire*,” writes Bourdieu, “*l’auteur par excellence, formule clairement les principes d’une lecture qui devrait inciter les lecteurs que nous sommes toujours peu ou prou à procéder à une analyse réflexive de la position sociale de lector et à faire de la critique de ‘l’oeil académique,’ un préalable à toute lecture, et tout spécialement à la lecture des auteurs.*”³⁷ As readers we must achieve a point of view from which the advent of the “author of authors” no longer feels inevitable, and our own interpretive assumptions correspondingly appear to us in all their contingency.

Bourdieu recovers Baudelaire’s originality by reconstructing the options available to him upon his entry in the field. In Bourdieu’s account, Baudelaire invents an altogether new, initially “impossible” position in the field by rejecting both the “*avant-gardisme esthétique*” and the “*avant-gardisme éthique*” which together dominated poetic production at the beginning of his career, both the “pure,” socially disengaged poetry and prose-writing of figures like Théophile Gautier or Leconte de Lisle, and the maximally engaged writings of the secular utopians.

³⁵ See “La conquête de l’autonomie. La phase critique de l’émergence du champ,” *Les Règles de l’art* (Paris: Seuil, 1998), 85-191; *Méditations pascaliennes*, 103.

³⁶ Pierre Bourdieu, *Manet: une révolution symbolique* (Paris: Seuil, 2013).

³⁷ *Méditations pascaliennes*, 103.

“Baudelaire s’oppose à la fois aux deux positions polaires,” writes Bourdieu, “tout en accordant et en prenant à chacune d’elles ce par quoi elle s’oppose le plus directement à l’autre: au nom du culte de la forme pure, qui le place à l’aile radicale de la littérature autonome, il refuse la soumission à des fonctions externes et le respect des normes officielles, qu’il s’agisse des préceptes moralisateurs de l’ordre bourgeois pour les poètes spiritualistes ou du culte du travail pour l’École moderne.” Mais il refuse tout autant le repli social des sectateurs de la forme pure . . . au nom de l’exaltation de la fonction incantatoire de la poésie, de l’imagination critique, de la complicité entre la poésie et la vie, et du “sentiment moderne” . . .³⁸ In the terms adopted by Bourdieu, Baudelaire’s position is “impossible” because he stakes his ground at the juncture of these two pre-existing poles of literary production, taking elements of each but belonging fully to neither. Only with time does the Baudelaire’s vision of literature become dominant, a vision of literature in which the writer is autonomous with regard to external powers yet also committed to commenting on and contesting them.

Like Baudelaire, the primary figures in the chapters that follow imagine a set of possibilities that did not yet exist in the scene of cultural production as they found it. Of these figures, the most successful may be Pierre-Simon Laplace, mentor to Biot and Arago. Together with allies like Lavoisier, Berthollet and Cuvier, Laplace effects a symbolic revolution in which mathematical physics becomes the predominating paradigm in the investigation of physical Nature, as well as, indirectly, in the sciences of living things. The institutionalized sciences in Paris proceeded confidently (though not inevitably) to impose a neo-Newtonian regime which would initiate the modern positive sciences, ultimately redefining the nature of scientific inquiry as a whole. If much of eighteenth-century physics had been grounded in sensory evidence or numerical estimations, the new breed of “*physiciens géomètres*,” as they called themselves, instead vaunted the precise quantification and rigorous mathematization of physical nature. These Parisian *physiciens* were the very first to apply high mathematics to the investigation of matter in a systematic manner: even as they battled to effect the recognition of “exact” science among their own colleagues, they also worked to convince their counterparts in other scientific capitals of the value of this neo-Newtonian approach. Working well before the advent of the atomic theory of matter, these *physiciens géomètres* nevertheless laid the groundwork for later nineteenth-century physics. Along the way, mathematical physics became “the paradigm of sound knowledge,” as Thomas Kuhn writes, the standard against which the scientificity of any form of cultural production claiming to produce knowledge was increasingly measured.³⁹ Spreading beyond France, governing the shapes taken by other sciences, the “exactitude” of the Parisian physical sciences ultimately set the terms for the modern sciences in general. The symbolic revolutions attempted by Bernardin de Saint-Pierre and Balzac each respond to these events with alternative points of view, a vehement anti-Newtonianism in the case of Bernardin and many of his literary contemporaries and a distinct hyper-Newtonianism engineered by Balzac and other proponents of a new

³⁸ Ibid., 105-06.

³⁹ Thomas Kuhn, “The Function of Measurement in Modern Physical Science,” *The Essential Tension: Selected Studies in Scientific Tradition and Change* (Chicago, UCP, 1977), 178. Emphasis Kuhn’s.

poetic science. Given the totalizing ambitions of these two writers, the symbolic revolutions they plotted could only have succeeded at the expense of Laplace and his allies and successors.

Each of the three chapters that follow takes the form of a set of tightly interrelated essays. In Chapter One, I zoom in on the knowledge claims of the partisans of a “hermeneutic” revolution through a reading of Bernardin’s *Études de la nature* (1784). A lengthy, stunningly diverse work, the *Études de la nature* both critique the neo-Newtonian assumptions of the exact natural philosophers and assemble the elements of a science that Bernardin hoped might one day supplant them. Far from relying on a doctrine of poetic intuition, as Foucault or Bénichou might assert, the *Études* espouse the explicitly “scientific” possibilities of hermeneutic natural philosophy. Its incorporation of elements of early eighteenth-century physico-theology, Rousseauvian sentimental writing, travel observations and engineering expertise attest to the adaptive, innovative character of hermeneutic science in the period. Though Bernardin’s anti-Newtonianism retained a modicum of authority through the first decades of the nineteenth century, it fell well short of undermining the increasingly powerful neo-Newtonianism of Biot and others members of the Parisian institutional sciences. Bernardin spent his career advocating for this hermeneutic natural science, but in the end few (or not enough) readers gave much credence to his ideas about the tides, the movement of the Earth in space, or the interactions among plants, animals and minerals.

Like the hermeneutic science of Bernardin de Saint-Pierre and others, the kind of knowledge conjured by the literature of 1830 was by no means restricted to the “*connaissance analogique*” of archaic natural philosophy or the “poetic intuition” of romantic poetry. Instead, figures like Balzac, Geoffroy Saint-Hilaire, or Saint-Simon countered the neo-Newtonianism of the exact sciences with a sort of “hyper-Newtonianism” of their own, regretting that the materialism of the exact sciences precluded the scientific study of the will or of vitality, and prophesying the eventual mathematization of these phenomena. Chapter Three defines the loose group of writers, savants and thinkers who espoused this hyper-Newtonian science and explores the role of Balzac in formulating and promoting it in particular depth. Though critics from Balzac’s day to our own have mostly ignored the scientific notions espoused in Balzac’s journalism and in the novels of the *Comédie humaine*, these writings played a major role in defining a total intellectual space in the eighteen-thirties and -forties in France. Alongside the physiologist Étienne Geoffroy Saint-Hilaire, Balzac campaigned against the increasing fragmentation and specialization of scientific endeavor, and argued instead that the institutional sciences should be unified under a set of general natural laws. The distinction between the physical sciences and the sciences of life seemed especially specious to Balzac and Geoffroy Saint-Hilaire; the modern sciences erred, they thought, in applying general laws of motion like those elaborated by Newton to brute matter alone, since Nature’s fundamental unity implied that such laws ought ultimately to be applied to living matter as well. Balzac’s articles and prefaces argued explicitly for these views, and his fictions incorporated them into narration and plot; the “Avant-propos” to the *Comédie humaine* (1842) famously describes the cycle as developing a new human science, and novels like *La Peau de chagrin* (1831) and *Louis Lambert* (1833) both showed and told their initial readers why a more capacious brand of science was necessary, as well as what shape it might take in the future.

For both Bernardin de Saint-Pierre and Balzac, the consequences of failing to effect a symbolic revolution were to be interpreted according to patterns other than those they themselves espoused. The *Études de la nature*, the work where Bernardin first and most comprehensively exposed his natural philosophical principles, were appreciated in his own lifetime for the poetry of their descriptions and the piety of their sentiments; and though the authority of Bernardin to write natural philosophy per se was not substantially contested, the *Études* were ridiculed for the content of their scientific claims. After his death, Bernardin continued to be best known as the author of *Paul et Virginie*, and the *Études* were re-published in excerpted editions that highlighted the aesthetic, rather than the natural philosophical value of the work.⁴⁰ As for Balzac, his novels were greeted as *littérature industrielle*, lauded and vilified by turns as fiction, never acknowledged as forces for the de-autonomization of the sciences and the institution of a new scientific-literary regime. In literary criticism, Balzac has been canonized as an initiator of realism, and his many scientific declarations have either been glossed over by critics, dismissed as visionary, or construed as evidence of the sciences' "influence" on him.

Between the moment of Chateaubriand or Bernardin de Saint-Pierre and that of Balzac, Laplace and his allies and disciples grew in influence and prestige, nearly monopolizing the key posts in France's scientific institutions, rising to the status of notables of the Empire, and garnering the admiration of the public. Thus, in Chapter Two, I explore how, flush with prestige, the partisans of the exact sciences succeeded in differentiating "science" from literature as a form of cultural production, while also distributing the principle of "exactitude" across multiple fields of scientific endeavor. Biot's notion of "exact ideas" emerges from the neo-Newtonian cast of these figures' conceptions, with their push to describe the microcosm of molecules or corpuscles with the same mathematical precision that Newton had achieved in the description of the cosmos.⁴¹ His essay partly reflects the strategies pursued by the partisans of exactitude more generally, and partly departs from them. As a document, the essay is valuable precisely because the partisans of the exact physical sciences so rarely acknowledged their opponents in print. As I suggested, the economy of recognition was crucial to the development of an autonomous science, and Biot's essay flouts the main tendencies of this economy to some degree. In Bourdieu's definition, modern science is distinguished by a scenario in which the "clients" of scientific agents' work are the same as their "competitors." According to this view, the only figures deemed capable of evaluating a given piece of scientific work are those bidding for the same kinds of recognition as those sought by its author. The specialization of scientific work implies that its audience will be limited to other scientific producers, but the ideals of exact and hermeneutic science were so deeply dissonant that the figures associated with each could hardly be said to recognize each other as scien-

⁴⁰ As, for example, the *Beautés des études de la nature* (Limoges: Ardant, 1885).

⁴¹ Though Biot is largely forgotten today, he was extraordinarily influential in early nineteenth-century European science. As one of his biographers writes, "Biot's early work represents the first attempt to put into practice and to define the new discipline of mathematized experimental physics. Such a physics had existed here and there in the eighteenth century, but only in Napoleonic Paris did the means—the education and research facilities—and the direction—the Laplace-Berthollet program—exist to create a community of specialists. If the conception of this discipline belonged largely to Laplace and Berthollet, its realization and formalization must be credited in great measure to Biot." Eugene Frankel, "J. B. Biot and the Mathematization of Experimental Physics in Napoleonic France," *Historical Studies in the Physical Sciences* 8 (1977), 72.

tific producers as such. In keeping with these dynamics, the increasingly specialized partisans of the exact sciences had little incentive to acknowledge rivals who fundamentally rejected their approach, and whom they fundamentally rejected. The fact that Biot *does* acknowledge Bernardin de Saint-Pierre and Chateaubriand as opponents suggests that this process of self-election is incomplete, that the public or some other outside authority may still be capable of thwarting it. It suggests that for Biot at least, there was a risk that the hermeneutic sciences continued to wield enough cultural authority to disrupt the institution of the economy of recognition favored by the exact sciences.⁴²

Acknowledging the exact sciences' dissenters, Biot's article departs from the exact sciences' strategies in another way, as well. The leaders of the exact sciences in France rarely if every imagine extending the principle of "exactitude" as far as literary production, as Biot does, yet they do generalize this principle to forms of scientific production beyond the physical sciences. Biot's essay is thus distinctive only in how far it generalizes the principle, not in the gesture of generalization itself. In this same chapter, I go on to show how the rhetoric of exactitude reshapes and sometimes realizes new scientific disciplines, even when the objects studied by these disciplines resist quantification or mathematization. This study of how the rhetoric of exactitude performs in domains beyond the exact physical sciences centers on Alessandro Volta's polemic with the physiologist Luigi Galvani over the nature of "animal electricity," and Volta's subsequent consecration at the Paris *Institut de France*. Volta's brand of experimentation, tactile and loosely quantitative, was antipathetic to the ideal of exactitude, but his work on electricity won him a degree of celebrity in France and abroad that the Parisian scientific establishment could not afford to ignore. Their attempts to assimilate Volta's work to the regime of exactitude afford an in-process look at the construction and application of this ideal. Given that Volta's electrical discoveries emerged from his polemic with Luigi Galvani over the nature of animal electricity, as Giovanni Pancaldi and others have shown, the Parisians' encounter with Volta provides a window onto how exactitude reshaped the emergent fields of contact electricity and experimental physiology.⁴³ Just as Biot imagined a place for "exact ideas" in literature, so the ideal of exactitude is made to orient experiments on the battery and on animals in France, as well. In keeping with these dynamics, the ideal of exactitude ultimately achieved ascendancy over the science of living things in France's learned institutions, prescribing the means and ends of sciences that came to be identified with positivist "biology."

If Laplace's symbolic revolution can be said to have succeeded, and Bernardin de Saint-Pierre's and Balzac's respectively to have failed, the three nevertheless share something in common that the authors of other symbolic revolutions do not. All three initiated symbolic revolutions that aimed to do more than re-order, or seek to re-order, the possibilities of an existing field; instead, they all initiated symbolic revolutions corresponding to the realization of entirely new fields. Laplace initiated a revolution that set the sciences on the path of autonomization, progressively differentiated from general letters and other neighboring forms of cultural production,

⁴² Even so, it is telling that Biot acknowledges the hermeneutic sciences in the context of a literary critique printed in a general interest publication, rather than in a scientific *mémoire* or on the floor of the *Institut national*.

⁴³ Giuliani Pancaldi, *Volta: Science and Culture in the Age of Enlightenment* (Princeton: PUP, 2003).

while Bernardin de Saint-Pierre and Balzac initiated revolutions that attempted to thwart this process of autonomization, and confound the sciences once more with the general cultural of letters. In Bernardin's case, the revolution was meant to *resist* the initial fragmentation of the traditional domain of letters, in Balzac's, to *reverse* this fragmentation after it had already come about. These figures can therefore be viewed as something more than "authors of authors;" rather, they are, as it were, "authors of authors of authors" because they innovate spaces where a symbolic revolution on the order of that provoked by Baudelaire or Manet can take place in the first place. In the sweep of cultural history, such figures are few in number, and probably only emerge at times when the borders among neighboring forms of cultural production are not yet, or only lightly, drawn. Indeed, this study concludes with Balzac because he was the last to mount a credible challenge to the regime of autonomy, the last to imagine a space of possibilities that would comprehend what was already being entrenched as the distinct domains of the literary and the scientific. As the last avatar of literary and scientific "totality"⁴⁴ he marks the end point of the pre-history of the regime of autonomy, and the inception of a definitively modern arrangement of fields of cultural production.

III. *Field Work: Methodological Interlude I*

If Laplace, Bernardin de Saint-Pierre or Balzac are each something more than the initiator of an ordinary symbolic revolution, then recounting the Post-Enlightenment in terms of field dynamics presupposes a certain amount of work on the notion of the field itself. Though Bourdieu frequently makes reference to the "emergence" of fields, the historical mechanics of this emergence are never (to the best of my knowledge) fully developed in his work.⁴⁵ The *Méditations pascaliennes*, for instance, takes up this question in a schematic mode, in which the precipitation of a discrete field from undifferentiated social space is construed as the discovery of the "*nécessité spécifique*" of the newly constituted field. In this account, we learn that the scientific field distinguishes itself from other fields thanks to the elaboration of characteristic rules of discussion and evaluation, and that these rules derive from "*une histoire tout à fait spécifique dans la logique quasi téléologique de son déroulement.*"⁴⁶ This assertion of a "quasi" teleological revela-

⁴⁴ The theme of totality re-emerges for Bourdieu with the advent of Sartre, "intellectuel total, *penseur écrivain, romancier métaphysicien, et artiste philosophe.*" As Bourdieu points out, Sartre's realization of the status of the total intellectual implies the dissolution of the boundaries between philosophy and literature in particular. If the view of totality advanced by Balzac can be seen as even more comprehensive than that of Sartre, this is primarily because he additionally imagines dissolving the bounds between literature and the natural sciences. See "Annexe: l'intellectuel total et l'illusion de la toute-puissance de la pensée," *Les règles de l'art*, 344-350.

⁴⁵ Given the breadth and coherence of Bourdieu's oeuvre, any such categorical declaration is admittedly risky. Reading Bourdieu is in many ways like reading Balzac, I would venture, a writer who was, as Henry James observes, continually "re-assaulted by supersessive terms, re-penetrated by finer channels, [who] never had on the one hand seen or said all or had on the other ceased to press forward." "Preface to *The Golden Bowl*," *Literary Criticism: European Writers and the Prefaces*, ed. Leon Edel (New York: Library of America, 1984), 1336. If Balzac famously revised older novels even as he produced new entries to the *Comédie humaine*, Bourdieu similarly revisits and advances a repertoire of linked concepts over the course of his long career.

⁴⁶ *Méditations pascaliennes*, 138.

tion moots the questions that might emerge in an empirical history of differentiation, questions that I think vital to an expanded conception of the field. However, a number of scholars writing in Bourdieu's wake have touched on problems similar to those provoked by an empirical history of field differentiation, including those regarding the identity, limits and intensity of the field. Perhaps most prominently, Pascale Casanova, Anna Boschetti, Christophe Charle and others have sought to conceptualize field boundaries in transnational spaces, with particular reference to the use of fields in comparative studies.⁴⁷ In the volume *Bourdieu and Historical Analysis*, edited by Philip Gorski, Charles Camic and Gil Eyal have broached similar conceptual concerns through the study of spaces between and interactions among fields, while Bernard Lahire and Jacques Defrance have sought to derive a vocabulary for describing fields with weak differentiation or weak incentives for investment.⁴⁸ In addition, Geoffroy de Lagasnerie has usefully called into question the presumed homogeneity of fields, the idea that, as he writes, "*le projet d'un écrivain se définirait par rapport aux projets d'autres écrivains (l'idée de "champ littéraire" développée par Pierre Bourdieu dans Les Règles de l'art), celui d'un peintre par rapport à d'autres peintres (le champ "pictural"), celui d'un compositeur par rapport à d'autres compositeurs (le "champ musical").*"⁴⁹

For Bourdieu, a field only emerges as an empirical reality to the extent that it achieves a minimum of autonomy, a state typically inaugurated when the agents of a particular kind of cultural production begin to free themselves from the influence of political or economic powers. Bourdieu's analysis of the nineteenth-century literary field shows that even relatively autonomous fields are usually at least partially subordinated by these powers. The "*pôle hétéronome*" of the modern literary field, for instance, assembles all those writers and playwrights whose works flatter the values and ambitions of the dominant classes, and who therefore stand a higher chance of receiving patronage or achieving bestseller status or box-office success; while the "*pôle autonome*" of the same field regroups those literary actors whose production is driven by values distinct from and often in opposition to those of the dominant classes, and who consequently write for fame but not for fortune. The progressive differentiation of literature and science in the nineteenth century also demonstrates, however, the degree to which the field's autonomy implies its independence from neighboring forms of cultural production, as well as from political or economic domination. Indeed, the question of whether and to what degree a given form of cultural production may be independent from political or economic powers can only be posed once the form of cultural production in question has been specified as such. It is therefore

⁴⁷ See, for example, Pascale Casanova, *La République mondiale des lettres* (Paris: Seuil, 1999); Anna Boschetti, "How Field Theory Can Contribute to Knowledge of World Literary Space," *Paragraph* 35.1 (2012): 10-29; Christophe Charle, "Comparaisons et transferts en histoire culturelle de l'Europe. Quelques réflexions à propos de recherches récentes," *Les Cahiers IRICE* 5 (2010): 51-73.

⁴⁸ Charles Camic, "Bourdieu's Two Sociologies of Knowledge"; Gil Eyal, "Spaces between Fields"; and Jacques Defrance, "The Making of a Field with Weak Autonomy: the Case of the Sports Field in France, 1895-1955" in *Bourdieu and Historical Analysis*, edited by Philip Gorski (Durham, NC: Duke University Press, 2013); Bernard Lahire, "Le champ et le jeu: la spécificité de l'univers littéraire en question," *Bourdieu et la littérature*, edited by Jean-Pierre Martin (Nantes: Cécile Defaut, 2010).

⁴⁹ Geoffroy de Lagasnerie, *Sur la science des oeuvres: Questions à Pierre Bourdieu (et à quelques autres)* (Paris: Cartouche, 2011), 54.

helpful, I think, to distinguish between two dimensions of the “autonomy” of a given field, a distinction that remains largely implicit in Bourdieu: on the one hand, the field’s relative independence from political and economic influence, and on the other, its relative independence from other forms of cultural production.

The story I present here presents a particularly compelling case for making this distinction, because the interplay between these two dimensions of the field plays a role in advancing the process of scientific autonomization (and likely plays an instigating role in processes of autonomization in general). Modern fields exhibit significant degrees of both dimensions of autonomy. The field of modern literature, as Bourdieu defines it, enjoys a relatively high degree of what we might call “vertical” autonomy in its independence from political or economic powers; in Baudelaire or Flaubert, literature owes nothing and gives nothing back to the political regime or economic interests. And it further enjoys a high degree of what we might call “horizontal” autonomy, since literature emerges as a form of cultural production with an identity all its own, a text-based art quite distinct from visual or musical production on the one hand, and the natural or human sciences on the other. (These horizontal distinctions may not be so absolute as we sometimes imagine, in fact; Baudelaire’s art and music criticism and his fascination with synesthesia suggest the degree to which even modern literature may be imbricated in horizontally proximal arts, and Flaubert’s interrogation of the sciences in *Bouvard et Pécuchet*, *La Tentation de Saint Antoine* or *Salammbô* similarly suggests the degree to which it may be imbricated in the sciences.) In similar terms, Bourdieu defines modern science as doubly autonomous in state, exempted from direct control by political or economic interests and specific enough in its objects and methods to achieve categorical distinction from other cultural endeavors.

Yet other permutations of these dimensions are possible. A form of cultural production may enjoy a low degree of both kinds of autonomy; one thinks of the plays of Molière in competition with the lyric dramas of Lully, both subordinated to royal patronage. A form of cultural production may presumably also enjoy a low degree of horizontal autonomy at the same time as a high degree of vertical autonomy. (The Arts and Crafts movement, the Bauhaus and other independent design movements might be shown to represent this scenario to some degree). Or a given field may enjoy a relatively high degree of horizontal autonomy, along with a relatively low degree of vertical autonomy, as is the case with the scientific field during the Empire. My account of the autonomization of the sciences in post-Enlightenment France argues that in this conjuncture, at least, these variables prove co-dependent, that the low degree of vertical autonomy implied by State patronage impels the sciences’ increasing horizontal autonomy. Bourdieu’s portrayal of field differentiation in *Méditations pascaliennes* evokes a virtuous circle in which the specific necessity of the field provides grounds for liberating it from the domination of political, economic, religious or other interests, and its liberation from these forces facilitates the articulation of its specificity. Yet the differentiation of the letters and sciences during the Post-Enlightenment suggests that the articulation of the scientific field’s specificity hinged on certain kinds of subordination. As First Consul and then as Emperor, Napoleon patronizes a group of scientific agents who advocated the liberation of the sciences from the literary, theological, and technological imperatives that had guided them throughout the eighteenth century, and thereby enables them to accumulate the material and symbolic capital necessary to advance their differentiation from these other forms of production. Napoleon by no means invents the problems or methods of

the sciences at this juncture, nor does he bend scientific speech to crudely ideological ends. Yet in patronizing this party to the exclusion of other eligible parties in the sciences, he definitively promotes a horizontally autonomous variety of science. The material and symbolic capital accumulated by figures like Laplace, Berthollet, Monge or Cuvier, partisans of exactitude and personal favorites of Napoleon, enables them to forge a new identity for science, one predicated on a definitive break with the qualitative, speculative or loosely quantitative sciences of their predecessors and contemporaries.

Though the distinction I am making here between “vertical” and “horizontal” dimensions may bring the mechanics of differentiation into focus, this distinction is purely heuristic in nature; in reality the political or economic power designated by the vertical axis is arbitrated by the dynamics of fields like any other. Political and economic fields merit a fundamental distinction from other fields of cultural production only to the degree that they specialize in coercion and the distribution of incentives. State sovereignty traditionally monopolizes legal forms of punishment, and in many cases, the State is also charged with the distribution of research funds and the institution of official societies; meanwhile, industry and finance are uniquely positioned to offer incentives inasmuch as they specialize in the generation of liquid and material as opposed to symbolic capital.⁵⁰ In the autonomization of the modern sciences in France, vertical field functions are exercised almost exclusively by the State, in the figure of Napoleon, though Napoleon’s near monopolization of state power makes it difficult to see these effects as a function of field dynamics.

If political or economic power originates in fields, moreover, these are not the only kinds of fields to generate effects of power. In principle, any field of cultural production may exercise influence on any other, such that a more prestigious field may shape the interests of the actors in a less prestigious field, and with it the kind of work they do. In the collection of lectures published posthumously as *Science de la science et réflexivité*, Bourdieu cites his own career trajectory as an illustration of this dynamic. Delivered in 2000-2001, at the very end of Bourdieu's career, these lectures reflect back on his beginnings as a student who abandoned philosophy in favor of sociology. In his account of this transition, Bourdieu sees himself as guided by the comparative advantage that may accrue to any actor who starts out in a more prestigious field and subsequently derogates to a less prestigious one. According to this comparative advantage, the store of symbolic capital accumulated through membership in the more prestigious field may prove more valuable in its less prestigious counterpart than it would if no change in fields had taken place. In light of this account, Bourdieu invites us to see his own work as a testament to the ways in which such a trajectory may transform the production of the less prestigious field. “*Une discipline est définie non seulement par des propriétés intrinsèques,*” writes Bourdieu, “*mais par des propriétés qu’elle doit à sa position dans l’espace hiérarchisé des disciplines. Parmi les principes de différenciation entre les disciplines, un des plus importants est l’importance du capital de ressources collectives qu’elle a accumulé (et en particulier, les ressources de type théorético-formel) et, corrélativement, l’autonomie dont elle dispose à l’égard des contraintes*

⁵⁰ See *Les structures sociales de l’économie* (Paris: Seuil, 2010), 11-26.

externes, politiques, religieuses ou économiques.”⁵¹ In this case, philosophy enjoys an advantage over sociology in the “*principe proprement scientifique*,” given its relatively richer store of “theoretical-formal” resources, as well as in the “*principe temporel*,” given its relatively high degree of independence from “external constraints.” Nearly concomitant with the birth of Western civilization, philosophy has had ample time to accumulate a repertoire of concepts capable of ordering the world, including the social world encompassed by sociology, and has likewise achieved a degree of freedom from political- or economic-driven meddling not enjoyed by the younger, much more heavily dominated field of sociology.⁵²

If Bourdieu’s own work enacts the potentially transformative effect which the migration of the analytical tools, the personnel, and other “collective resources” of one field into another may exert, the self-reflexivity of his work and its general valorization of scientific autonomy for its own sake has nevertheless conduced to the autonomization of sociology, rather than to its ongoing subordination to philosophy and other fields. In the scenario of “hybridization,” as Bourdieu calls it, the superior fund of cultural capital accumulated by one discipline enables it to transform scientific (or artistic, etc.) production in the other. Bourdieu quotes Ben-David and Collins’ definition of this scenario, in which “*l’intention délibérée de créer un nouveau rôle*” instigates the adaptation of “*les méthodes et les techniques d’un rôle ancien aux matériaux d’un nouveau rôle.*”⁵³ Though this notion of hybridization is conceptually rich, Bourdieu declares that it is just one modality according to which disputes among disciplines may lead to fundamental changes in a given domain of cultural production. In the breathless clip of these final lectures, we do not learn what other modalities of disciplinary interaction Bourdieu has in mind.⁵⁴ But though he does not present hybridization as a comprehensive concept, it does tell us something fundamental, I think, about his conception of the field more generally. In hybridization, scientific changes occur when pre-existing fields collide; the disciplines in question already exist as such, though for “temporal” and “scientific” reasons they find themselves at different places in the hierarchy of disciplines. Hybridization in general implies the crossing of two independent

⁵¹ Pierre Bourdieu, *Science de la science et réflexivité* (Paris: Raisons pour agir, 2001), 131.

⁵² Additionally, as Bourdieu suggests in *Méditations pascalienues*, clusters of associated fields may exert a collective influence on the internal affairs of an auxiliary field. The “*solidarité organique*” among incommensurable yet mutually dependent fields is evident, for instance, in the complicity Bourdieu identifies between scholastic and economic fields. This subtle solidarity actualizes itself, he writes, “*au travers des actions et des réactions, en apparence anarchiques, mais en fait structurellement contraintes, d’agents et d’institutions insérés dans des champs à la fois concurrents et complémentaires . . . et engagés dans des circuits d’échanges légitimants de plus en plus longs et de plus en plus complexes, donc de plus en plus efficaces symboliquement, mais faisant de plus en plus de place, au moins potentiellement, aux conflits de pouvoir et d’autorité* (123-24).”

⁵³ Joseph Ben-David and Randall Collins, “Les facteurs sociaux dans la genèse d’une nouvelle science. Le cas de la psychologie,” *Éléments d’une sociologie historique des sciences* (Paris, PUF, 1997), quoted in *Science de la science et réflexivité*, 133.

⁵⁴ Certainly Bourdieu’s work affords other instances of cross-field interaction, as in the influence of Baudelaire’s art criticism on contemporaneous art practice.

entities.⁵⁵ As such, Bourdieu's own account of what I am calling "horizontal" dynamics typically presumes the existence and the identity of the fields in question, though the history of the sciences additionally requires that we consider how scientific change occurs in the absence of pre-existing fields.

This picture of scientific change is congruent with, even predicted by, Bourdieu's general idea of the field. For Bourdieu, each field is underwritten by a distinct "legality," an ensemble of implicit injunctions that guarantees the coherence of the activities corresponding to the field. This law is something more than a written code or a collection of conceptual categories; rather, it can better be conceived as the identity of the field, the grounds on which such elements arise. As such it is both historically contingent and implicit in the attitudes of the agents of the field. Bourdieu conveys the arbitrary and implicit nature of the "*loi fondamentale*" of the field, the *nomos*, in suggesting that "*il vaudrait mieux [la] rendre par "constitution", qui rappelle mieux l'acte d'institution arbitraire, ou par "principe de vision et de division", plus proche de l'étymologie.*"⁵⁶ Symbolic revolutions like those perpetrated by Baudelaire or Manet, and presumably instances of hybridization as well, result in amendments to this constitution, as it were, alterations in the very grounds of what it is possible for adherents to the field to perceive or articulate. Of symbolic revolutions, Bourdieu writes that "*ce sont les oppositions les plus fondamentales et les plus profondément enfouies, que subvertissent ou anéantissent les auteurs des grandes révolutions symboliques—tel Manet, par exemple, qui révoque les oppositions canoniques de la peinture académique, entre antique et contemporain, "esquisse" et "fini".*"⁵⁷ In superseding such oppositions, the author of a successful symbolic revolution of this sort does not destroy or transform the field itself, but rather transposes the terms in which the identity of the field is expressed, interpreting the constitution of the field in new terms, as it were. In the case of the symbolic revolution perpetrated by Manet, the re-constitution of the field of visual art provokes a shift in accredited pictorial and personal values but retains a "*disposition esthétique*" in general. In this way, symbolic revolutions may re-order the field without suspending the *nomos* of the field itself.

If "hybridization" or "symbolic revolution" designate alterations in the order of existing fields, Bourdieu additionally countenances (though does not to my knowledge develop) the process by which fields initially appear. A passage on the differentiation of fields from the *Méditations pascaliennes* begins by evoking the special correspondence between the field and its objects, the process by which the "*être*" and the "*connaître*" of the field emerge in tandem. "*Le processus de différenciation du monde social qui conduit à l'existence de champs autonomes,*" declares Bourdieu, "*concerne à la fois l'être et le connaître: en se différenciant, le monde social produit la différenciation des modes de connaissance du monde; à chacun des champs correspond un point de vue fondamental sur le monde qui crée son objet propre et qui trouve en lui-*

⁵⁵ As Bourdieu specifies, "la discipline est un champ relativement stable et délimité, donc relativement facile à identifier." *Science de la science et réflexivité*, 128.

⁵⁶ *Méditations pascaliennes*, 116.

⁵⁷ *Ibid.*, 121.

même le principe de compréhension et d'explication convenant à cet objet."⁵⁸ Bourdieu calls attention here to the ways in which fields realize their own objects, in keeping with the "principles of vision and division" which characterize them respectively. The passage alludes to the specific difference of previously similar forms of cultural production as much as to the liberation of the field from various temporal powers. Yet the focus of the passage soon switches from the process of differentiation to the results of that process, in particular the nature of the point of view through which the objects of the field are articulated. "*Le principe de vision et de division,*" Bourdieu continues, "*et le mode de connaissance (religieux, philosophique, juridique, scientifique, artistique, etc.) qui ont cours dans un champ, en association avec une forme spécifique d'expression, ne peuvent être connus et compris qu'en relation avec la légalité spécifique de ce champ comme microcosme social.*"⁵⁹ In evoking the process of differentiation that leads to the emergence of discrete forms of cultural production in society—the religious, the philosophic, the juridical, and so on—Bourdieu also evokes the appearance of a "constitution" where none had been before. A certain tension consequently emerges between the differentiation of various kinds of cultural production as a process and the denomination of a new law *toute faite*. In this account, the constitution is clearly a product of history, but we are not made privy to the history of the constitution's appearance. Perhaps we might say that Bourdieu's account of the "constitution" of the field recognizes its existence and details its amendment (in processes like symbolic revolution and hybridization), but omits a description of its "drafting."

In the chapters ahead, I attempt to describe the drafting of the constitution of a field, the means by which the *nomos* of a given field initially appears. The differentiation of the exact sciences from the generalized culture of letters, for instance, takes place as a kind of fission in which the world of science comes to see itself and achieve external recognition as a self-contained, self-arbitrating world, governed by a *nomos* totally incommensurable with that of literary endeavor and certain traditional modes of scientific endeavor, as well. To pursue the legal metaphor, the process of differentiation in this case might be likened to "secession," in which a territory rejects one constitution in order to give itself another. A coherent field encompasses conflicting positions, but conflicting positions only belong to the same field insofar as they are each "recognized" as fundamentally viable by the other. "*Ce sont les grandes oppositions obligées qui, paradoxalement, unissent ceux qu'elles opposent,*" Bourdieu remarks, "*puisqu'il faut avoir en commun de les admettre pour être en mesure de s'opposer à leur propos, ou par leur entremise, et de produire ainsi des prises de position immédiatement reconnues comme pertinentes et sensées par ceux-là mêmes à qui elles s'opposent et qui s'opposent à elles.*"⁶⁰ In the case of the secession of the sciences from "letters" this mutual recognition no longer obtains. As we have seen, Bernardin de Saint-Pierre and Chateaubriand perceive themselves as pursuing a hermeneutic natural philosophy and can only acknowledge Biot's position by transvaluing it as a desiccating arbitrary language; Biot, on the other hand, perceives himself as pursuing exact, posi-

⁵⁸ Ibid., 119.

⁵⁹ Ibid.

⁶⁰ Ibid., 121.

tive natural science and can only acknowledge his counterpart's position by transvaluing it as the play of fanciful imagination. Their differences are by no means predicated on the "immediate recognition" of a set of shared assumptions. An altogether new constitution comes into view when the neo-Newtonian exact natural philosophers redefine natural science, and the autonomization of the sciences shows that it is ultimately ratified even without the consent of all affected parties.

Though the ratification of new constitutions conceivably takes place in a variety of ways, the autonomization of the sciences during the Post-Enlightenment offers a model in which it is driven primarily by "vertical" effects. If we imagine that luminaries like Lavoisier or Laplace initially draft the constitution of the exact positive sciences, then it is Napoleon who affords the means to put it into effect. Napoleon's cultural policy overwhelmingly favors the partisans of exact science, those who wished to secede from the broader province of letters, and the heavy charge of symbolic and material capital his patronage affords notables like Laplace, Berthollet and Cuvier allows them to dominate scientific inquiry, monopolizing the definition of what constituted legitimate science and who could be included, who excluded from the scientific scene. In the differentiation of the sciences, the ideal of exactitude expresses the legality of a new field.

IV The Virtues of the Field: Methodological Interlude II

The law of the field exists empirically only insofar as it attracts actors willing to abide by it. In Bourdieu's cultural theory, the "*illusio*" designates the ideal that compels agents to invest in the field, the aspect of the law that magnetizes the hopes and dreams of its adherents. Divided by controversy though the members of a field may be, they are all in principle fascinated by the same *illusio*, the same "*forme partiulière de croyance*" in the value of a particular mode of cultural production. "*Au titre de croyance fondamentale dans la valeur des enjeux de la discussion,*" writes Bourdieu, "*et dans les présupposés inscrits dans le fait même de discuter, elle est la condition indiscutée de la discussion. . . . L'illusio n'est pas de l'ordre des principes explicites, des thèses que l'on pose et que l'on défend, mais de l'action, de la routine, des choses que l'on fait, et que l'on fait parce qu'elles se font et que l'on a toujours fait ainsi.*"⁶¹ The notion of exactitude elaborated in Biot's article demonstrates many of the traits of the *illusio*. The "exact ideas" evoked in the title are never explicitly defined, even as Biot sets about describing how the principle of exactitude might go about reforming literary creation. This omission is perhaps less an effect of intellectual sloppiness than of the fundamental nature of the *illusio*, the difficulty of objectivizing the grounds of the discourse in which one lives and thinks. For their part, Bernardin de Saint-Pierre and Balzac similarly adhere to principles of intellectual creation that prove distinct from each other as well as from exactitude, principles that only the conflict with the exact sciences compels them to attempt to articulate as such, even as the profound incommensurability of one *illusio* to another means that discussion about them is riven with misrecognitions among competing points of view.

⁶¹ Ibid.,122.

In the chapters ahead, I develop the notion of the *illusio* in tandem with a similar, in many ways complementary concept, Lorraine Daston and Peter Galison's "epistemic virtue." Much like Bourdieu's scholastic *illusio*, Daston and Galison's epistemic virtue serves to shape the kinds of knowledge a given set of cultural protagonists view as desirable to produce. (Not all *illusiones* are scientific, of course, but all epistemic virtues potentially are. At the same time, one could easily imagine a corresponding notion like an "aesthetic virtue" at work in fields of artistic production.⁶²) "Epistemology can be reconceived as ethics has been in recent philosophical work," write Daston and Galison: "as the repository of multiple virtues and visions of the good, not all simultaneously tenable (or at least simultaneously maximizable), each originally the product of distinct historical circumstances, even if their moral claims have outlived the contexts that give them birth."⁶³ The notion that a given epistemic ideal possesses a certain "virtue" implies that it makes some aspects of an object knowable while obscuring others. Though contemporaries may construe the ideal as an absolute, any epistemic ideal inevitably poses certain advantages and disadvantages in the knowing of an object. Crucially, Daston and Galison's notion does not assail the reality or utility of the knowledge the ideal makes possible; rather, it emphasizes the necessarily partial knowledge a given ideal produces, and asks us to view each ideal as bringing out certain objects and certain aspects of objects that others leave out. The task of objectivizing "exactitude" as an epistemic virtue (or *illusio*) requires that we compare its advantages and disadvantages with those of other, competing virtues, stating the kinds of knowledge about Nature that exactitude minimizes but that Bernardin's epistemic ideal, for instance, maximizes, and that exactitude maximizes but that Bernardin's ideal, for its part, makes it difficult or impossible to see.

In Daston and Galison's usage, the word "virtue" designates both the powers a given epistemic ideal can exert on objects in its domain, as well as the moral qualities viewed as underwriting the ideal. "If knowledge were independent of the knower," they write, "then it would indeed be puzzling to encounter admonitions, reproaches, and confessions pertaining to the character of the investigator strewn among descriptions of the character of the investigation. . . . The mastery of scientific practices is inevitably linked to self-mastery, the assiduous cultivation of a certain kind of self."⁶⁴ Though the discourse of "objectivity," for instance, generally treats its guiding ideal as an epistemic absolute, Daston and Galison recast it as a virtue that coordinates discourse about both the kinds of knowledge it is desirable to generate and the kinds of knowers who are deemed fit to make that knowledge. As they point out, the truth discourse of objectivity is shadowed by a moral discourse which emphasizes the denial of the will and the suppression of the particularity of the thinker or observer. Their emphasis on the dual ethico-epistemic nature of knowledge creation recalls Bourdieu's account of the way the adherence to an *illusio* shapes the

⁶² Daston and Galison themselves hint at the notion of an "aesthetic virtue" in the epilogue of their work, on recent transformations in the sciences. The self-conscious aestheticization they highlight in nanotechnology image galleries fuses scientific and artistic criteria, they argue, in a way that transforms the nature of scientific knowledge itself. This state of affairs echoes what I view as the self-conscious fusion of aesthetic and scientific criteria in much of eighteenth-century natural history, a point I elaborate in Chapter One. "Representation to Presentation," *Objectivity* (New York: Zone Books, 2007).

⁶³ *Objectivity*, 33.

⁶⁴ *Ibid.*, 39-40.

selves of the agents of a given field. “*L’habitus spécifique*,” he writes, “*qui s’impose aux nouveaux entrants comme un droit d’entrée, n’est autre chose qu’un mode de pensée spécifique (un eidos), principe d’une construction spécifique de la réalité, fondé dans une croyance pré-réflexive dans la valeur indiscutée des instruments de construction et des objets ainsi construits (un ethos)*.”⁶⁵ Just as adherents to the discourse of objectivity espoused ethical norms and codes of behavior which inevitably corresponded to distinct social profiles (including styles of dress, membership in certain networks of sociability, and so on), so the aspirants to a given field must evince the internal constitution and external markers corresponding to its norms. In defining epistemic virtues as “norms that are internalized and enforced by appeal to ethical values, as well as to pragmatic efficacy in securing knowledge,” Daston and Galison offer compelling grounds for understanding them, in Bourdieu’s terms, as the values of the field expressed in an incorporated state.⁶⁶

The scholastic “*illusio*” and the epistemic “virtue” each transport epistemology from the plinth of absolute truth to the shifting ground of knowledge “values,” from extra-personal necessity to intimately personal dressage. Though they overlap in many regards, each offers resources, I believe, for developing aspects of the other. In particular, Bourdieu’s notion helps us see how Daston and Galison’s “epistemic virtue” can be understood to coordinate social fields, and Daston and Galison’s work on virtues can help us see how a single epistemic ideal, like objectivity, can govern the work of multiple fields. Indeed, Daston and Galison themselves invite us to read virtues as the linchpins of fields when they contrast “the static tableaux of paradigms and epistemes” of other histories of science with their own “history of dynamic fields, in which newly introduced bodies reconfigure and reshape those already present, and vice versa.”⁶⁷ Though Daston and Galison never cite Bourdieu, it would be easy to construe the “dynamic fields” they invoke as fully Bourdieusian in nature. As they point out, each of the virtues that regiment scientific discourse in their historiography guides the scientific production of a given field or cluster of fields, or at least subsists as an outmoded ideal within them. Within this scenario it would be possible to show that the battle for dominance waged among different parties in the field takes place under the banner of conflicting virtues, or that the limits of adherence to a given virtue mark the boundaries of the field itself.

Moreover, Daston and Galison’s emphasis on the interplay among virtues designates a theory of scientific change compatible in many respects with that of Bourdieu. In Bourdieusian terms, the rise of a given epistemic virtue may mark a symbolic revolution which reorganizes the relative value of positions in the field, diminishing the authority of adherents to an older virtue without eliminating them altogether. “Instead of the analogy of a succession of political regimes or scientific theories, each triumphing on the ruins of its predecessor,” Daston and Galison write, we should “imagine new stars winking into existence, not replacing old ones but changing the

⁶⁵ *Méditations pascaliennes*, 120.

⁶⁶ *Objectivity*, 40.

⁶⁷ *Ibid.*, 19.

geography of the heavens.”⁶⁸ In this metaphor, the night sky figures the ideals that co-exist within a field, or that perhaps radiate through multiple fields. In their attentiveness to the variable prevalence of epistemic virtues in different fields and disciplines, Daston and Galison offer grounds to conjugate their historiography with a historical sociology of fields, one which would aim to narrate in detail the interactions among different virtues insofar as they organize the competition of various fields for authority over the description of Nature.

Daston and Galison’s attention to the ways that a single virtue, like objectivity, can permeate scientific culture (and sometimes even general culture) helps us see how such a virtue might stand as the *illusio* of several fields. In Bourdieu, the *illusio* often seems confined to its corresponding field, self-identical and non-transferrable. Indeed, the name of the concept itself evokes the “illusory” nature of the stakes of a field’s game to those who stand outside, looking in. The law of a given field, we read in Bourdieu, is “*irréductible et incommensurable à toute autre; chaque champ . . . enferme ainsi les agents dans ses enjeux propres qui, à partir d’un autre point de vue, c’est-à-dire du point de vue d’un autre jeu, deviennent invisibles ou du moins insignifiants ou même illusoire*.”⁶⁹ Though the notion that the ideal of a field is “irreducible to and incommensurable with” any other does not necessarily imply that it shares no elements in common with them, Bourdieu nevertheless emphasizes the one-to-one correspondence of *illusio* to field. In contrast, Daston and Galison highlight the ways that a given virtue may permeate multiple fields, sometimes in company with other virtues. “New epistemic virtues come into being;” they write, “old ones do not necessarily pass away Epistemic virtues, once entrenched, seem to endure—albeit to differing degrees in different disciplines.”⁷⁰

(Though Bourdieu often stresses the correspondence of *illusio* and field, he also works out means for articulating an ideal’s appearance in multiple fields. In a passage from *Science de la science et réflexivité*, he proposes that different disciplines may be coordinated by a same “style,” and that this style may be imposed by more prestigious on less prestigious disciplines. The elements of a discipline that Bourdieu characterizes as imbued with a certain style are precisely those elsewhere described as being shaped by adherence to an *illusio*. He specifies, for instance, that “*les produits d’un même habitus sont marqués par une unité de style (style de vie, manière, écriture d’un artiste)*,” and additionally evokes the notion of “*styles de pensée*,” underwritten by “*une “tradition de présupposés partagés” pour une grande part invisibles et jamais mis en question*” And Bourdieu pursues this notion of style to show that the style of one discipline may inflect the style of others standing lower on the hierarchy of disciplines. In the event, he cites none other than mathematical physics as the example of a discipline whose style has molded that of a range of other disciplines. Very briefly, he evokes this history: “*Cette notion de “style” est importante pour au moins désigner, montrer du doigt, une propriété des différentes sciences, ou disciplines, qui a été écrasée, obnubilée, dans toute la réflexion sur la science, par le fait que la physique et, plus précisément, la physique quantique a été constituée en modèle ex-*

⁶⁸ Ibid., 18.

⁶⁹ *Méditations pascaliennes*, 116-17.

⁷⁰ *Objectivity*, 41.

*clusif de la scientificité, au nom d'un privilège social converti en privilège épistémologique. . . .*⁷¹ Bourdieu thus sketches out a framework for the manner in which a “style,” or in the parlance I have adopted here, a “virtue” may permeate a multitude of other disciplines.)

As Daston and Galison’s remark about the entrenchment and succession of virtues suggests, a given ideal’s presence across fields shifts with time. Of scientific ideals, they add, “the new did not always edge out the old. Some disciplines were won over quickly to the newest epistemic virtue, while others persevered in their allegiance to older ones. The relationship among epistemic virtues may be one of quiet compatibility, or it may be one of rivalry and conflict. In some cases, it is possible to pursue several simultaneously; in others, scientists must choose Contradictions arise.”⁷² This competition or fusion of various scientific virtues invests each field with a distinct temporality. In similar terms, Bourdieu calls attention to the way that the dialectic between new and old occurs at a rate that varies with the dynamics of the field in question. Each field, Bourdieu remarks, has “*son temps propre, une chronologie unique tendant à aplatir dans une fausse unilinéarité des temporalités différentes, les séries indépendantes correspondant aux différents champs qui peuvent d’ailleurs se rencontrer, à l’occasion notamment des crises historiques.*”⁷³ These historical crises act to “synchronize” fields invested with various temporalities in the pursuit of a common ideal. Though for Bourdieu the ideal in question at such moments is most often extra-scientific (as in the politics of the May ’68 strikes), the dynamics of “synchronization” additionally suggest a way of understanding the distribution of a scientific ideal across fields. In periods of historical stability (as opposed to historical crisis), that is, fields might be seen as synchronized to the degree that they share in a same epistemic ideal. During much of the nineteenth and twentieth centuries, for instance, scientific disciplines might be said to have been “modern” to the degree that they espoused objectivity.

Perhaps it might be objected that the potential compatibility of one epistemic virtue with another demarcates Daston and Galison’s notion from Bourdieu’s absolute *illusio*. And indeed Daston and Galison never explicitly discuss the epistemic virtue as an element which constitutes the very grounds of scientific discussion. Insofar as a virtue like objectivity remains a marginal presence in a given field, moreover, it admittedly cannot function as an *illusio*. But to the degree that an epistemic virtue colors the bulk of the work undertaken in a given field, or even, like objectivity, spills over to saturate scientific culture in general, it may well constitute the implicit grounds of discussion, reconciling the tenants of opposing theses. At a given stage of the field, the virtue in vogue may stand as the contemporary expression of the *nomos* of the field, an expression subject to the changes brought about by symbolic revolution, yet no less fundamental for that. During the heyday of objectivity, as Daston and Galison construe it, and even to the present day, this ideal becomes more or less concomitant with scientific inquiry per se, in the eyes of both scientific specialists and the general public. Though as Daston and Galison point

⁷¹ *Science de la science et réflexivité*, 129-30.

⁷² *Objectivity*, 28.

⁷³ *Science de la science et réflexivité*, 127-28.

out, these adherents to objectivity make frequent reference to their elected ideal, they do not refer to it *as* a virtue—or as an *illusio*. The originality of Daston and Galison’s book is to call attention to the moral underpinnings of the discourse of objectivity, elements that the adherents of objectivity are, in the spirit of the *illusio*, least able to distinguish.

Daston and Galison’s historiography of the sciences ultimately focuses on epistemic virtues which acted on a grand scale, in each case shaping the shared grounds of scientific inquiry in general for a century or more. Stretching from the eighteenth to the twenty-first centuries, this historiography presents a sequence in which the epistemic virtues they identify as most characteristic of scientific culture in general at a particular time give way to something new: the idealizing “truth-to-nature” of the eighteenth-century cedes to the mechanical “objectivity” of the nineteenth, and the objectivity of the nineteenth, by and large, to the expert’s “trained judgment” of the twentieth. But, they insist, “there is a deep historical rhythm to this sequence; in some strong sense, each successive stage presupposes and builds upon, as well as reacts to, the earlier ones. Truth-to-nature was a precondition for mechanical objectivity, just as mechanical objectivity was a precondition for trained judgment.” If the older virtues pre-condition the newer ones, the newer ones also re-fashion the older. “As the repertoire of epistemic virtues expands, each redefines the others. This is not some neat Hegelian arithmetic of thesis plus antithesis equals synthesis, but a far messier situation in which all the elements continue in play and in interaction with one another.”⁷⁴

This dynamic and multi-layered sequence is one more reason why Daston and Galison seemed so congenial to me as aids in assembling a picture of post-Enlightenment culture. The piecemeal, partial, and sometimes contradictory interactions they stage among virtues, sometimes subsisting inertly together, sometimes transforming each other mutually, suggested a means of describing the remarkable discursive heterogeneity of the age. But as I went about determining just how to account for this heterogeneity, it seemed to me that the particular virtues they themselves propose fell short of elucidating the peculiar dynamics of the Post-Enlightenment. Historically speaking, after all, “truth-to-nature” reigned from the mid-eighteenth century, they contend, and “objectivity” as such appears only in the eighteen-thirties and -forties. A historical gap appears, then, at precisely the moment when something unmistakably new was agitating the sciences, and my own readings confirmed that ideals other than truth-to-nature or objectivity regimented the sciences of this period, that the new mathematical physics was guided by an entirely new ideal. The pro-Newtonianism of the exact natural philosophers, the anti-Newtonianism of Bernardin or Chateaubriand, and the hyper-Newtonianism of Balzac and Geoffroy Saint-Hilaire are each in a sense the explicit expression of the more elusive *illusiones* that fascinated these figures. Taking my cue from the language these cultural producers themselves drew upon, I have identified these expressions with a distinct sequence of virtues, different from those delineated by Daston and Galison but working at an equivalent temporal and institutional scale. In the following chapters, I show that Bernardin’s natural philosophy adheres to the virtue of “admiration,” the science of Laplace, Biot and other mathematizing physicists to that of “exactitude,” and the writings of Balzac and Geoffroy to that of “synthesis.” Just as the adherents of objectivity speak the language of objectivity without having attained a point of view from which it could

⁷⁴ *Objectivity*, 18.

be construed as a virtue as such, the adherents of each of these ideals use some variation of these words—admiration, exactitude, synthesis—to describe their visions of right knowledge, even as in espousing their ideal they cannot picture it on an equal footing with that of their rivals or antecedents, or view it as scientific and ethical all at once.

Though these post-Enlightenment virtues differ from those identified by Daston and Galison, they nevertheless tell a complementary, not a contradictory story. “Exactitude” fills the gap prior to the emergence of objectivity, at a time when “truth-to-nature” persisted but could not have been responsible for the very new, very sudden birth of modern positive science. (If, methodologically speaking, it seemed advantageous to square Bourdieu with Daston and Galison, historiographically speaking, it seemed necessary to square Daston and Galison with Foucault.) At the same time, “admiration” and “synthesis” broaden the picture beyond the modality of “representation” assumed by Daston and Galison, a step compelled by the scope of debates over the nature of scientific knowledge during the period. The problem of how literary and scientific forms of knowledge production about Nature came to be differentiated requires a broader view of scientific virtues than that afforded by the modality of “representation,” because such principles not only organized debates on scientific work but also organized debates about the nature of scientificity. As I have suggested, figures like Bernardin and Chateaubriand espoused a “hermeneutic,” not a “representational” regime, a regime in which Nature was seen to organize itself according to a grammar with which the discourse of the natural philosopher was co-extensive, and in which any conventional language—verbal, mathematical, or visual—destroyed Nature’s harmony. Likewise, synthesis calls into question the scientificity of exact science itself in the eighteen-thirties and -forties, in a way that goes beyond the succession of values depicted by Daston and Galison within undisputedly “scientific” terrain. In articulating this ideal, Balzac, Geoffroy Saint-Hilaire and others clearly build on the representational mode of exactitude, in much the same way that Daston and Galison claim “truth-to-nature” pre-conditioned “objectivity.” Yet they push representation beyond its tipping point into some other, new mode of language, where the autonomy of the sign itself begins to be overwhelmed. This new language modality cannot be assimilated to the old hermeneutics, as we shall see, but instead evokes the dissolution of the sign or symbol itself in materiality, or a corresponding elevation of matter to semi-symbolic status.

Admiration, exactitude, and synthesis: these three epistemic virtues scan the culture of post-Enlightenment France, sometimes co-existing, sometimes clashing, sometimes re-defining one another. Along the way they each govern or aim to govern the gamut of scientific pursuits, from the sciences of physical Nature to those of living things. Refusing any fundamental distinction between literary and scientific cultures, admiration and synthesis additionally extended their purview to literary pursuits; and as Biot’s article suggests, the partisans of exactitude could sometimes espouse this totalizing vision, as well. The argument is not, of course, that these virtues defined *all* of literature at a given time, or that they reigned undisputed as literary imperatives. But they do constitute the conditions of legibility of a broad array of texts, and stake out limit cases where the values, institutional affiliations and authorities of literature were thrown into intensive negotiation. With the emergence of objectivity, literature and science resolve into distinct entities, each commanding an uncontested terrain. Prior to that peace, though, French lettered culture is a contested field, riven by conflicts among rival points of view. The often puz-

zling works of the French Post-Enlightenment emerge as cohesive in their fashion when we can see them as entries in the conflict over how to know. In this effort, the caveat issued by Bénichou in his study of post-Enlightenment literature, written at the height of literary autonomy, is still pertinent today: “*Il est difficile aujourd’hui de soutenir avec la science une concurrence quelconque dans l’ordre de la connaissance,*” Bénichou cautions, “*si l’on ne pose d’abord que le mot “connaître” a plusieurs sens, et doit s’entendre à plusieurs niveaux, ce qui est précisément en question.*”⁷⁵

IV. The Origins of Life Itself

What does “life” have to do with the rise and fall of these virtues? If field formation concerns both “*l’être*” and “*le connaître*,” as Bourdieu has it, both the object and the means of knowing it, this succession of virtues transforms notions of animation and animated things along with the techniques designed to bring them to light. Once again, this history hinges on the singular epistemic rupture which initiates the modern positive sciences. The real object of eighteenth-century natural history was not life at all, as Foucault affirms, but merely living things. Only with the advent of the modern positive sciences did anything like “life” as a discrete, autonomous element of the organism come into view, along with the discourses and techniques of modern “biology.” In *Les mots et les choses*, Foucault casts Cuvier as the prime avatar of this shift, a figure in whom the notion of life itself reaches a certain early perfection. Foucault briefly evokes transitional figures like Vicq d’Azyr or Jussieu, whose commitment to experimental physiology and the development of a “natural method” of classification fall somehow midway, he tells us, between the neat taxonomies of high eighteenth-century natural history and the functional animal bodies of later nineteenth-century biology. Yet we never learn just how these sciences participate, if at all, in the elaboration of a notion of life itself, how the transition from natural history to biology really takes place and what deformations the concept concomitantly brooks.

Foucault’s insight about the advent of life itself has remained foundational in histories of biopolitics, but seems to play a less important role in histories of the life sciences. Following Foucault, historiographies of life have focused either on detailing the posterity of life itself in an age of bio-capital and fascism, or on exploring conceptions of life that arose as alternatives to those perpetuated by modern positive biology. Studies like Nikolas Rose’s *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century* or Nicole Shukin’s *Animal Capital: Rendering Life in Biopolitical Times* have shown how bio-engineering and industrialized animal production manipulate living things and their composite parts for utility or profit; while Giorgio Agamben and a host of other theorists have shown how various political regimes presuppose their own conceptions of life as an element of living things.⁷⁶ Another distinct current of bio-history has focused on the empirical and philosophical histories of alternative, often “Ro-

⁷⁵ “Réflexions sur le romantisme français,” *L’école du désenchantement*, 2013.

⁷⁶ Nikolas Rose, *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century* (Princeton: Princeton University Press, 2007); Nicole Shukin, *Animal Capital: Rendering Life in Biopolitical Times* (Minneapolis: University of Minnesota Press, 2009); Giorgio Agamben, *Homo sacer: Sovereign Power and Bare Life* (Stanford: Stanford University Press, 1998).

mantic” conceptions of life, elaborated in non-positivist sciences or non-scientific domains, particularly in the German and English traditions. Studies like Timothy Lenoir’s *The Strategy of Life: Teleology and Mechanics in Nineteenth-Century German Biology*, Lynn K. Nyhart’s *Biology Takes Form: Animal Morphology and the German Universities, 1800–1900* or the essays in *Romanticism and the Sciences*, edited by Andrew Cunningham and Nicholas Jardine have documented the relationship between German *Naturphilosophie* and the disciplinization of biology in Germany,⁷⁷ while Elizabeth A. Williams’ *The Physical and the Moral: Anthropology, Physiology and Philosophical Medicine in France*, Robert Mitchell’s *Experimental Life: Vitalism in Romantic Science and Literature*, and John Tresch’s *The Romantic Machine*, among others, have elicited the prevalence of a vital materialist tradition in and beyond France, developing in counterpoint to nineteenth-century positivist biology.⁷⁸ Curiously, the biopolitical current has embraced Foucault’s insight about the advent of “life” more actively than the cultural historical one; most of the latter texts examine the history of vital materialism without reference to Foucault’s archaeology of life itself. Perhaps for this reason, the means by which modern biology and the concomitant notion of “life” itself came to be have received little subsequent scrutiny in socio-historical terms, in spite of the fundamental nature of Foucault’s insight and in spite of the likelihood that such vital materialisms played a role either in competing with or contributing to the advent of this notion. (Thus, for example, in Chapter Two I show how the conception of life associated with galvanism profoundly conflicts with that supposed by the positivist life sciences, but in so doing helps sharpen the positive sciences’ life itself.)

Though a comprehensive account of the emergence of life itself lies beyond the bounds of the present study, the chapters to come engage in sustained examinations of life (or merely animation) as a stake in disputes among rival scientific ideals. In asking just where “life” comes from, they build on the work of Mary Terrall, Peer Hanns Reill, Jessica Riskin and others who have expanded our conceptions of eighteenth-century science beyond the natural historical taxonomies so influentially foregrounded in *Les mots et les choses*, highlighting the pervasiveness of experimentation, speculation, collecting, aristocratic sociability and other practices to boot.⁷⁹ In enriching our picture of eighteenth-century French natural history, Terrall’s studies of Réaumur, Maupertuis, Diderot, and other natural philosophers and experimentalists have drawn attention to the various conceptions of animation that accompanied mid-century studies of living

⁷⁷ Timothy Lenoir, *The Strategy of Life: Teleology and Mechanics in Nineteenth-Century German Biology* (Boston: Reidel, 1982); Lynn K. Nyhart, *Biology Takes Form: Animal Morphology and the German Universities, 1800–1900* (Chicago: University of Chicago Press, 1995); *Romanticism and the Sciences*, ed. Andrew Cunningham and Nicholas Jardine (Cambridge: Cambridge University Press, 1990).

⁷⁸ Elizabeth A. Williams, *The Physical and the Moral: Anthropology, Physiology and Philosophical Medicine in France* (Cambridge: Cambridge University Press, 1994); Robert Mitchell, *Experimental Life: Vitalism in Romantic Science and Literature* (Baltimore: The Johns Hopkins University Press, 2013).

⁷⁹ See “Speculation and Experiment in Enlightenment Life Sciences,” in *Heredity Produced: At the Crossroads of Biology, Politics, and Culture, 1500-1870*, ed. Staffan Müller-Wille and Hans-Jörg Rheinberger (MIT Press, 2007); *The Man Who Flattened the Earth: Maupertuis and the Sciences in the Enlightenment* (Chicago: University of Chicago Press, 2002); and *Catching Nature in the Act: Réaumur and the Practice of Natural History in the Eighteenth Century* (Chicago: University of Chicago Press, 2013). For Jessica Riskin, see *Science in the Age of Sensibility: The Sentimental Empiricists of the French Enlightenment* (Chicago: University of Chicago Press, 2002).

things. In similar fashion, I work in this study to elicit the conceptions of life and living things that accompanied the experimentation and speculation of the last two decades of the century. This dance of vital objects and the modes of knowledge that corresponded to them is inscribed in the broader history of successive epistemic virtues. The emergence of life itself, I believe, can be understood as an instance of scientific change in which the principle of exactitude manages to co-opt the study of living things in the sciences in France. Over the course of the virtues' mêlées, the exact sciences manage to subordinate existing fields of medical or scientific knowledge relative to living things, and also realize altogether new ones. Co-opting the study of living things perpetuated in natural histories like those of Bernardin de Saint-Pierre or Chateaubriand, as well as in the medical faculties, they institute a physico-chemical point of view on the organism, setting the stage for the vital materialist reaction of Geoffroy Saint-Hilaire, Balzac and many others.

Bernardin de Saint-Pierre's *Études de la nature* confirm the Foucauldian picture of eighteenth-century natural history in many ways. Though Bernardin de Saint-Pierre's natural philosophy departs from the Linnaean taxonomies that Foucault identifies with eighteenth-century natural history in general, it similarly evinces an almost exclusive focus on the plants' and animals' outsides as opposed to the bodily depths of the later "functional" view. As Foucault points out, taxonomists generally completed their classifications on the basis of some superficially visible characteristic, and while Bernardin is less interested in classifying than in determining how and why various plants, animals and minerals co-exist, his gaze is nonetheless attracted exclusively to feathers, scales and skin. In contrast, the modern positivist biology represented in *Les mots et les choses* by Cuvier's comparative anatomy envisions the animal as an ensemble of functions, conducing to help it meet the "conditions of life." This functional perspective penetrates the animal's surfaces to explore the organs and operations which contribute to a given life function. In this perspective, "life" is the function of functions, the *raison d'être* of a given animal body, as well as an entity lurking in the depths of the body, at once everywhere and nowhere within it. The rhetoric of exactitude conspires to realize the notion of life insofar as it divides the animal body into material and immaterial elements, with the material element available for study in terms devised by the exact physical sciences and the immaterial element construed as animal matter's constituent but non-knowable other.⁸⁰ Just as Biot generalizes the principle of exactitude to poetry and literary fiction, figures like Cuvier and the experimental physiologist François Magendie work to generalize it to the study of living things, and it is the exact sciences that provided the theoretical and rhetorical resources these figures needed to realize a new view of animal physiology, even as these resources are themselves fundamentally transformed in contact with the animal body.

While the distinction between the points of view of natural history and positivist biology is relatively stark, positivist biology's dispute with medical physiology takes a bit more parsing. Yet this disparity is fundamental to an account of the transition between eighteenth-century physiologies and the positive nineteenth-century ones that succeeded them. Though one might imagine that Foucault's archaeological mode absolves him of addressing the problem of transition, he

⁸⁰ As Foucault argues, the immaterial other in question is itself a new entity, a "quasi-transcendental" distinct from the metaphysical transcendentals of "will" or "soul" in eighteenth-century physiology. See *Les mots et les choses*, 326-29 for the relationship between the new positivities and the old metaphysics.

does in fact allude to the clinician and medical physiologist Vicq d'Azyr in particular as a "transitional" figure, a sort of predecessor of Cuvier.⁸¹ Yet, Foucault's account is as notable for who and what it leaves out as for who and what it includes; such extra-hexagonal luminaries of eighteenth-century experimental physiology as the Swiss-German Albrecht van Haller (1708-1777) or the Italian Lazzaro Spallanzani (1729-1799) receive no mention at all, though their modes of opening up the animal body and their fame in France make them relevant to the story. Moreover, Foucault views the proliferation of vitalisms during the final decades of the eighteenth century and the first decades of the nineteenth as merely epiphenomenal to the deeper, structural shift from natural history to biology: "*C'est ce passage de la notion taxonomique à la notion synthétique de vie,*" he asserts, "*qui est signalé, dans la chronologie des idées et des sciences, par le regain au début du XIXe siècle, des thèmes vitalistes.*"⁸² As a means of asking just how these transitional or vitalist figures play a role in the process of scientific change, I examine the reception of the polemic between Alessandro Volta and Luigi Galvani in France as a tipping point between rival conceptions of animation. Galvani's and Volta's polemic seems to me to be a moment when new, half-articulated conceptions of the animation of living things are afoot, conceptions that are never fully articulated but which suggest a transition between the sort of passive animation of living things in eighteenth-century natural history, and the discrete "life" at work in the animal body in nineteenth-century biology.

Over the course of this polemic, the medico-physiological point of view on the animal body gradually cedes to the physico-physiological point of view, Galvani ultimately capitulating to Volta. Though Galvani's notion of "animal electricity" subsequently became construed as scientific, even quasi-occult, his position was entirely consistent with that of other medically trained experimental physiologists of the time. Galvani and his colleagues wanted to identify the physical agent of voluntary movement and perception in the animal body, a kind of substance which many suspected was electrical in nature. Galvani and others were searching for a specific physical agent, produced under physiological conditions in the animal's body; but Volta suspected that the agent Galvani ultimately isolated could be explained by the behaviors of purely physical materials. He proved his case in part by building the very first battery, an instrument that definitively showed that inanimate materials could generate electricity through physical contact alone. Volta's invention won him acclaim all over Europe and shifted the very terms of the dispute with Galvani: the invention of the battery showed only that inanimate materials could generate electricity, not that the animal body could not, nor that voluntary motion and other nervous phenomena were produced by specific, alternative means. Though Volta's intervention in the polemic does not itself evince the functional perspective on the animal body that would come to be identified with the positive biologies of Cuvier or the experimental physiologist François Magendie, it nevertheless marks the precedence of a physico-physiological perspective over the medico-physiological perspective represented by Galvani, and paves the way, as I show, for a shift in authority over the knowledge of living things from the medical faculties and other medical institutions to the institutionalized sciences in France.

⁸¹ *Les mots et les choses*, 243-245.

⁸² *Ibid.*, 281.

For Arago, Volta's battery was the signature triumph of the nineteenth-century physical sciences, tangible proof of their advanced state relative to the other sciences. After all, the battery had resolved the discomfiting spontaneity of Galvani's frogs into the surprising regularity of a mere physical process. But the uses of the battery were many, and the physiologist Geoffroy Saint-Hilaire, on the contrary, viewed it as an all-new model of animation, in which the very distinction between physical and physiological problems was dissolved. The battery's ambiguous status called for a new kind of science, one that could overcome the distinction between brute and animate matter. As Geoffroy has it, this generalized physiology would supplant the physical sciences' limited point of view on such devices, which the physiologist defined as bodies "*qui aussi ont leur sorte de viabilité, qui vivent à leur manière et qui de toutes façons sont gouvernés dans leurs actes vraiment physiologiques, comme se conduisent les êtres organisés donnés directement par la nature.*"⁸³ Geoffroy's interest in such hybrids took shape in the context of his conviction that science ought to evince a fundamental unity, rather than follow the drift of increasing specialization so pronounced in the nineteenth century, and he shared this belief in the fundamental unity of the sciences with many of his contemporaries, including Balzac, his friend and fellow traveler. A volley of citations hints at their shared ambitions. Geoffroy famously adopts a citation from Balzac's *Seraphîta* for the epigraph to his *Notions synthétiques, historiques et physiologiques de philosophie naturelle* (1838)--"*La science et une, et vous l'avez partagée!!!*"—while Balzac foregrounds Geoffroy's unifying law of "*soi pour soi*" in the "Avant-propos" to the *Comédie humaine* (1842).⁸⁴ Séraphîta's accusation decries the incongruity of the sciences' *connaître* to the *être* of Nature as a whole; while Geoffroy's notion expresses the wish to root disciplinary unity in a single law pertaining to both living and non-living matter. Together, Balzac and Geoffroy sought to rally what the physiologist called the "*têtes synthétiques*" of the age--those thinkers capable of surmounting the piecemeal work of the exact sciences to arrive at a single science grounded in a vital materialism.

With this turn toward the total science of Geoffroy Saint-Hilaire, Balzac and their allies, this study rejoins the recent critical interest in vital materialist alternatives to the modern physical and physiological sciences. As John Tresch points out, the cultural products of this period are rife with "fascination with animated matter, lifelike machines, the creative forces of "naturing nature," and even pantheism." This fascination was generalized to a wide range of cultural productions—appearing not only in "the works of extravagant speculators like Fourier or artists like Grandville," writes Tresch, "nor only in works of fantastic literature, visual arts, and music, but even—and most consequentially—in the writings of prominent physicists, astronomers, biologists, and engineers."⁸⁵ Why the credence of physicists, astronomers, biologists and engineers should be more consequential in this context is not immediately clear, but the citations of these

⁸³ Étienne Geoffroy Saint-Hilaire, *Études progressives d'un naturaliste pendant les années 1834 et 1835* (Paris: Roret, 1835), 180.

⁸⁴ Étienne Geoffroy Saint-Hilaire, *Notions synthétiques, historiques et physiologiques de philosophie naturelle* (Paris: Dénain, 1838); Honoré de Balzac, "Avant-propos," *La Comédie Humaine*, vol. 1 (Paris: Gallimard, 1976), 7-8.

⁸⁵ *The Romantic Machine*, 16.

professional titles is misleading. The tendency of a wide variety of figures to espouse vital materialist thinking is only consequential insofar as they espoused it *as* prominent members of their professions, yet there is a crucial difference between entertaining such matters privately and integrating them into one's professional identity. Thus, when Geoffroy Saint-Hilaire finally recounts the epiphany that revealed matter's inherent vitality to him in a work of professional physiology, it reads as a kind of intellectual confession, or even a coming out. "*Depuis 33 ans que mon esprit est incessamment poursuivi par de telles idées, je n'avois point osé (foiblesse d'âme qui m'affligeoit) et je vivois dans la persuasion que je n'oserois jamais dire, après un laps de temps aussi long, ce que j'ai toujours considéré comme vrai.*"⁸⁶ In a similar way, one may appreciate the scope of Ampère's spiritualism, as Tresch does, without dismissing the advanced mathematics in which his findings were cast as mere "window-dressing,"⁸⁷ while Geoffroy's coming out precipitated his fall from scientific grace, Ampère's observance of forms helped maintain his professional dignity.⁸⁸ More plausible is to conclude, with Robert Darnton, that the institutional sciences maintained an inflexible opposition to spiritualist or vital materialist sciences *as* science. The revival of mesmerism in the eighteen-twenties and beyond "aroused its natural enemies," Darnton writes, "the orthodox doctors and scientists, who fought it once more with the tried and true weapons of ridicule and academic commissions."⁸⁹ As Darnton points out, Balzac is among many prominent figures who fought to budge this hard line. Speaking in the name of "*les platoniciens, les swedenborgistes, les illuminés, les martinistes, les boehmenistes, les voyants, les extatiques, peuple poète, essentiellement croyant, acharné à comprendre et nullement à dédaigner,*" Balzac assures his mentor Charles Nodier, for instance, that in matters of scientific truth he will refer him "*ni à Bichat, ni à Laplace, ni à Savary, ni à M. Arago, parce que nous planons un peu plus haut qu'ils ne parviennent dans les espaces.*"⁹⁰ However generalized these and other spiritualisms may have been in the intellectual landscape of post-Enlightenment France, they remained contrary to the spirit of the professional sciences as such, as Balzac acknowledges. It might even be said that the rejection of vital materialism constituted the "point

⁸⁶ *Études progressives d'un naturaliste*, 146.

⁸⁷ *The Romantic Machine*, 45.

⁸⁸ These are the social dynamics referred to in the epigraph from Proust. Proust's play on "*monde*" evokes the ways in which both natural and social worlds are in a process of continual reinvention. "*La création du monde n'a pas eu lieu au début, elle a lieu tous les jours. La marquise de Saint-Loup se disait: "Je suis la marquise de Saint-Loup", elle savait qu'elle avait refusé la veille trois dîners chez des duchesses. Mais si dans une certaine mesure son nom relevait le milieu aussi peu aristocratique que possible qu'elle recevait, par un mouvement inverse le milieu que recevait la marquise dépréciait le nom qu'elle portait. Rien ne résiste à de tels mouvements, les plus grands noms finissent par succomber (Albertine disparue, 249).*" In precisely the same way, prestigious titles like "physicist," "engineer" and so on are not endowed with an inalterable sum of authority; rather they fluctuate with the activities of the agents who bear them, and in this dynamic the espousal of vital materialist or pantheistic in professional speech parallels the *marquise's* damaging reception of an un-aristocratic crowd.

⁸⁹ Robert Darnton, *Mesmerism and the End of Enlightenment in France* (Cambridge: Harvard University Press, 1968), 141.

⁹⁰ "Lettre à M. Ch. Nodier sur son article intitulé 'De la palingénésie humaine et de la résurrection'," *Oeuvres diverses*, vol. 2 (Paris: Gallimard, 1996), 1204 and 1207.

of honor” of orthodox physicists and natural philosophers, the very principle which enabled them to discriminate between themselves and their visionary contemporaries.

In recent cultural histories and philosophies, the very words “vital” or “vibrant” seem to deliver a charge to those who are disposed to receive it. This power is not perhaps a mystical one, but rather expresses, I suspect, the anxieties and hopes condensed in these tokens themselves: perhaps a freeing sense that cultural historians and other humanities scholars, can discourse on Nature, too, a refusal to be penned up by the humanities' crisis but rather to go loafing in other fields. If, with Jane Bennett, we might claim a place for humanities criticism in conceptualizing thinking, will and other corollaries of animation, we might nevertheless balk at grounding this imperative in a new form of vital materialism. In *Vibrant Matter* Bennett calls for a turn away from the mode of “demystifying” that dominates academic criticism, to one invested in risking “positive formulations of alternatives.” “A relentless approach toward demystification,” she says, “works against the possibility of positive formulations.”⁹¹ This call for a creative criticism is inspiring; yet what strikes me as singular about many of the participants in the critical trend of new materialisms is their apparent reluctance to engage with the contemporary sciences. Surely the way to venture a positive formulation of the way matter informs agency is not to ignore the many and varied accounts of animation developed by the contemporary sciences, even if we ultimately find them unsatisfactory. But cultural histories and philosophies of alternative conceptions of vitality seem to me to share in common a preference for metaphysics in general and for the experimental realm only insofar as it belongs to a lapsed scientific past. Yet the empirical sciences today encompass a rich repertoire of motifs of “life,” including, as the anthropologist Stefan Helmreich tells us in the an article entitled “What Was Life?”, the “lateral” transfers of genetic material undertaken by certain deep-sea organisms, able to exchange genes without reproduction; or the “biosignatures” tracked by astrobiologists as a means of verifying the presence of extra-planetary life.⁹²

Interesting amalgams of physics and physiology already exist in academic and industrial science, ones which seem to heed Georges Canguilhem’s call for a vital rationalism in which not only the fact of animation but also its meaning are elicited. One thinks of a field like “physical oncology,” in which the individual cancer cell is treated as a unit capable of orienting its own forces, acting at the intersection of genetics, its physical milieu, and its particular volition. “In living organisms,” we read in a recent special issue of *Nature* on the subject, “cells are continuously exposed to physical forces, such as compression, tension, hydrostatic pressure and shear stress. They respond by modifying their behaviour and generating their own forces. “We're finding these forces are key to the way cells divide, interact, signal, move and attach,” says Muhammad Zaman, a biomedical engineer at Boston University in Massachusetts. “There is a deeper appreciation now that cells are very touchy-feely — they're not just these things that receive and process signals.”⁹³ Though these researchers are eliciting the particular “living” of the cancer cell

⁹¹ Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, NC: Duke University Press, 2010), xv.

⁹² Stefan Helmreich, “What Was Life? Answers from Three Limit Biologies” *Critical Inquiry* 37.4 (2011), 676-77

⁹³ Erika Jonietz, “Mechanics: the forces of cancer,” *Nature* 491 (2012), S56.

to a particular end, they are engaged in distinguishing tendencies toward volition on a cellular, if not material level. The call to articulate a creative criticism that can speak to the natural sciences today must not only find its inspiration in the alternatives of the past but also enter into a dialectic with modern physics or contemporary biophysics. After all, even the avatars of “synthesis,” visionary as they were, maintained an interest in the ends and means of the positive sciences.

V. Science is Soon Said

The notion that the physical sciences should provide a model for the life sciences may be so ingrained in the status quo as to seem inevitable. After all, the modern biological sciences realized themselves as such in the first place, the argument goes, to the degree that they assimilated the criteria of the physical sciences in the investigation of living objects.⁹⁴ Yet Biot’s notion that the principle of exactitude should similarly guide the reform of literary composition and criticism seems a step too far, a case of serious overreach. To the degree that literature discovered an identity for itself over the course of the nineteenth century, after all, it did so by distinguishing itself from the natural sciences, and sometimes even by contradicting them. The assertion that the epistemic principle of the physical sciences should exercise its virtues over the entire gamut of cultural pursuits seems hubristic, or at least odd in a way that doctrines of progress so often ultimately do. As Henry James writes in an appreciation of Émile Zola, “‘Science’ is soon said—the whole thing depends on the ground so covered. Science accepts surely *all* our consciousness of life; even, rather, the latter closes maternally round it—so that, becoming thus a force within us, not a force outside, it exists, it illuminates only as we apply it.”⁹⁵ With this declaration, James punctures Zola’s ambition to import the methodology of the positive sciences into literary fiction, a move that echoes that of Biot in many ways. For if Biot sought to dominate literary production from the standpoint of the sciences, Zola courted the subordination of literary production to the sciences from within the literary field. As James point out, the “science” of literary production is a function of the means and objects of the writing itself, however, rather than of the application of some fixed, extrinsic principle, whether that principle be an ideal like exactitude or a positivist methodology like that adopted by Zola.

The totalizing scenario imagined by Biot would not be ratified, of course; even Zola’s perverse application of positive science to literature would only become possible once literature and science had become rigorously differentiated. Yet Biot’s essay may nevertheless strike a chord today. If the physicist denies that writers can produce science as such, the presumption that literature is inherently “non-scientific” likewise obtains today, especially beyond academia. For

⁹⁴ This is the argument famously developed by Georges Canguilhem in “Aspects of Vitalism” and other essays. See *Knowledge of Life*, trans. Stefanos Geroulanos and Daniela Ginsburg (New York: Fordham University Press, 2008).

⁹⁵ Henry James, “Émile Zola,” *Literary Criticism: European Writers and the Prefaces*, ed. Leon Edel (New York: Library of America, 1984), 891.

while within academia, a number of scholars have been eliciting the *savoirs de la littérature*⁹⁶—the science that literature says, sometimes as such—, the view prevails outside of academia, it seems, that neither literary composition nor literary criticism really participates in the production of original knowledge. Thus, among American commentators, an Adam Gopnik can boldly lament, in an article defending the humanities no less, that “the study of English, to be sure, suffers from its own discontents: it isn’t a science, and so the “research” you do is, as my colleague Louis Menand has pointed out, archival futzing aside, not really research.”⁹⁷ And general interest justifications of the humanities and artistic creation often reiterate the very assumptions underpinning Biot’s notion of *bonnes lettres*. Artistic creation and humanities scholarship are valuable insofar as they reveal eternal moral verities or evoke ineffable sentiments, we often hear today from commentators writing in publications not so different from the *Nouveau Mercure*. “The humanities, after all, deal with elusive questions of aesthetics, existence and meaning,” we read, for instance, in a recent *New York Times* article on the digital humanities, “the words that bring tears or the melody that raises goose bumps.”⁹⁸

If Biot’s assumptions about what literature is mirror our own in many ways, his article may resonate today in yet another way. Though the physicist construes exact science and literary production as fundamentally incommensurable in their ends, they are not so different for him that literary production could not be assimilated to scientific means. In a similar way, present-day commentators have been arguing that humanities scholarship should be reformed by “scientific” standards, however different the objects treated by the humanities and the natural sciences may be. One recent contributor to the *New York Times* Op-Ed page goes so far as to ground a general theory of culture in quantification, in terms uncannily reminiscent of Biot’s propagation of “exact ideas.” The editorial argues that “the transformation of the humanities into science” requires quantification, not only because, we learn, “numbers are the signature of science,” but also because “they allow us to describe patterns and relationships with a precision that words do not.” “The quantification of the humanities is driven by an inexorable logic,” this particular piece pursues: “Digitization breeds numbers, and numbers demand statistics . . . The new breed of digital humanists is mining and visualizing data with the facility that bioinformaticians analyze genomes and cosmologists classify galaxies.” For this unreconstructed believer in scientific progress, biologists’ success in deriving “a theory of evolution whose major tenets are couched in math and generally agreed” offers a model for producing a “mathematical theory of culture,” and

⁹⁶ In its own way, Bourdieu’s view of literary creation highlights the kinds of knowledge that go into the construction of the work. See for example “Prologue. Flaubert analyste de Flaubert,” in *Les règles de l’art*. In Germany, the scholars Joseph Vogl and Michael Gamper have become associated with research on *das Wissen der Literatur*.

⁹⁷ Adam Gopnik, “Why Teach English?” *The New Yorker*, August 27, 2013, <http://www.newyorker.com/books/pageturner/why-teach-english>.

⁹⁸ Patricia Cohen, “Digital Keys for Unlocking the Humanities’ Riches,” *The New York Times*, November 16, 2010, <http://www.nytimes.com/2010/11/17/arts/17digital.html>.

from there, no less, in echo of Biot's totality, the "promise . . . that the Republic of Learning, so divided for so long, will become one."⁹⁹

This op-ed may be singular in developing an explicit ideology of scientific domination, but it attests to the broad plausibility of advocating varieties of such domination today, including those executed in subtler terms. General interest commentators on the humanities often presume the superior "scientificity" of data science, but they tend to do so less in the spirit of subordinating the humanities to an absolute epistemic principle than of drafting them into the temporality of technological innovation. Incontestably useful as data science and other modalities of technological innovation are in humanities research, the "innovation" in question tends to steamroll the dialectic of positions native to humanities disciplines. Such a development is evident in a recent *New York Times* Books section article on a Stanford Literary Lab project devoted to mapping of emotions in the literature of Victorian London. This new "data mining project," the article tells us, aims to match place names and affects in Dickens, Austen and seven hundred thirty-eight other nineteenth-century English-language authors. Though the project seems rather traditional in its exploration of an affective geography, its methodology, the article argues, packs a novel punch. The aggregation of data on novels is one way of exploring, the article continues, "the computer's nearly limitless possibilities for textual analysis, which will find," it is prophesied, "increasingly valuable future applications."

But if the project is imagined to be ingeniously "scientific," we might with James doubt in this case whether "the majestic name is absolutely at one with its own pretension."¹⁰⁰ The article terms the project an instance of "computational criticism," but the status of "criticism" is ambiguous here, the value of computation still more so. For if criticism has been merged with philosophical critique in recent decades, the project severs this alliance absolutely; and here as elsewhere, the value of the computations undertaken depends entirely on the value of the data computed. Rather than relying on a given literary scholar's argument about how affect and place interrelate in a given set of texts, in a given period, the project called for a crowd of readers to code their own impressions of which affects corresponded to which places. "The crowdsourcing for the project," we learn in the article's final paragraph, "— the anonymous workers who categorized the literary references — was performed by Amazon Mechanical Turk, an online labor force." It may be no great critical insight to point out that Amazon's contemporary workers are likely not equipped to evaluate the affective responses of nineteenth-century reading publics, though the suspicion may be worth voicing all the same. Perhaps even more important, though, is the way the consultation of these workers transforms the meaning of academic labor. "A marketplace for work that requires human intelligence," as Amazon describes it, Mechanical Turk replaces thinking with HIT-ting, or the completion of Human Intelligence Tasks. An eighteenth-century hoax, the Turk was an automaton that could apparently play chess, a machine simulating human intelligence (a real human chess-master hid inside the machine.) Perversely, Amazon's version of the Mechanical Turk reverses this illusion, providing human intelligence that can

⁹⁹ Armand Marie Leroi, "One Republic of Learning: Digitizing the Humanities," *The New York Times*, February 13, 2015, <http://www.nytimes.com/2015/02/14/opinion/digitizing-the-humanities.html>

¹⁰⁰ "Émile Zola," *Literary Criticism: European Writers and the Prefaces*, 891.

mimic automated data production. While the original Mechanical Turk played to the acclaim of heads of state, moreover, Amazon's anonymous workers enjoy no recognition and, more importantly, no benefits.¹⁰¹ Collecting rewards for discrete data tasks, they are exposed to the vagaries of the sharing economy.

The scientificity of the project is problematic not only insofar as it entails the application of data science to literary studies but also insofar as data science itself can lay claim to the majestic name. Standing at the intersection of technology, mathematical sciences and finance, it is a consummately hybrid field, emblematic in this respect of the processes of heteronomization that have marked the sciences more broadly over the last thirty or forty years. Undermining the autonomy that has characterized the sciences in modernity, these processes of heteronomization are intimately bound up in the properly epistemic changes that Daston and Galison see at work in the sciences today, including a turn away from the traditional mode of representation toward an entirely different mode of “doing” science. In the sciences today, Daston and Galison suggest, representation and action often go hand in hand. They point out that in recent nanotechnology ventures “the aim [has not been] simply to get the images right but also to manipulate the images as one aspect of producing new kinds of atom-sized devices.”¹⁰² This emphasis on manipulation over mimesis characterizes the engineering-oriented sciences of the current period. “By the early twenty-first century,” they continue, “nanomanipulation, suspended between science and engineering, sidestepped the long-standing struggle between representing and intervening. Atomic physicists, surface chemists, and cellular biologists began making common cause with electrical engineers.”¹⁰³ This disciplinary hybridization was not a spontaneous effect of the development of the scientific principles of these fields, but was rather formally coordinated with industry in many instances, as Daston and Galison show. “Universities were obliging,” they write of efforts to reform science programs in light of industry goals, to loosen intellectual property rules and to develop coalitions with industry: “scientists were now more keen to join industrial and academic laboratories and to create interdisciplinary graduate and postdoctoral positions.”¹⁰⁴ If Daston and Galison sense opportunity as well constraint in the new dispensation, it is no less the case that pure science comes to look like an artifact of high modernity in their account, increasingly obsolete. Though standards of quantification continue to underpin arguments about the superiority of the sciences, the physics of Biot and others—the science which raised the prestige of quantification per se to an unprecedented pitch while initiating the autonomization of science—is now dominated by industry. Though the prestige of quantification remains, scientific autonomy has increasingly faded away.

Objectivity is the modern scientific ideal par excellence, the scientific ideal that most closely corresponds to the sciences in the heyday of their autonomy, yet for Daston and Galison it is ultimately just one scientific ideal among many, a conception that emerged with the institu-

¹⁰¹ <https://www.mturk.com/mturk/help?helpPage=overview>.

¹⁰² *Objectivity*, 382.

¹⁰³ *Ibid.*, 393.

¹⁰⁴ *Ibid.*, 395.

tionalization of “pure” science and is presently ceding to ideals whose orientation is less purely epistemic and more forwardly aesthetic or commercial. (What Daston and Galison call the increasingly “self-conscious aestheticization of scientific depictions” in recent decades intersects, for instance, with the demands of publicity in the production of new technologies).¹⁰⁵ For Bourdieu, in contrast, objectivity remains the absolute goal of a self-reflexive science, the point of view from which all points of view may in principle be glimpsed. It comes as no surprise, therefore, that Bourdieu's later work on the sciences should condemn historical processes which Daston and Galison document in more neutral terms. As the re-insertion of self-interest in scientific endeavor, the heteronomization of the sciences stands for him for the destruction of the conditions in which objectivity can emerge. The achievement of a degree of scientific autonomy occurs in step with the discovery of “*la nécessité spécifique de chaque champ*,” and this sort of discovery occupies a crucial place in Bourdieu’s philosophy of history.¹⁰⁶ “*Les champs scientifiques*,” he writes, “*ces microcosmes qui, sous un certain rapport, sont des mondes sociaux comme les autres, avec des concentrations de pouvoir et de capital, des monopoles, des rapports de force, des intérêts égoïstes, des conflits, etc., sont aussi, sous un autre rapport, des univers d'exception, un peu miraculeux, où la nécessité de la raison se trouve instituée à des degrés divers dans la réalité des structures et des dispositions.*”¹⁰⁷ Only with the discovery of the rule of the field does “reason” begin to emerge. Neither “*tombée du ciel*,” nor “*réductible à l'histoire*,” reason for Bourdieu is nonetheless the product of the history of autonomizing fields.¹⁰⁸ As such, the heteronomization of scientific fields can not but stall or reverse the progress of reason. With abundant cause, Bourdieu cautions that “*il est à craindre que la logique de la concurrence qui, comme on a pu le voir, en d'autres temps, dans le domaine de la physique, peut porter les chercheurs les plus purs à oublier les usages économiques, politiques ou sociaux qui peuvent être faits des produits de leurs travaux, ne se combine et se conjugue avec la soumission plus ou moins contrainte ou empressée aux intérêts des entreprises pour faire dériver peu à peu des pans entiers de la recherche dans le sens de l'hétéronomie.*”¹⁰⁹

Whatever the consequences of this “drift” may be, it does not take a sociologist or a philosopher on the order of Bourdieu to see it occurring. As I wrote this dissertation, I had as much opportunity to witness it as another. Living in San Francisco, indeed, the opportunities were ample. My writing was sometimes interrupted by the spectacle of motorcades sweeping world leaders past my window from Nob Hill toward the headquarters of Twitter—the President once or twice, the Prime Ministers of Japan and of Italy, and the President of France following suit. If like Hegel glimpsing Napoleon, I could not help but feel that I was watching history pass by, though not on horseback, then at least in tinted van, the symbolic recognition afforded tech

¹⁰⁵ Ibid., 403

¹⁰⁶ *Méditations pascaliennes*, 138.

¹⁰⁷ Ibid., 131.

¹⁰⁸ Ibid., 130.

¹⁰⁹ *Science de la science et réflexivité*, 7.

firms like Twitter by these leaders is producing an entirely different effect on cultural production than that performed by Napoleon himself. For if as we shall see in the coming chapters, the Emperor eagerly advanced the autonomy of the sciences during his reign, it must be said that in my experience, at least, his modern day counterparts did not visit the same regular fanfare on the departments and laboratories of the University whose seal marks this work, sites where disinterested science is still in some cases produced. Pure scientists of the sort produced by the sciences in modernity risk being marginalized, Bourdieu insists, “*au moins dans certains domaines, du fait de l’insuffisance des soutiens publics, et malgré la reconnaissance interne dont ils font l’objet, au profit de vastes équipes quasi-industrielles, travaillant à satisfaire des demandes subordonnées aux impératifs du profit.*”¹¹⁰ And if the empire claimed for data science over humanities scholarship is all the more puzzling for being devoid of explicit profit motives, its source in the same drift toward heteronomization is no less apparent. Though we might hesitate to affirm, with Bourdieu, the coincidence of autonomization and the progress of reason, we may nevertheless wish to correct the effects of heteronomization when they prove manifestly unreasonable.

¹¹⁰ Ibid., 6.

CHAPTER ONE

Bernardin de Saint-Pierre and the Virtues of *Admiration*: Sentiment, Spectacle and the “Science to Come” in the *Études de la nature* (1784)

“Le cri de l’admiration est: “Ah! mon Dieu.”¹¹¹
--Bernardin de Saint-Pierre

I. Bernardin de Saint-Pierre, Natural Philosopher

Subscribers to the 1806 edition of Jacques-Henri Bernardin de Saint-Pierre’s *Paul et Virginie* might have been pleased at how much bang they had gotten for their buck. For the re-publication of his most famous work, Bernardin de Saint Pierre (1737-1814) had not only commissioned sumptuous engravings based on original work by Girodet, Gérard, Prudhon and other celebrated painters, he had also taken it upon himself to compose a “Préambule” nearly as long as the novel itself. Substantial as it might have been, however, this “Préambule” may well have been felt to clash with the sweet, sentimental tale of two children growing up in a South Seas wonderland. Mixing reproofs of Bernardin’s own subscribers with complaints about the betrayals of book agents and engravers, tirades against unreliable patrons, and recriminations over the author’s personal bankruptcy, the text goes on to elaborate a theory of tides and of the shape of the Earth, as well as to mount polemics against the official sciences of the day and the journalists who defended them. Launching on a flight through deep time as enchanting as his financial gripes were embarrassing, Bernardin endeavors to show that the ocean’s waters have modeled the Earth’s shape, in the process displaying his expertise as a former naval engineer, corroborating the Flood story, and even refuting Newtonian mechanics. Amid the welter of financial and scientific speculations we encounter in the text, this anti-Newtonian theme forms what is perhaps Bernardin’s most pressing motive. The thirteen-page endnote which concludes the “Préambule” pays homage to those who reject Newtonian physics:

Heureux ceux qui, forts de leur conscience première, ne cherchent l’auteur de la nature que dans la nature même, avec les simples organes qu’elle leur a donnés! Ils n’étudient point en tremblant les destinées du genre humain (1),¹¹² dans une polyglotte. Ils ne cherchent point, à la faveur d’un télescope, à travers le Serpent, le Cancer, et les autres monstres de cieus, le retour assuré d’une comète, pour confirmer une théorie du hasard. Les objets de la nature les plus communs sont pour eux les plus dignes d’admiration et de reconnaissance. Dès l’aurore, ils voient le soleil repousser vers l’orient le voile sombre de la nuit, et ranimer de ses rayons une terre couverte de

¹¹¹ *Études de la nature* (Saint-Etienne: Publications de l’Université de Saint-Étienne, 2007), 461.

¹¹² This note to the annotation reads: “Newton lui-même.”

*végétaux et d'êtres sensibles; à midi, l'astre qui fait tout voir disparoît enseveli dans une splendeur éblouissante; mais vers le soir, déployant à l'occident le voile de sa lumière, il découvre sur l'horizon qu'il abandonne des cieux tout étincelants de constellations. Qu'admireront-ils de plus? sera-ce la lunette astronomique, qui pour en nombrer les étoiles, s'allonge en vain toutes les nuits dans les airs, depuis des siècles; ou les yeux que leur donna la nature, pour en embrasser le spectacle infini, dans un instant?*¹¹³

This chapter arises out of the desire to know just why a writer like Bernardin de Saint-Pierre would attack Newton's authority, and with what hopes of success. The question is all the more compelling in view of how widespread anti-Newtonian sentiment had become in the era of *Paul et Virginie*: authors as dignified as Goethe and as disreputable as Marat, by way of Chateaubriand, Louis-Sébastien Mercier, Rétif de la Bretonne and many others, all launched virulent campaigns against Newton, Newtonians, mathematicians, and astronomers in general during the last decades of the eighteenth century. What pressures were driving these figures to denigrate Newton, and what exactly were they suggesting should take the place of the physics he had inspired? I suggested in this dissertation's Introduction that Chateaubriand's lamentations over the eclipse of what he calls "*l'évidence morale*" epitomize these figures' positions: "*Les sciences exactes,*" Chateaubriand writes in the *Génie du christianisme* (1803), "*nous ont accoutumés à dédaigner l'évidence morale, si féconde en belles sensations, et qui est faite pour déterminer les opinions et les actions de notre vie.*"¹¹⁴ In spite of the very different character of the evidence contemplated by the anti-Newtonians, on the one hand, and the mathematical physicists on the other--the sentiments aroused by a beautiful sunset, for example, versus the composition of the atmosphere--Nature, it seemed to Chateaubriand, Bernardin and the others, was not big enough to accommodate both points of view. (And as we shall discover in Chapter Two, this impulse toward a monopoly on the study of Nature also characterizes, from a different standpoint, the Newtonian mathematical physicists in Paris.) Chateaubriand's conflation of the knowledge of Nature, the "*belles sensations*" that arise from studying it, and the determination of "*les opinions et les actions de notre vie*" forges a three-dimensional mode of cultural production that is equal parts epistemic, aesthetic and ethical.

This valorization of the moral evidence disrupts the link between natural science and rationality forged in the modern era. While in modern science's parlance sentiment clouds "objectivity," Chateaubriand, and Bernardin along with him, I would claim, imagines a kind of science in which sentiment and knowledge-making are fused. The explicitly virtuous character of these sentiments links them, moreover, to an ethical program for right action and right feeling. This exaltation of sentiment stands in direct contrast to what Lorraine Daston and Peter Galison have depicted as modern science's history of suppressing it. Eliciting modern science's latent ethical dimension, Daston and Galison develop the notion of an "epistemic virtue," an ideal that governs the kind of knowledge a given group seeks to maximize in the study of Nature while also prescribing the kinds of self-work that make that knowledge possible. In contrast to moral virtues, they write, "epistemic virtues are preached and practiced in order to know the world, not the

¹¹³ Ibid., xcii.

¹¹⁴ *Génie du christianisme, ou Beautés de la Religion Chrétienne*, vol. 3 (Paris: Migneret, 1803), 47.

self.”¹¹⁵ Focusing on the way a succession of epistemic virtues has molded the representation of knowledge about Nature since the eighteenth century, Daston and Galison show that the corpuses of images and verbal descriptions they call “atlases” coordinate scientific communities around shared ideas about what it is desirable to know and what kind of person is fit to produce such knowledge. Objectivity becomes just one historically circumscribed ideal in this succession, requiring the sacrifice of some modes of knowing favored before its rise in the nineteenth century and conflicting, they argue, with present-day techno-scientific goals.

As Daston and Galison’s examination of these atlases makes clear, epistemic virtues shape not only the knowledge that is sought about a given scientific object but also the aesthetic choices that are made in the representation of knowledge, an area of contingency which is similarly suppressed, they claim, in the discourse of modern science. The ideals governing the work of an engraver for one of Buffon’s *Histoires naturelles*, for example, differ from those determining how photographs of bacteria or planets would be made in the nineteenth century, or again how quantities of data would be charted in the twentieth. In each of these cases, the images that result depend as much on the choices made by the men and women creating them as they do on the technologies in use or the objects being represented. Given that a definitive or comprehensive view of any object is unimaginable, these choices are inevitably made in light of the kinds of knowledge historical protagonists are most compelled to produce about a given object. Though such choices may not always be guided by what seems most “beautiful” about the object in question, choices about how to represent scientific objects are nevertheless made with considerations of size, shape, color and position in mind. For this reason, it seems justified to speak of an aesthetic dimension in scientific representation, even of the activity of what we might call “aesthetic virtues” in echo of Daston and Galison’s signature notion. While the positive sciences have traditionally downplayed or concealed the pertinence of aesthetic and moral considerations in the work they do, the anti-Newtonians, like Daston and Galison, insist on these elements’ mutual inextricability. Indeed, at the very moment when positive science took shape in France and throughout Europe, the sentimental science of Chateaubriand, Bernardin de Saint-Pierre and others was combatting it on the grounds that epistemic, aesthetic and moral considerations are inevitably entangled. Though the anti-Newtonians may often seem rhapsodic, they are certainly right that modern science, no less than their own sentimental brand, emerges from the interplay of all three dimensions.

If the epistemic virtue of nineteenth-century science is “objectivity,” according to Daston and Galison, what might we call the epistemic virtue of anti-Newtonian science? In naming this virtue “admiration,” I wish to call attention to the way Chateaubriand, Bernardin and others consistently use this very term to accentuate the reciprocity of aesthetic pleasure, moral edification and natural philosophy. For these writers, truth, beauty and goodness name three aspects of a same ideal. Ethical virtues are developed through the knowledge of Nature and the contemplation of beautiful things; the knowledge of Nature ceaselessly reveals the providential beauty and the moral goodness inherent in it; and the pleasure of contemplating beautiful things in turn exposes the providential commensurability between self and world, while inspiring virtuous sentiment in the observer. The experience of admiring Nature, that is, induces its knowability, while

¹¹⁵ *Objectivity* (New York: Zone Books, 2007), 39.

simultaneously actualizing the ethical standpoint at which both appreciation and knowledge emerge. Far from interfering with the study of Nature, as their rivals believed, appreciating and revering it make the mode of knowing Nature they value possible.

Bernardin's anti-Newtonianism begins to take shape within this intellectual context, and indeed the "*Préambule*" to *Paul et Virginie* culminates in an exemplary call for the mode of knowing I am proposing we call "admiration." This paean incites us to admire the beauty and enormity of the universe through a rhetoric of "spectacle" that crystallizes the farthest reaches of space and the familiar plenitude of earthly living, the breaking of dawn and the setting of the sun, into a succession of brilliant tableaux. In perceiving these tableaux, the naked eye, according to the passage, seems preferable to the "*lunette astronomique*" because it is among the "*simples organes*" that Nature itself has given us for the purpose of perception. While our eyes alight on everything it is useful for us to know, "embracing the infinite spectacle, in an instant," the telescope scans points in barren space, disrupting the perception of natural wholes. What might be called the "synoptic" power of the spectacle of Nature coexists, moreover, with a hermeneutic rhetoric in which Nature is construed as a language available to a human observer in touch with his or her "*conscience première*."¹¹⁶ In so doing, the passage introduces a contrast between "the author of nature" and those degenerate "polyglots" identified with Newton himself. These polyglots deform the text of Nature by translating it into a second, sterile language associated with the mathematization of comets' revolutions and the laborious "numbering" of the stars. Yet even as the babble of the Newtonians interrupts our capacity to delight in the universe and to be grateful for it, it also, and perhaps most importantly, waylays our "search" for the author of Nature. In spite of its piety and its aestheticism--indeed because of them--the admiration of Nature is emphatically a means to *know*.

To those of us habituated to the autonomy of knowing, the explicit aesthetic and ethical dimensions of admiration may well compromise the virtue's epistemic value, even disqualify it as an authentic epistemic ideal. Yet Bernardin and many of his contemporaries sustained this virtue's superiority to the knowledge-making style of Newtonian physics and the institutionalized sciences in France in general, while attempting to demonstrate its utility in the study of a variety of natural objects. Their insistence on the epistemic value of wonder compels us to ask why, how and how long a preference for enchantment persisted in the scientific milieu of the Enlightenment, contrary to accounts which insist on its demise. The dates in the title of Lorraine Daston and Katharine Park's *Wonders and the Order of Nature, 1150-1750*, for instance, tell a characteristic story. Even as wonder, in its many guises, has been recognized as animating natural philosophy throughout the Early Modern period, we are usually told that its influence as a scientific affect had dimmed by the advent of the Enlightenment. In keeping with this historiography, Daston and Park affirm that "marvels persisted in eighteenth-century Europe, both as words and as things. Yet among intellectuals, among somber theologians as well as gadfly *philosophes*,

¹¹⁶ Though I do not develop the notion at length here, it seems clear that as what we might call a "synopticon" the spectacle invites comparison to the "panopticon" established by Foucault as a major mode of modern visibility. While the panopticon abets a technology of governing "in detail" by inculcating self-surveillance in its subjects, the spectacle acts powerfully to magnify the vision of the spectator, often sweeping phenomena from the ends of the earth into a single scene and advancing, as such, a kind of visual mercantilism. For the panopticon, see Michel Foucault, "*Le Panoptisme*" in *Surveiller et punir: naissance de la prison* (Gallimard: Paris, 1975).

the star of the marvelous had indeed waned, if not completely vanished.”¹¹⁷ As Mary Terrall and others have shown, however, marvels, including spectacles, continued to serve as objects of legitimate scientific inquiry well into the Enlightenment.¹¹⁸ The story of Bernardin de Saint-Pierre suggests just how energetic the discourse of marveling remained in what is sometimes called the Post-Enlightenment, animating the curious mix of rationality and spirituality that characterized the era succeeding the deaths of Voltaire, Diderot and d’Alembert. Much more than a dubious relic of pre-Enlightened times, wonder actively shaped both science and meta-scientific discourse through the early nineteenth century.¹¹⁹

The potency of admiration helps us see that Daston’s later work with Peter Galison tells part, but not all, of the story about how epistemic virtues translated Nature during the eighteenth century. Their examination of scientific “atlases” tends to close off inquiry into the epistemic ideals that ordered the wider world of eighteenth-century natural history. While the notion of the atlas makes visible the kinds of representations favored by a community of savants, neither the primacy of representation in eighteenth-century natural history nor the criteria for belonging to the community can be viewed as foregone conclusions. Indeed, the claim that scientific labor should result in representations was itself a tendentious position, presuming as it did a split between words (or images) and things that many eighteenth-century natural historians and readers of natural history were far from conceding. For specialists and non-specialists alike, the conviction that Nature itself was grammatical generated a basic commensurability between language and the world.

¹¹⁷“The Enlightenment and the Anti-Marvelous,” *Wonders and the Order of Nature, 1150-1750* (NY: Zone Books, 1998), 329.

¹¹⁸ In conversation with Daston and Park, Terrall writes, “Enlightened philosophy was supposed to be useful rather than pleasurable, and in order to be useful, nature had to be utterly predictable. But what happened when reputable observers reported something as unanticipated as regeneration or parthenogenesis? . . . Alongside the trend, chronicled by Daston and Park, to castigate the marvelous as vulgar amusement, new kinds of marvels emerged to fascinate genteel and philosophical audiences. These natural wonders were demonstrated to be regular, even predictable, and thus appropriate objects of enlightened attention.” Moreover, as we shall see in exploring the science of admiration, utility and delight themselves were not always at odds in Enlightenment-era natural history. *The Man who Flattened the Earth: Maupertuis and the Sciences in the Enlightenment* (Chicago: University of Chicago Press, 2002), 204-05. The persistent though ambiguous viability of spectacular displays has been examined with regard to electricity in works by Christian Licoppe and Giuliano Pancaldi. Licoppe shows that the methods and the results of the Abbé Nollet’s spectacular experiments on electricity were called into question by Benjamin Franklin and his Parisian acolytes during the 1760s and 70s, while Pancaldi shows that Volta’s quest for international legitimacy as a natural philosopher in the 1780s required him to distance himself from the spectacular display of his electrical machines. Here again, it is less the case that wonders, as expressed in spectacular displays, are delegitimized *per se*; rather the forms of scientifically viable wonders seem to change with time. Licoppe, “L’Efficacité persuasive du spectacle expérimental remise en question,” *La Formation de la pratique scientifique: le discours de l’expérience en France et en Angleterre (1630-1820)* (Paris: Éditions la Découverte, 1996), 161-194; Pancaldi, “Volta’s Science of Electricity: Conception, Laboratory Work, and Public Recognition,” *Volta: Science and Culture in the Age of Enlightenment* (Princeton: Princeton University Press, 2003), 121-125.

¹¹⁹The best translation of “wonder” in eighteenth century French is probably “*admiration*.” By the eighteenth century “*le merveilleux*” had come to be associated with the implausible fancies of 17th-century romances and with the aesthetic of French lyric drama through the reigns of Jean-Baptiste Lully and Jean-Philippe Rameau at the Opéra. “*L’admiration*” connotes the kind of appreciation or astonishment that natural philosophers most often cast themselves as experiencing in response to Nature’s effects. “*Étonnement*” conveys an extreme astonishment, perhaps devoid of pleasure; “*ravisement*” conveys the delight of witnessing natural spectacles.

Since *Lets mots et les choses*, the authority of Foucault has sufficed to collapse the variegated scene of eighteenth-century natural history into a single regime of “representation.”¹²⁰ By compelling us to protract the reign of wonder, however, the evidence of Bernardin and others likewise compels us to extend the historical scope of what Foucault calls the hermeneutics of “resemblances.”¹²¹ As the spectacle that concludes the “Préambule” to *Paul et Virginie* suggests, a hermeneutics of Nature persists during the eighteenth-century heyday of tabular natural history, underpinning the science of admiration as an alternative to the work of representation. The hermeneutics of Nature not only countered the mode of representation in natural history, but also objected to Newtonian physics on the basis that it constituted a kind of representation, as well. In the cosmic spectacle evoked in the “Préambule,” Bernardin casts us as a spectator seeking out the “author of nature” in the relationships the naked eye can see, of which “*le Serpent, le Cancer*” and the other constellations in the sky are self-consciously emblematic. The spectacle of Nature courts a hermeneutics capable of discerning why the objects in the spectacle cohere together rather than disperse, what hidden harmonies account for the constellations of stars or the patterns according to which the surface of the earth is “*couverte de végétaux et d’êtres sensibles.*” Indeed, in tracing the spatial distribution of plants and animals over the surface of the earth, the sympathies Bernardin distinguishes in spectacles like this one often emerge through the ancient figure of what Foucault calls *convenientia*, a trope in which resemblance is shaped by contiguity or proximity.¹²² Though Foucault’s account of natural history has no place for Bernardin and others like him, he elsewhere gives us tools to understand just what is going on in them.

Convenientia belong to a battery of archaic rhetorical figures through which, Foucault tells us, the “resemblances” inhering in Nature could be elicited. In Foucault’s account of the Early Modern science of resemblances, an order of symbols mediates between the scholar and the text of Nature, flagging the presence of sympathies to decipher in Nature, yet remaining functionally distinct from them. “*Il faut que les similitudes enfouies soient signalées à la surface des choses;*” writes Foucault, “*il est besoin d’une marque visible des analogies invisibles.*”¹²³ This play of visible marks and invisible resemblances carries on in the eighteenth century’s natural history of admiration, though the marks which bring to light the need for a hermeneutics of Nature have mutated in the meantime. For Bernardin, the natural grammar that governs the arrangement of animals, plants and terrain become visible through spectacle rather than through the hosts of “*blasons, caractères, chiffres*” hieroglyphs and enigmas that once populated the book of Nature. In this use of spectacle we can discern the grafting, as it were, of a classical aes-

¹²⁰ There, he writes, “*L’histoire naturelle a pour condition de possibilité l’appartenance commune des choses et du langage à la représentation; mais elle n’existe comme tâche que dans la mesure où choses et langage se trouvent séparés. Elle devra donc réduire cette distance pour amener le langage au plus près du regard et les choses regardées au plus près des mots. L’histoire naturelle, ce n’est rien d’autre que la nomination du visible.*” (Gallimard, Paris, France, 1966), 144

¹²¹ Ibid., “La prose du monde,” 32-40.

¹²² Ibid., 33.

¹²³ Ibid., 41. Foucault distinguishes between hermeneutics (the reading of Nature’s language) and semiology (the study of the signs which give away the presence of something to be deciphered). *Ibid.*, 48.

thetic of theatricality onto a much older natural historical problematic. With the advent of the spectacle, the book of Nature takes the stage. Where the silent tracery of a site's sympathies had once emerged through the play of symbols, it now emerges in the drama of an event.

In this spirit, Bernardin recalls the gorgeous lakescapes he had once witnessed near the Swiss town of Caux, where lakeside cliffs, mottled crustaceans and skeins of marine plants forming "groups" that no "painter," Bernardin marvels in the *Études de la nature*, could compose "*quand il les imaginerait à plaisir.*" "*Beaucoup de ces harmonies marines me sont échappées,*" he laments, "*car je les croyais alors des effets du hasard. Je les voyais, je les admirais, et je ne les observais pas: je soupçonnois cependant, dès ce temps-là, que le plaisir que leur ensemble me donnoit, tenoit à quelque loi qui m'étoit inconnue.*" The lakeside spectacle volunteers to disclose the order of Nature, Bernardin tell us, but he did not initially realize as much. In place of the old arcana, a modern landscape arouses the intuition that the scene is brimming with truth, framing the site according to a distinctly eighteenth-century visual sensibility confected from some blend of the dark materiality of Hubert Robert and the rococo extroversion of Boucher: "*On trouve au pied des rochers du pays de Caux,*" he writes, "*chargés de vignots noirs, des homards azurés, des crabes marbrés de rouge et de brun, et des légions de moules d'un bleu noir, avec des lépas d'un gris cendré. Tous ces coquillages vivants forment les harmonies les plus agréables, avec une multitude de plantes marines qui tapissent ces rochers blancs et noirs, par leurs couleurs pourprées, grises, couleur de rouille, brunes et vertes, et par la variété de leurs formes et de leurs agrégations en feuilles de chêne, en houppes découpées, en guirlandes, en festons, et en longs cordons que les flots agitent de toutes les manières.*"¹²⁴ Ruminating in the scene before Bernardin, flitting through these "*harmonies marines,*" the "*loi*" which governs the scene's organization lies waiting to be discovered. The task of bringing this law to light entails recognizing that the composition of the scene is not merely incidental, and that in order to understand how the scene coheres, witnessing it and even admiring it must give way to the more sustained and intensive task of "observing" it. If the theatricality of the spectacle alerts the witness to the presence of meaning, observing the elements of the spectacle--the disposition of parts, the relative values of color, texture, weight and pattern--sets the necessary groundwork for deciding what natural laws determine the composition. Observing elicits the sympathies which bind the scene's objects into an "ensemble."

Though the spectacle may embody all the aesthetic novelty of a Salon landscape, the sympathies in question are as ancient as Paracelsus. In resurrecting a science of sympathies, Bernardin is no mere nostalgic eccentric, however. Other anti-Newtonians similarly embrace the development of a science of sympathies, defending the viability of a hermeneutics of Nature against rival epistemic imperatives, including those of the exact sciences, as we shall see in Chapter Two. Their texts therefore differ in kind from those which Foucault sees as embracing hermeneutics in the spirit of a literary "counter-discourse." Romantic literature, Foucault observes, resurrects the archaic symbolic order as a protest against the divorce of language and Nature by then ordering every other domain of cultural production. This anomalous use of language comes to characterize literature in general, constituting the recurrence of language as a thing and not as a sign, "*le langage en son être.*" In the age of literature's "*autonomie,*" literary language is

¹²⁴ *Études de la nature*, 303.

doubly isolated: on the one hand, from the language of representation otherwise prevalent in modernity; on the other, from the natural objects whose exegesis it no longer has the authority to undertake. In the tradition I am excavating here, on the contrary, legitimate knowledge of Nature could still emerge through the agency of language as a thing that retained the roughness, the thickness, the weight of the Nature it interpreted, “*cet être brut*,” itself a thing of language. Not yet engaged in what Foucault calls the proliferation of language “*sans départ, sans terme et sans promesse*,” not yet lost in the “*espace vain et fondamental*” where this proliferation takes place (a space which Bourdieu would name the “field”), literature still clings in Bernardin to the ballast natural objects afforded.¹²⁵

Not all proponents of natural sympathies in Bernardin’s age claimed the same epistemic status for them. A comparison of Bernardin’s science of plants and his mentor Jean-Jacques Rousseau’s botanizing reveals how, with regard to the question of natural sympathies, one writer’s “literature” might be another’s *science*. In the “Septième promenade” of the *Rêveries du promeneur solitaire*, Rousseau sets the imperatives of the agreeable in opposition to those of the useful: *Ces idées médicales*,” he writes of those who botanize in search of herbal remedies, “*ne sont assurément guère propres à rendre agréable l’étude de la botanique; elles flétrissent l’émail des prés, l’éclat des fleurs, dessèchent la fraîcheur des bocages, rendent la verdure et les ombres insipides et dégoûtantes; toutes ces structures charmantes et gracieuses intéressent fort peu quiconque ne veut qu’épiler tout cela dans un mortier, et l’on n’ira pas chercher des guirlandes pour les bergères parmi les herbes pour les lavements.*”¹²⁶ The very attempt to put Nature to use destroys it for Rousseau. Yet where Jean-Jacques decries the vulgarity of those who botanize for medicinal reasons alone, Bernardin often remarks on the potential utility of the sympathies he has discovered among places, plants and animals. For Bernardin, the admiration of Nature discloses a knowledge with the potential for practical application, evoking the prospect, for example, of an enlightened management of land and living things. “*Il y a à la vérité des insectes nuisibles qui rongent nos fruits, nos grains, et même nos personnes;*” he remarks, “*mais si les chenilles, les hannetons et les sauterelles ravagent nos campagnes, c’est que nous détruisons les oiseaux de nos bocages qui les mangent, ou parce qu’en transportant des arbres des pays étrangers dans le nôtre, tels que les marronniers d’Inde, les ébéniers, etc. nous avons transporté avec eux les oeufs des insectes qu’ils nourrissent, sans apporter les oiseaux du même climat qui les mangent.*” Ignorant of the harmonies which govern a given site, humans cause imbalances in species populations, in Bernardin’s view. Yet Bernardin goes beyond proposing to restore the harmonies among plants, insects and locales to their primitive states, insisting instead that the play of natural harmonies is amenable to human improvement. He cites the insect-eating

¹²⁵ *Les mots et les choses*, 59. In Bernardin words are not heavy because they are themselves natural objects, in the sense Foucault conveys when he writes that, in the sixteenth century “*le langage n’est pas un système arbitraire; il est déposé dans le monde et il en fait partie à la fois parce que les choses elles-mêmes cachent et manifestent leur énigme comme un langage, et parce que les mots se proposent aux hommes comme des choses à déchiffrer* (49-50).” Rather, words in Bernardin are heavy because they claim to be able to produce knowledge about natural objects, through the mediation of the spectacle. One might say language is weighty in Bernardin because it is “*sans départ, sans terme et avec promesse*,” it continues, that is, to double the language of Nature (with a difference) as it had in the Renaissance, proliferating exegeses of Nature without conceivable end; but in contrast to literature in Foucault’s account, it does so with the promise of producing genuine knowledge about Nature.

¹²⁶ *Oeuvres complètes*, vol. 1 (Paris: Gallimard, 1959), 1064.

birds he himself has observed at the Cape of Good Hope and in the “Indies” as possible reinforcements for their scarce French counterparts. “*Si on naturalisait ces oiseaux en Europe,*” he exuberantly concludes, “*il n’y a point de découverte dans les sciences qui fût aussi utile aux hommes.*”¹²⁷

This chapter examines, then, not the familiar case of Rousseau but the stranger one of Bernardin de Saint-Pierre precisely because, caught between the eighteenth century and the nineteenth, between Enlightenment and Romanticism, between delight and utility, between the *sacre*¹²⁸ of literature and its *savoirs*, Bernardin offers us texts which, on close examination, expose the tensions that gripped the domain of letters at the inception of modernity in France. In the *Études de la nature*, Bernardin intersperses the acres of descriptive prose which arise from the potentially inexhaustible task of deciphering Nature with proposals for agricultural improvements, rails against the mathematicians of his age while spitting out calculations of his own, and pleads the case of the best of all possible worlds while helping to voice the melancholy new aesthetic of ruins. This chapter parses the work’s discursive heterogeneity by developing a genealogy of the spectacle in eighteenth-century natural history, through which we will subsequently be able to discern the specificity of Bernardin’s own science of admiration; by describing how the virtue of admiration informs a science of sympathies which links plants, animals and places in an incipient discourse of “milieu;” and finally, by showing how this premise gives rise to a science of the earth and a theory of the tides. In these various domains of “*la science à venir,*”¹²⁹ as Bernardin called it, literary language seized hold of as many natural objects as possible, from the tiniest lichen to the globe itself. In the “Préambule” to *Paul et Virginie* (1806), Bernardin, already an old man, could write with satisfaction that even his critics acknowledged him as “*un des plus grands écrivains du siècle;*” but while flaunting this epithet, he accuses those who praise him as a “writer”--and only a writer--of imagining that in literature “*la forme est tout*” while “*le fond est peu de choses.*”¹³⁰ For Bernardin, *Paul et Virginie* belonged in that “*espace vain et fondamental*”¹³¹ where the play of literary form perpetuated itself without responsibility to natural objects. However perfect the “form,” it was the scientific “content” of language that counted most for him.

¹²⁷ *Études de la nature*, 189.

¹²⁸ In *Le sacre de l'écrivain: 1750-1830*, Paul Bénichou famously argues that in an increasingly secular age literature assumed the moral authority thereto enjoyed solely by religion. As Bénichou’s other studies of post-Enlightenment literature show, this intensification of literature’s ethical vocation often goes hand in hand with the assertion of philosophic or scientific authority. In *Les Mages romantiques* for example, he writes, “*Ni le français ni aucune langue que je sache n’ont de mot pour désigner de façon distinctive le type de pensée qui fait l’objet de ce livre. On est conduit, dans un travail comme celui-ci, à employer tour à tour, selon la circonstance, lest mots ou expressions “pensée”, “philosophie”, “religion”, “credo”, “profession de foi”, “vue des choses”, “distribution des valeurs”, “figuration”, “idéologie” même, ou tout autre terme qui convienne à l’occasion, et à tenir pour sous-entendu que le poète, quoi qu’il pense, le pense en poète.*” The meaning of Bénichou’s notion of “thinking like a poet” cuts two ways, however, calling attention to what literature “knows” while tending to confine this knowledge within the domain of literature as a form of autonomous cultural production. *Les Mages romantiques* (Paris: Gallimard, 1988), 14.

¹²⁹ *Études de la nature*, 382.

¹³⁰ *Paul et Virginie*, xix.

¹³¹ *Les mots et les choses*, 59.

Bernardin's resistance to the popularity of *Paul et Virginie* indicates just how stubborn literature's grip on natural objects could be. While *Paul et Virginie* had first been published as part of the second edition of the *Études de la nature* (1788), by the 1806 edition, it was the natural philosophy of the *Études* that was riding the coattails of the novel. The "Préambule" to this edition, we have seen, exploits the popularity of the novel to reaffirm the *Études*' anti-Newtonian cosmography, excoriating the journalists who had denigrated the *Études*' theories of the tides and of the shape of the Earth while dismissing the European-wide bestseller *Paul et Virginie* as nothing more than "*ce petit ouvrage*," the "*délassement de mes études de la nature*."¹³² Never yielding to the success of his novel, Bernardin persisted in staking his reputation as an author on his natural philosophy. His last work, the *Harmonies de la nature* (1815), a follow-up to the *Études*, appeared the year after his death, a cry of admiration uttered from beyond the tomb.

II. The Rhetoric of Spectacle

The "spectacle" is probably the eighteenth century's most powerful technology for inspiring admiration. The visualization of a scene as a spectacle almost inevitably compelled admiration, even as admiration usually presented itself, in turn, as the most suitable or even as the only possible reaction to spectacle. The spectacle therefore becomes one of the essential material and discursive apparatuses of admiration as an epistemic virtue. As a material technology, spectacle shaped the distribution of the physical components of experiments or demonstrations; as a social technology, it shaped the strategies experimenters relied on to produce credible witnesses; and as a literary technology it shaped their discursive strategies for recounting the events of an experiment or advancing an interpretation of Nature.¹³³ The spectacle adapts itself, moreover, to an enormous range of uses in natural philosophy, conditioning the basic possibility of visualizing ensembles as big as sky-scapes and as small as microscope-scapes, and of studying problems as diverse as the nature of electricity and the mechanics of generation. Though often coordinated with the language of "representation," in the expansive sense Foucault lends this term, spectacle was frequently coordinated with hermeneutic responses to Nature as well.

In the genealogy of admiration developed here, I focus on the way the discourse of spectacle envisions natural wholes that solicit admiration while manifesting the book of Nature. The hermeneutics which the book of Nature invites here proceeds, moreover, along the lines of what we might liken to a discourse of "milieu." In this discourse, knowing Nature becomes a question of understanding the place-specific relationships that inhere among the things of the globe. In the strongest form of this hermeneutics of place, the task of deciphering the relationships among proximate living things, as well as among living things and their material environments, becomes tantamount to deciphering the book of Nature.

¹³² Ibid., i-ii.

¹³³ In Steven Shapin and Simon Shaffer's sociology of experiment, what they call material, social and literary technologies are crucial to the production of "fact" from experiment. Spectacle functions as one of the primary tools of each of these technologies, I am arguing, but its utility exceeds the domain of experimentation; in addition to experiment, spectacle also shapes the practices of natural philosophical speculation and the hermeneutics of Nature. *Leviathan and the Air-pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ: PUP, 1989), 25-6.

The paean that concludes Bernardin's "Préambule" to *Paul et Virginie* epitomizes, we have seen, the co-articulation of spectacle and hermeneutics as an epistemic ideal. The knowledge this ideal maximizes bears on the secret sympathies which determine the limits and internal organization of natural wholes. At the same time, this ideal minimizes certain kinds of knowledge, in particular those which subordinate, in its view, the relationships among natural objects to a "theory of chance." The question of what admiration maximizes and what it minimizes--and how--is even more explicitly conveyed in a passage from Rousseau's *La Nouvelle Héloïse* (1761). In a letter to his friend, Saint-Preux, the erstwhile lover of the novel's heroine, Julie, laments the atheism of Julie's husband, Wolmar:

*Imaginez Julie à la promenade avec son mari; l'une admirant dans la riche et brillante parure que la terre étale l'ouvrage et les dons de l'Auteur de l'univers; l'autre ne voyant en tout cela qu'une combinaison fortuite où rien n'est lié que par une force aveugle: Imaginez deux époux sincèrement unis, n'osant de peur de s'importuner mutuellement se livrer, l'un aux réflexions l'autre aux sentiments que leur inspirent les objets qui les entourent, et tirer de leur attachement même le devoir de se contraindre incessamment. Nous ne nous promenons presque jamais Julie et moi, que quelque vue frappante et pittoresque ne lui rappelle ces idées douloureuses. Hélas! dit-elle avec attendrissement; le spectacle de la nature, si vivant si animé pour nous, est mort aux yeux de l'infortuné Wolmar; et dans cette grande harmonie des êtres, où tout parle de Dieu d'une voix si douce, il n'aperçoit qu'un silence éternel."*¹³⁴

Saint-Preux's and Julie's sensitivity to the "spectacle de la nature" alerts them to the gifts fanned out before them by "l'Auteur de l'univers." By the same token, their devotion to the author of the universe is what enables them to perceive these gifts in the first place. In this reciprocity, the spectacle of Nature evokes the possibility of undertaking a hermeneutics of Nature, even as acknowledging the providential character of the text in question preconditions the "striking and picturesque views" which constitute the spectacle. The ethical imperative to recognize Providence shapes Julie's and Saint-Preux's manner of perceiving nature, its role in shaping perception or even making it possible thus endowing it with an aesthetic dimension. In Saint-Preux's formulation, the spectacle brings the world to light, rather than merely shedding light on the world. Given, moreover, this capacity to manifest the world, and to manifest it as "text," the spectacle also comports an epistemological dimension, producing a natural language for a hermeneutics to decipher. In Saint-Preux's natural theology, the interplay of ethical, aesthetic and epistemological elements forms a closed loop in which Nature's magnificence confirms the existence of Providence.

In contrast, the atheist Wolmar's belief in a universe of pure chance not only deprives him of the ability to marvel at Nature but also to see or hear Nature at all. The kind of knowledge that

¹³⁴ *Oeuvres complètes*, vol. 2 (Paris: Editions Gallimard, 1993), 220. This equation of sensation with spectacle is also illustrated quite vividly in Bernardin de Saint-Pierre's "Avant-propos" to the 1789 edition of *Paul et Virginie*. There, he writes, "Heureux par les spéculations ravissantes de la nature, c'est à elle seule que ma plume doit les foibles images qui l'ont rendue recommandable. Hors d'elle, je ne sens rien et je ne vois rien." (Paris: De l'Imprimerie de Monsieur, 1789), xix.

admiration not only minimizes but also quite vociferously combats bears on the mechanisms by which “*une force aveugle*” might be shown to link the elements of Nature. Wolmar’s deep-seated insensibility to the objects around him lends itself to the senseless materialism he espouses, even as this materialism reinforces his insensibility to the marvels of Nature. His lack of sensibility is such a fundamental aspect of his character, he laments, that he would gladly absolve himself of the obligation to feel altogether. “*Si je pouvois changer la nature de mon être et devenir un oeil vivant,*” he confesses to Julie and Saint-Preux, “*je ferois volontiers cet échange.*”¹³⁵ In this strange formulation, Wolmar fantasizes about becoming a mere principle of vision with no corresponding capacity to be affected by what he sees. The fantasm of the “living eye” becomes a figure for the autonomy of knowledge, a kind of knowing associated here with the “*force aveugle*” underlying a rational-mechanical mode of understanding the universe. In its extraction from the network of relationships in which vision usually takes shape, Wolmar’s living eye might be said to incarnate the fantasy of panoptic vision, a fantasy of total surveillance undertaken from nowhere in particular. In its universal scope and its absence of a particular standpoint, Wolmar’s panoptic vision differs starkly from what I earlier called the *synoptic* vision espoused by Julie and Saint-Preux. As the tableaux of the seasons and the constellations of Bernardin’s “Préambule” hinted, this synoptic vision also attains to a kind of universality. But the universality in question arises from the situatedness of the spectator in place and time, his or her attainment of a point from which it is possible to witness the vastness of earth and sky, along with the passage of time. The “*grande harmonie des êtres*” Julie and Saint-Preux witness similarly arises from their situation in a particular place and time, their walks in the countryside around Julie’s estate. The harmony they experience on their walks cannot be perceived by vision alone, but also requires a capacity to be affected corporeally by things in one’s proximity.

Country walks, in fact, turn out to be a major material-social technology of the sciences of admiration. The walk discloses spectacles which inspire admiration, while also spatializing the discovery of relationships among natural objects. In this way, it links what Foucault called the semiological and hermeneutic layers of the sciences of admiration, occasioning the spectacle that alerts us to the presence of natural sympathies as well as tracing out the experience of deciphering them. The Abbé Pluche’s 1732 *Spectacle de la nature* used the narrative frame of the country walk to expose the natural marvels evident in everyday life. Enormously popular in its time, Pluche’s narrative of the strolls and hunting and fishing parties undertaken by the fictional Comte de Jonval and his young charge, the Chevalier du Breuil, had run through seventeen editions by 1771.¹³⁶ Subtitled *Entretiens sur les particularités de l’histoire naturelle qui ont paru les plus propres à rendre les Jeunes-Gens curieux, & à leur former l’esprit*, Pluche’s *Spectacle* recasts a pre-existing natural theological tradition as a pedagogical program for young minds. A providential commensurability between the order of Nature and the order of the mind, Pluche claims, makes natural history a fitting basis for the development of children’s mental faculties. Rather than passing methodically from “*des connoissances générales & des idées universelles aux particulières,*” as he puts it, Pluche unfolds his presentation of Nature in imitation of what he calls “the order of Nature itself,” by beginning with “*les premiers objets qui se trouvent autour de*

¹³⁵ Part IV, Letter XII (Paris: Gallimard, 1961), 491.

¹³⁶ De Baere, Benoît. *Trois Introductions à l’Abbé Pluche: sa vie, son monde, ses livres* (Geneva: Droz, 2001), 108.

nous, & qui sont à tout moment sous notre main: je veux dire les animaux & les plantes."¹³⁷ By the "order of Nature" Pluche means at once the relationships inhering among natural objects in the countryside, and the sequence in which an observer would be likely to encounter them there. In these jaunts through the estate of his aristocrats, Pluche stresses the value of practical, inductive means for piquing children's "curiosity." But this schema is more than a concession to pedagogy: the embodied relationships which these walks, like those of Julie and Saint-Preux, develop, enable us to delight in Nature, to read truth in it and to harvest practical knowledge. Given this crucial element of proximity, the country walk models the decipherment of Nature as the incorporation of bodily *hexeis*. "*Tous les corps qui nous environnent,*" affirms Pluche, "*les plus petits comme les plus grands, nous apprennent quelques vérités: ils ont tous un langage qui s'adresse à nous, & même qui ne s'adresse qu'à nous.*"¹³⁸ The proximity of these natural objects is what enables them to affect us, and the pedagogy of Nature is one which teaches us to heed the "voices" in Nature in their anthropocentric eagerness to fill "*notre vie de commodités, notre esprit de vérités, notre coeur de reconnaissance.*"¹³⁹ The hermeneutics of Nature fills us with enjoyment and yields practical, natural historical and spiritual varieties of knowledge, only on condition that we are able to enter into contact with natural objects, for their "*rappports entre eux*" only emerge for us in tandem with their rapports "*avec nous.*"

Is the alignment of the spectacle of Nature and a hermeneutics of Nature the exclusive province of "popularizing" literature like that of the Abbé Pluche, of fictions, like Rousseau's *Julie*, or of ambiguous efforts like Bernardin's *Études*? The work of Pluche's contemporary René Antoine Ferchault de Réaumur (1683-1757) offers some insight into the correspondence between the discursive characteristics of natural history texts in this period and the audiences to whom they were addressed. In Réaumur and other celebrated eighteenth-century natural historians, we witness the interleaving of a science of hermeneutics and a science of classification, a state of discursive heterogeneity that remains unresolved in their work. In the first volume of the *Mémoires pour servir à l'histoire des insectes* (1734), the famous naturalist extols the spectacular character of these tiny creatures:

*La prodigieuse variété des formes des insectes de différentes classes & de différents genres, offre un grand spectacle à qui sçait le considérer: quelle variété dans la figure de leurs corps, dans le nombre des jambes, dans leur arrangement, dans la figure & la structure des ailes, dont les unes sont des especes de gazes, & dont les autres sont couvertes de poussiere de figures régulières, & arrangées comme des tuiles; d'autres ailes ont des étuis, dans lesquels elles se tiennent le plus souvent pliées avec art!*¹⁴⁰

The spectacle of insect bodies is visible, Réaumur writes, "for those who know how to discern it." But who exactly are these discerning persons? Elsewhere in the first *Mémoire*, Réaumur

¹³⁷ *Spectacle de la nature*, vol. 1 (Paris: chez la Veuve Estienne, 1732), vi.

¹³⁸ *Ibid.*, iv

¹³⁹ *Ibid.*, v

¹⁴⁰ *Mémoires pour servir à l'histoire des insectes*, vol. 1 (Paris: Imprimerie royale, 1734), 14-15.

draws a stark line between “*ceux qui veulent sçavoir à fond l’histoire naturelle*” and “*ceux qui ne sont touchés que de ce que cette science offre d’agreable*.” To these latter, he offers his apologies for the places in his work where the spectacular qualities of insects cede to the more technical demands of classing and describing. “*J’ai a leur demander grace*,” he confesses, “*pour tous les endroits où il s’agira de ces distributions de classes & de genres, ou pour le mieux encore je leur conseille de ne les point lire. Les sciences dont les dehors sont les plus riants, ont du sec & de l’aride, lorsqu’on les approfondit; qui n’y veut trouver que de l’agreable, doit se borner à les effleurer.*”¹⁴¹ In addressing itself to two audiences, the text seems to live two lives, splitting along the fault of the agreeable versus the arid, the spectacular versus the taxonomic. Given that not everyone may initially know how to distinguish insects’ admirable qualities, even the agreeable elements of the science require some instruction, Réaumur implies. Yet the work’s taxonomic elements constitute the definitive border between its specialist and non-specialist audiences. Taxonomy is the province of the specialist alone, but the spectacular qualities of insects persist in specialists’ mode of envisioning their objects. In this way, the whole work—its spectacular elements as well as its more technical ones—belongs to the domain of savants and serious diletantes, while merely curious readers, Réaumur expects, will busy themselves with the spectacular elements alone.

Yet the rhetorics of spectacle and taxonomy do not simply persist as irreconcilable blocs in Réaumur’s work. Instead, Réaumur’s notion of what it means to make “*distributions de classes & de genres*” is itself informed by the rhetoric of spectacle, even as in the morphological detail of a spectacle of insect bodies we can perhaps discern the influence of classification on spectacle. One principal object of the work, Réaumur remarks, would be to give “*des caracteres des classes & des genres des differents insectes, tirés de leurs formes & assés sensibles pour qu’on pût décider sur le champ à quel genre appartient celui qu’on voit pour la premiere fois.*”¹⁴² The descriptions of butterflies and caterpillars which occupy the first two volumes of the work enter into minute comparisons, for example, of the shapes of butterfly wings.¹⁴³ In these passages, Réaumur’s classification departs from a description of the “*dehors riants*” of specific kinds of insects to accede to a consideration of the morphological relationships among different kinds of insects. But for Réaumur, these morphological considerations are just one factor in determining the distribution of insect varieties, as the caveat that insect forms should constitute the basis of classification only as long as these “*caracteres*” are “*assés sensible*” suggests. Rigorous morphological considerations, that is, must cede to ease of identification in cases where a conflict arises. This motley formulation ultimately reveals the prominence of a practical relationship to Nature in the natural history of Réaumur as in that of Pluche, one grounded in the human body’s disposition in relation to its environment. Insects which exist in multiple forms over the course of their life spans, for example, ought to be treated in a single entry, Réaumur insists, and classified ac-

¹⁴¹ Ibid., 40-41.

¹⁴² Ibid., 40.

¹⁴³ Thus, we read, for example: “*Quoique dans quelques positions, les aîles superieures soient cachées par les inferieures, elles sont, generalement parlant, celles qui se font le plus voir, & celles d’où on doit le plus tirer les caracteres. Toutes ont des figures triangulaires; les unes sont des especes de triangles rectilignes, les autres des triangles curvilignes, & les autres des triangles mixtilignes.*” Ibid., 263.

ording to the state in which they are most likely to strike our eye. Such a procedure is not at all arbitrary in his view, but rather corresponds to a heuristic whose logic he dramatizes in a scene of encounter: “*Je vois voler une Mouche à longues ailes, je deviens curieux de sçavoir quelle est l’origine de cette mouche; c’est en consultant l’histoire des Mouches, que je dois chercher à m’en instruire. Là je trouverai cette Mouche, j’y apprendrai peut-être qu’elle vient d’un insecte aquatique que je n’eusse jamais connu si cette Mouche ne m’eût donné envie de le connoître.*”¹⁴⁴ Réaumur departs from adherence to what he calls “*l’ordre general,*” in favor of an order in which natural objects appear in the text according to their relative accessibility in our everyday lives. The airborne fly is much more likely to cross our paths than the nymph in its pond. Rather than advocating some inexorable classification principle, Réaumur thus pleads for the utility of organizing facts in such a way that “*celles qui précédent aident à acquérir celles qui les suivent, & de mettre l’esprit en état de les mieux retenir toutes.*”¹⁴⁵

This emphasis on “instruction” not only leads Réaumur to assert the necessity of keeping “*chaque Chenille jointe à son Papillon,*” but also of keeping each insect adjoined to the circumstances in which it leads its life. The second volume of the *Mémoires pour servir à l’histoire des insectes* concludes Réaumur’s studies of butterflies and caterpillars, and characteristically follows them with “*l’Histoire des Insectes ennemis des chenilles.*” For Réaumur, the sympathies and “enmities” of living things trump morphology as an organizing principle for classification. The advantage of this distribution is confirmed by the agricultural benefits which a knowledge of caterpillars’ enemies might accrue. Réaumur’s classifications express the providential character of natural relationships in general by foregrounding the relationships that exist among plants and animals, as well as the relationships that exist between the natural world and the human. Réaumur discerns the hand of Providence, for example, in the fact that caterpillars spare wheat, that staple of the human diet, in spite of their general rapaciousness. With regard to the providential relationships inhering in the natural world, he even discerns the workings of Providence in the habits of a parasitic fly. This fly, we learn, lays its eggs in caterpillars and keeps its host alive until they hatch. “*L’Auteur de tant de merveilleux ouvrages,*” Réaumur insists, “*a voulu que ces vers se perpetuassent, qu’ils parvinssent à se transformer en mouches, & ils n’y parviendrirent pas si la chenille qui les doit fournir d’alimens, mourroit trop vite.*” In this way, he continues, “*toutes les vuës sont remplies, la chenille vit & croît, & elle fait vivre & croître les vers.*”¹⁴⁶

Ultimately, the value of an embodied rhetoric depends for Réaumur on both the practical advantages it offers and on the contingencies of natural history in his time. Conscious of undertaking a new kind of natural history, Réaumur laments the dearth of high-quality observations of insects. In the absence of such observations, he concedes, it was perhaps premature to make claims about what the proper system for ordering insects might be. “*Il n’est peut-être pas aussi essentiel ici,*” Réaumur writes, “*de mettre les faits dans un bon ordre, que d’en rassembler assés*

¹⁴⁴ Ibid., 41.

¹⁴⁵ Ibid., 42

¹⁴⁶ Réaumur acknowledges this scenario might not be quite as providential for the caterpillar as for the fly: “*Mais elle [la chenille] ne parviendra pas à se métamorphoser en papillon,*” he grants, “*& les vers parviendront à se transformer en mouches.*” *Mémoires pour servir à l’histoire des insectes*, vol. 2 (Paris: Imprimerie royale, 1736), xi.

de ceux qui méritent attention.”¹⁴⁷ While Réaumur foresees assimilating the observations he has made into tabular form, he defers the inductive task of deciding which categories will be the most useful and sound for the future, so submerged is he for the present, he regrets, in the tasks of observing and describing. For these reasons, the contingencies of a spectacular regime supplant the systematic characteristics of a tabular one in the sequence of descriptions Réaumur follows in the *Mémoires* and in aspects of the descriptions themselves. From another point of view, though, these “contingencies” are thoroughly motivated by their own logic, one that prizes the decipherment of natural relationships in light of Nature’s admirable providence. Indeed, the ongoing pertinence of the spectacle of Nature and of the hermeneutics it invokes helps us gauge the power of admiration as an epistemic virtue in Réaumur’s natural history.¹⁴⁸

This tension between the spectacle and classification, between description as a hermeneutic discourse and description as a discourse of representation, also inheres in the work of Réaumur’s great rival, Georges-Louis Leclerc, comte de Buffon (1707-1788). Buffon’s many volumes of *Histoires naturelles* of quadrupeds, birds, and varieties of man assimilate these objects to a tabular regime, even as they also deploy an extravagant rhetoric of spectacle. As in Réaumur, the deployment of spectacle not only takes place in the form of explicit set-pieces but at a more implicit level as well, ordering the sequence of descriptions and shaping their length and character. Like Réaumur, Buffon attributes the discursive heterogeneity of his work to the diverse audiences it must accommodate. In the *Avertissement* to the 12th volume of the *Histoire naturelle* (1764), he writes:

*Comme les détails de l’Histoire naturelle ne sont intéressants que pour ceux qui s’appliquent uniquement à cette science, et que dans une exposition aussi longue que celle de l’Histoire particulière de tous les animaux, il règne nécessairement trop d’uniformité, nous avons cru que la plupart de nos lecteurs nous sauraient gré de couper de temps en temps le fil d’une méthode qui nous contraint, par des discours dans lesquels nous donnerons nos réflexions sur la Nature en général, et traiterons de ses effets en grand. Nous retournerons ensuite à nos détails avec plus de courage; car j’avoue qu’il en faut pour s’occuper continuellement de petits objets dont l’examen exige la plus froide patience, et ne permet rien au génie.*¹⁴⁹

In this passage, Buffon, like Réaumur before him, apportions spectacular effects to his lay readers, while pursuing the more plodding work of comprehensive description on behalf of specialists. Yet Buffon also echoes Réaumur in construing spectacle as much more than a concession to his lay readers, reserving it, indeed, as the place where the “*génie*” of the natural historian may be given ample reign. The spectacle gives form to the natural historian’s highest calling, that of

¹⁴⁷ *Mémoires pour servir à l’histoire des insectes*, 1:38.

¹⁴⁸ In her forthcoming book on Réaumur, *Catching Nature in the Act: Réaumur and the Practice of Natural History in the Eighteenth Century*, Mary Terrall similarly dwells on the tensions that reign between spectacle and classification in the naturalist’s ordering of natural objects. In particular, Terrall examines the way this tension played out in the material rhetoric at work in the display of animals and plants in Réaumur’s natural history cabinet.

¹⁴⁹ *Oeuvres* (Paris: Gallimard, 2007), 984.

reflecting on Nature in general. The opening peroration of the *Histoire naturelle* (1, 1749), one of the most famous pieces of writing during the eighteenth century, richly illustrates just what such images of Nature “*en grand*” meant to Buffon. There, he begins, “*L’Histoire naturelle prise dans toute son étendue, est une Histoire immense, elle embrasse tous les objets que nous présente l’Univers. Cette multitude prodigieuse de quadrupèdes, d’oiseaux, de poissons, d’insectes, de plantes, de minéraux, etc. offre à la curiosité de l’esprit humain un vaste spectacle, dont l’ensemble est si grand, qu’il paraît et qu’il est en effet inépuisable dans les détails.*”¹⁵⁰ Iterating the oscillation between cosmic effects and terrestrial details that we earlier encountered in Bernardin’s “Préambule,” Buffon goes on to insist that the study of Nature requires two seemingly contrary qualities, “*les grandes vues d’un génie ardent qui embrasse tout d’un coup d’oeil, et les petites attentions d’un instinct laborieux qui ne s’attache qu’à un seul point.*”¹⁵¹ The drone-like “*instinct laborieux*” of a naturalist like Réaumur might suffice for the task of describing such profusion in adequate detail, but the truly inspired natural historian, Buffon argues, rises to the more exalted challenges posed by the spectacle of Nature. While the spectacle envelops the world of detail, it also realizes the natural ensembles which form the basis of philosophizing about Nature. The “*grandes vues*” of the inspired naturalist are not only the spectacles his moral grandeur allows him to perceive in Nature, but also the speculations he subsequently makes about the universe.

The varieties of natural knowledge signaled by the spectacle in Buffon are evident in the overture of the twelfth volume of the *Histoire naturelle*, the text known as “De la nature. Première vue” (1764). In this text, the spectacle is articulated with a hermeneutics of Nature, whose providential character shines through as Buffon defines mankind’s place in Nature:

*La terre élevée au-dessus du niveau de la mer, est à l’abri de ses irrutions; sa surface émaillée de fleurs, parée d’une verdure toujours renouvelée, peuplée de mille et mille espèces d’animaux différents, est un lieu de repos, un séjour de délices, où l’homme placé pour seconder la Nature, préside à tous les êtres; seul entre tous, capable de connaître et digne d’admirer, Dieu l’a fait spectateur de l’Univers et témoin de ses merveilles; l’étincelle divine dont il est animé le rend participant aux mystères divins; c’est par cette lumière qu’il pense et réfléchit, c’est par elle qu’il voit et lit dans le livre du monde, comme dans un exemplaire de la Divinité.*¹⁵²

In this passage, all the motifs of natural theology are present, the spectacular display of Earth’s beings, the assimilation of Nature to a book to be deciphered (this time construed, interestingly, as just one “copy” of Divinity), the insistence on the anthropocentric character of Nature, the

¹⁵⁰ Ibid., 29.

¹⁵¹ Ibid., 30.

¹⁵² Ibid., 989-90.

prevalence of admiration and gratitude as the appropriate response to Nature.¹⁵³ Providence intervenes not only to render the Earth a “*séjour de délices*” for the benefit of mankind, but also to light a spark that enables him both to witness the “marvels” of the universe and to interpret their meaning. This distinction between “seeing” and “reading” quite clearly reiterates the two kinds of visibility that had informed the science of admiration all along, establishing the semiological function of spectacle in Buffon relative to the hermeneutics invoked by the “*livre du monde*.” Indeed, the providentially sealed relationship between the spectacle and the world is characteristic of Buffon in his moments of afflatus, shaping his philosophical reflections on the stuff and organization of the world.

The expansive philosophic views to which “spectacle” gives rise in Buffon ultimately lead to a drift, as it were, in its rhetorical function. Conditioning Buffon’s thinking about matter, the spectacle strikes up a new affiliation with mathematical physics. Indeed, spectacle in Buffon bridges the antagonism between the hermeneutics of Nature and Newtonian physics that would inhere, for example, in Bernardin’s “Préambule,” disclosing the means and objects of each respective mode of knowing Nature. In letting hermeneutics coexist with physics, Buffon erases the distinction between God as “*Auteur*” and God as “*Ouvrier*,” a distinction which had oriented much of natural theology’s reflections about the ends of natural history. While the interpretation of the book of Nature sufficed, as Pluche put it, to impart a sense of “*le beau, l’utile et le vrai*,”¹⁵⁴ investigations into the mechanics of Nature lifted its skirts in a spirit that seemed immodest in more ways than one. “*Prétendre pénétrer le fond même de la Nature;*” cautions Pluche, “*vouloir rappeler les effets à leurs causes spéciales; vouloir comprendre l’artifice & le jeu des ressorts, & les plus petits élémens dont ces ressorts sont composés, c’est une entreprise hardie & d’un succès trop incertain.*”¹⁵⁵ In grafting the spectacle onto Newtonian mechanics, Buffon unabashedly situates himself as one of what the earlier naturalist had lauded as “*ces génies d’un ordre supérieur; à qui il peut avoir été donné d’entrer dans ces mystères & de voir.*” For Buffon, too, it is the spectacle that makes it possible to “see.” Moreover, the spectacle’s capacity to bring these mysteries to mind makes possible the kind of “entering into” that Pluche imagines, opening up the operations of a “*Dieu Ouvrier*” to speculations about the combinations of matter and the revolutions of the planets, even as the special technical means such geniuses might have at their disposal conduce in turn, we gather, to making the mysterious visible.

In the “*Première Vue*,” the rhetoric of spectacle shapes Buffon’s speculations about how the forces of attraction and impulsion organize the “*volume immense de matière.*” In these passages, Buffon revisits the debates on Newton’s law of gravitation that had swirled through the Académie des sciences between 1747 and 1749. Though Parisian geometers widely preferred Newton’s gravitation to Descartes’ whirlpools by this time, they still struggled to reconcile gravitation with a host of astronomical observations. Buffon’s own fundamentally Newtonian celestial spectacle sets in motion a scenario in which the universal agency of attraction is locally modified

¹⁵³ Indeed, the piece concludes with a prayer: “DIEU BIENFAITEUR, nous seconderons [la Nature], nous la cultiverons, nous l’observerons sans cesse pour vous offrir à chaque instant un nouveau tribut de reconnaissance et d’admiration.” Ibid., 993.

¹⁵⁴ *Spectacle de la nature*, viii-ix.

¹⁵⁵ Ibid., ix.

by the variable agency of impulsion, a scenario in which two cosmic forces replace the single force of Newtonian physics. “*La première de ces forces,*” Buffon writes of attraction, *est également répartie; la seconde,*”--impulsion--“*a été distribuée en mesure inégale: chaque atome de matière a une même quantité de force d’attraction, chaque globe a une quantité différente de force d’impulsion;*

*aussi est-il des astres fixes et des astres errants, des globes qui ne semblent être faits que pour attirer, et d’autres pour pousser ou pour être poussés, des sphères qui ont reçu une impulsion commune dans le même sens, et d’autres une impulsion particulière, des astres solitaires et d’autres accompagné de satellites, des corps de lumière et des masses de ténèbres, des planètes dont les différentes parties ne jouissent que successivement d’une lumière empruntée, des comètes qui se perdent dans l’obscurité des profondeurs de l’espace, et reviennent après les siècles se parer de nouveaux feux; des soleils qui paraissent, disparaissent et semblent alternativement se rallumer et s’éteindre, d’autres qui se montrent une fois et s’évanouissent ensuite pour jamais.*¹⁵⁶

In this passage, Buffon modifies the central Newtonian tenet of universal gravitation to account for the heterogeneous densities of matter.¹⁵⁷ The statement of this premise expands into a gradual enumeration of cosmic phenomena, the rational mechanics of objects “*dans le milieu du vide,*” gradually spinning into form as a spectacle of deep space, the parataxis of the descriptions of cosmic bodies conveying the logic of proliferation and plenitude, of infinity in instantaneity, of embodied proximity, of admirable scope and design characteristic of the spectacle. Though the grandeur of the spectacle still implies the moral stature that natural philosophy requires, it is no longer articulated with hermeneutic technique in this passage. Instead, it is articulated with the mathematics of celestial mechanics, serving both as the precondition for visualizing cosmic phenomena and the means of representing them in text, even as the practices of astronomic observation and the formulation of mathematical “laws” constitute the mode of knowing Nature in question here.¹⁵⁸

¹⁵⁶ *Oeuvres*, 987.

¹⁵⁷ Stéphane Schmitt’s “Notice” on Buffon’s “Réflexions sur la loi d’attraction” in the Pléiade edition of his works provides a succinct summary of the context for Buffon’s ventures into celestial mechanics, in particular the debates among Clairaut, d’Alembert, Euler and others about how best to modify Newton’s law of gravitation so as to account for irregularities observed in the movements of the Earth’s moon and other bodies. In addition, the first note to the text helpfully clarifies how Buffon’s espousal of two forces, attraction and impulsion, modifies Newton’s own conception of attraction. *Ibid.*, 1377-80.

¹⁵⁸ Georges Canguilhem quite rightly remarks that Buffon’s notion of place is informed both by the “anthropo-geographical” tradition and by his admiration for Newtonian mechanics. In the celestial mechanics conjugated here with spectacle, we can see that even Buffon’s celestial mechanics bears the characteristics of a geographical conception of space. For Buffon, the universal laws that describe physical forces express the variable densities of matter, rather than dissolving matter into the perfectly uniform space mocked by Bernardin; in Buffon’s imagination “*des lieux fixes*” pock “*le milieu du vide,*” while “*des routes déterminées*” furrow it. Canguilhem’s essay “The Living and its Milieu” offers a brief account of Buffon’s enthusiasm for Newton’s rational mechanics. *Knowledge of Life* (New York: Fordham University Press, 2008), 100-01.

Beyond the virtuoso animation of particular spectacles, as in these passages in which the spectacle arises as a kind of rhetorical set piece, spectacular logic underpins the distribution of the objects of natural history in the order of the text. Just as in Pluche and Réaumur, that is, the spectacle in Buffon exercises a determinant influence on the sequence according to which animals and plants are presented. As in Réaumur, this logic enters into tension with that of classification. While Buffon seeks to identify species, he eschews a purely morphological system of classification based on an arbitrary body part like “teeth, nails or hooves” in the case of animals, or “leaves or flowers” in the case of plants. Instead, as he puts it, “*l’individu tout entier*” grounds the examination of the differences and resemblances marking an individual relative to other individuals: “*Il me paraît que le seul moyen de faire une méthode instructive et naturelle,*” he writes, “*c’est de mettre ensemble les choses qui se ressemblent, et de séparer celles qui diffèrent les unes des autres.*”¹⁵⁹ The task of classification, for Buffon, depends on identifying both the degree of difference inhering in a given characteristic of an individual with regard to the same characteristic in other individuals, as well on the number of differences in question. Natural objects remain entire in Buffon in a way which precludes their distribution in tables: while Linnaeus’ “*système artificiel*” distributes species according to their differences with regard to a single feature, rendering them representable in tabular space, Buffon’s “*méthode instructive et naturelle*” takes into account the differences among individuals with regard to a host of features, lending itself to heuristic groupings of more or less similar individuals. Given the heuristic nature of these groupings, Buffon, like Réaumur and Pluche before him, accents the natural historian’s discretion in determining the textual distribution of his objects. “*À l’égard de l’ordre général et de la méthode de distribution des différents sujets de l’Histoire naturelle,*” he remarks, “*on pourrait dire qu’il est purement arbitraire.*”¹⁶⁰

The arbitrary nature of distribution in Buffon offers a point of entry for the kind of embodied logic that orders Pluche’s and Réaumur’s texts as well. As discretionary as the distribution of the objects in natural history texts may seem, this distribution is nevertheless thickly determined. In Buffon’s view, any distribution will do, as long as it follows the order the author deems to be “*le plus commode ou le plus communément reçu.*”¹⁶¹ In Buffon, the “convenience” and “familiarity” in question are defined in ways that closely echo the considerations at work in Pluche and Réaumur. Like his predecessors, Buffon emphasizes the need to distribute the objects of the natural historical text according to the order that best accords with the working of the human mind, and this optimal order is likewise imagined to reflect the order in which an individual will likely have encountered these objects in experience. In Buffon, this notion takes on a more explicitly sensationalist cast than it had in Pluche or Réaumur. “*Imaginons un homme,*” he proposes, “*qui a en effet tout oublié ou qui s’éveille tout neuf pour les objets qui l’entourent, plaçons cet homme dans une campagne où les animaux, les oiseaux, les poissons, les plantes, les pierres se présentent successivement à ses yeux.*”¹⁶² Like Condillac’s Galatea, Buffon’s amnesiac

¹⁵⁹ *Oeuvres*, 40.

¹⁶⁰ *Ibid.*, 46.

¹⁶¹ *Ibid.*

¹⁶² *Ibid.*, 47.

progressively acquires mental contents in contact with the objects surrounding him. The succession of objects he encounters develops his mind as they strike his senses, even as they come to inhere in his mind within a web of associations determined, we infer, by the sequence in which the man perceives them. In this way, the links among the objects as they form in his mind necessarily reflect their proximity to each other in nature, as organized by the perspective from which he views them. Transported to the countryside, the man awakens to a succession of objects quite clearly animated by the rhetoric of spectacle.

This sensationalist approach to classification depends entirely on the life experience of an embodied individual, and of the relationships which this individual and the surrounding environment strike up. Given this scenario, the mental links that form among the objects of natural history are conditioned not only by their proximity to each other but also by their proximity to Buffon's placeholder subject. However, the "common" and "familiar" order Buffon has in mind is also suggested by the relative utility of the natural objects in question. The things that are nearest will have entered the hypothetical man's head first, even as, close at hand, they will likely turn out to be the most useful to him. In a tableaux of the hypothetical man's mental development, Buffon illustrates the mutual compatibility of his sensationalist theory of learning and this spatial array of utility:

Ensuite mettons-nous à la place de cet homme, ou supposons qu'il ait acquis autant de connaissances, et qu'il ait autant d'expérience que nous en avons, il viendra à juger les objets de l'Histoire naturelle par les rapports qu'ils auront avec lui; ceux qui lui seront les plus nécessaires, les plus utiles, tiendront le premier rang, par exemple, il donnera la préférence dans l'ordre des animaux au cheval, au chien, au boeuf, etc. et il connaîtra toujours mieux ceux qui lui seront les plus familiers; ensuite il s'occupera de ceux qui, sans être familiers, ne laissent pas que d'habiter les mêmes lieux, les mêmes climats, comme les cerfs, les lièvres et tous les animaux sauvages, et ce ne sera qu'après toutes ces connaissances acquises que sa curiosité le portera à rechercher ce que peuvent être les animaux des climats étrangers, comme les éléphants, les dromadaires, etc. Il en sera de même pour les poissons, pour les oiseaux, pour les insectes, pour les coquillages, pour les plantes, pour les minéraux, et pour toutes les autres productions de la Nature; il les étudiera à proportion de l'utilité qu'il en pourra tirer, il les considérera à mesure qu'ils se présenteront plus familièrement, et il les rangera dans sa tête relativement à cet ordre de ses connaissances, parce que c'est en effet l'ordre selon lequel il les a acquises, et selon lequel il lui importe de les conserver.¹⁶³

The logics of sensationalism and of utility converge here thanks to Buffon's particular mode of spatializing the objects of natural history. In this highly normative, historically embedded distribution, the natural objects most likely to cross the path of Buffon's average metropolitan French man precede those which are likely to lay farther afield. Horses must appear before camels, for example, and domesticated animals before hunted ones. This spatial logic promotes a theory of learning according to which preserving the sequence according to which associations among nat-

¹⁶³ Ibid., 47-48.

ural objects were likely to have been formed during childhood facilitates the absorption of knowledge about them as an adult. Regarding the “*productions de la Nature*,” writes Buffon, “*l’ordre selon lequel il les a acquises*,” is also the order according to which, “*il lui importe de les conserver*.” The presumed constancy of the normal man’s milieu means, moreover, that what was likely to have been familiar to him as a child will remain part of his daily environment as an adult. By distributing the productions of Nature in concentric circles of greater to lesser familiarity, Buffon not only respects what he conceives as the mental arrangements of metropolitan French readers but also promotes the utility of natural history. A useful book of natural history is one where useful animals come first, and in the rough equivalence Buffon draws between familiarity and utility, the natural objects that populate the milieux of French metropolitan subjects take pride of place. Animals of hearth and stable come first, those of the colonies and beyond bring up the tail.

This practical logic belongs to the rhetoric of spectacle because of the way it privileges the spatial relations among things in the extra-textual world, rather than arranging them according to a table of abstract differences and similarities. This logic insinuates itself, moreover, into the descriptions themselves, which often enact, rather than merely describe, the characteristics of a given animal or the relationships inhering between a given animal and man. “*Dans la description l’on doit faire entrer la forme, la grandeur, le poids, les couleurs, les situations de repos et de mouvements, la position des parties, leurs rapports, leur figure, leur action et toutes les fonctions extérieures; si l’on peut joindre à tout cela l’exposition des parties intérieures, la description n’en sera que plus complète L’histoire doit suivre la description et doit uniquement rouler sur les rapports que les choses naturelles ont entre elles et avec nous.*”¹⁶⁴ Buffon prescribes a schema according to which the animal’s description must precede its “history”—that is, the sequence of events (birth, death, mating, migration and so on) which make up its life course; and he proscribes entering too deeply into descriptions of particular parts of animals in a way that might best belong to memoirs of “comparative anatomy.” His emphasis is on proportionality—a sensible focus on the relative importance of the animal’s parts with regard to one another, and on a given event of the animal’s life with regard to other characteristic events of its history; proportionality, too, with regard to the significance, even size, of the animal relative to other animals, and with regard to its significance to humans.

Buffon’s means of insinuating (“*faire entrer*”) the form, size and weight of the animal into the articles exceed the explicit description of these characteristics, however. The article on “La souris,” for example, a mere three paragraphs, vanishes as quickly as the animal itself, re-enacting in its brevity the smallness, speed and timidity of its subject. The article on the somewhat larger rat is commensurably longer in length, this time growing to five paragraphs. These short articles embody the corporeal characteristics of their animal objects as well as their relative indifference or uselessness to humans in a way which differs significantly from the signifier-signified relationship that inheres in “representation.” The rhetoric of enacting or embodying brings the physical relationships among the objects of natural history into the text itself.

For Buffon, moreover, the practical logic of this disposition penetrates even into the regime of the table: “*Ne vaut-il pas mieux ranger*,” he asks, “*non seulement dans un traité*

¹⁶⁴ Ibid., 45-46.

*d'Histoire naturelle, mais même dans un tableau ou partout ailleurs, les objets dans l'ordre et dans la position où ils se trouvent ordinairement, que de les forcer à se trouver ensemble en vertu d'une supposition?"*¹⁶⁵ The coexistence of tabular and spectacular discourses in Buffon compels us to re-examine Foucault's notion Buffon and Linnaeus partook of a same representational logic. As I have been attempting to argue, Buffon belongs to a tradition which privileges the embodied relationships among the objects it treats, while also pursuing a project of classification. The three-dimensionality of Buffon's texts resists the flattening effect of tabular form. This feature of natural history writing in Buffon and among his peers, predecessors and, as we shall see, successors, compels us to re-examine Foucault's historiography of eighteenth-century natural history more broadly. A small but decisive shift in the way we see eighteenth-century natural history, this insight is all the more urgent given the enormous influence Foucault's writing on this subject has exercised on subsequent scholarship. Both within and beyond the field of history of science the theme of "representation" has dominated perspectives on eighteenth-century natural history. Yet the many uses of spectacle indicate the extent to which a hermeneutic orientation to Nature remained prevalent in Buffon's age and beyond.

Mary Louise Pratt's notion of the way eighteenth-century natural history participates in producing a "planetary consciousness" offers just one example of how Foucault's influence has shaped disciplines well beyond the history of science per se.¹⁶⁶ For Pratt, natural history played a crucial role in bringing the extra-European world to visibility for "imperial eyes," and the strongly scopic character of this consciousness arises in conjunction with her reading of Foucault. Yet given the many and varied practices that make up eighteenth-century natural history, as Pratt herself points out--not only classing and describing but also traveling, collecting, packing and shipping--its pursuit could not but have arisen from and fed into a sense of place and proportion. Indeed, it might well be expected that it was the spectacle of Nature that organized voyagers' encounters with Nature through the anthropocentric rings of commonness, corporeality and usefulness, instead of the grid of representation with its disembodied catalogue of morphological relations. The corporeal hexis at work in the texts of Buffon and others reminds us that imperial eyes were attached to imperial bodies, that eyes were but one of the organs through which imperial bodies incorporated new relations of place. The persistence of Linnaean binomial nomenclature into our own time, as well as the prominence of Foucault's model of tabular organization (of which Linnaeus' taxonomy is the primary emblem), have combined to occlude the material and discursive natural historical practices that in France, at least, remained as authoritative as those of Linnaeus in the late eighteenth century. Yet, no less "totalizing" in their own ways, the natural history projects of Réaumur, Pluche, Buffon, and as we shall see, Bernardin, arrived at alternative means of thinking about Nature on a global scale.

III. Stranger Uses of Spectacle

¹⁶⁵ Ibid., 49.

¹⁶⁶ *Imperial Eyes: Travel-writing and Transculturation* (New York: Routledge, 1992), in particular Part 1, "Science and sentiment, 1750-1800."

In eighteenth-century natural philosophy, the spectacle seems “detachable.” It shapes the articulation of an array of modes of knowing Nature, even as these modes of knowing Nature are often also shaped by alternative means. (This may come as no surprise given the way the spectacle itself had displaced the symbols of earlier times in articulating the hermeneutics of Nature.) Classification and rational mechanics, for example, could be articulated through spectacular logic, but they could also be articulated through tables and equations. Speculation and experimentation were likewise articulated through spectacle, while also prone to alternative technologies of visualization and imagination. In speculation and experimentation, spectacle conditioned the visualization at work in thought experiments about the inner mechanisms of Nature, as well as shaping the material and discursive dispositions of real experiments. As I show here, these modes of knowing Nature stretched spectacle toward and sometimes beyond its limits as a technology of admiration, framing tableaux of Nature that at their most daring called Providence itself into question. This glimpse at the discursive options opened up by spectacle will ultimately throw into relief the specificity of Bernardin de Saint-Pierre as a late eighteenth-century writer in whom the use of hermeneutics and spectacle as literary technologies of admiration remained intact.

Buffon opens the preface to the thirteenth volume of the *Histoire naturelle* (1765) with an invitation to a thought experiment. “*Mettons aujourd’hui l’espèce à la place de l’individu,*” he proposes in “*De la nature. Seconde vue,*” “*nous avons vu quel était pour l’homme le spectacle de la Nature, imaginons quelle en serait la vue pour un être qui représenterait l’espèce humaine entière.*”¹⁶⁷ In this thought experiment, Buffon turns the synoptic element of the spectacle of Nature to new ends, asking us, in effect, to treat its rhetorical capacity to condense infinity into instantaneity into a frame for speculations about continuity in deep time. By positing the epitome of a species rather than a specific individual as the spectator of Nature, Buffon presses the rhetorical form to disclose just how the deep time of species life unfolds on Earth. The spectacle’s ability to capture the universe as a sublime whole now informs reflections on the mechanics of “generation.” The synoptic powers of the spectacle allow the immemorial time of species generation to take shape in the eyes of the super-being, rhythms of destruction and creation scanning Nature at much more leisurely intervals than the experience of time’s passage on Earth could allow. In the passage of the seasons, for instance, this being admires a monotonous majesty, distinguishing “*dans cette destruction, dans ce renouvellement, dans toutes ces successions,*” nothing other than “*permanence et durée; la saison d’une année est pour lui la même que celle de l’année précédente, la même que celle de tous les siècles; le millième animal dans l’ordre des générations, est pour lui le même que le premier animal.*”¹⁶⁸

The synoptic faculty of the spectacle allows Buffon to evoke his assumptions about the constancy of species through time; the representative of a thousandth generation of an animal, he assumes, will no more differ from the representative of the first generation of the species than a second individual from the first generation will differ from another. “*Dans le torrent des temps qui amène, entraîne, absorbe tous les individus de l’Univers,*” affirms Buffon, the super-being will find, “*les espèces constantes, la Nature invariable: la relation des choses étant toujours la même, l’ordre des temps lui paraît nul; les lois du renouvellement ne font que compenser à ses*

¹⁶⁷ *Oeuvres*, 994-95.

¹⁶⁸ *Ibid.*, 995.

yeux celles de la permanence; une succession continuelle d'êtres, tous semblables entre eux, n'équivaut, en effet, qu'à l'existence perpétuelle d'un seule de ces êtres." Collapsing the magnificent succession of individuals into the persistence of just one, Buffon draws on the speculative frame the spectacle traces to pose a series of questions about how the continuity of species may work:

À quoi se rapporte donc ce grand appareil des générations, cette immense profusion de germes, dont il en avorte mille et mille pour un qui réussit? qu'est-ce que cette propagation, cette multiplication des êtres, qui se détruisant et se renouvelant sans cesse, n'offrent toujours que la même scène, et ne remplissent ni plus ni moins la Nature? d'où viennent ces alternatives de mort et de vie, ces lois d'accroissement et de dépérissement, toutes ces vicissitudes individuelles, toutes ces représentations renouvelées d'une seule et même chose?¹⁶⁹

The passages that follow expose Buffon's theory of how generation takes place in animals. This theory is grounded in the assumption that matter consists on the one hand of "*molécules brutes*" which, Buffon affirms, will one day be shown to organize themselves according to the laws of Newton's cosmology, and, on the other hand, of "*molécules vivantes*," which find themselves attracted to places in "molds" which perpetuate the respective forms of species bodies. The spectacle enables Buffon to articulate a problem in natural history (the generation of species), to speculate as to how the fixity of species across generations is maintained, and to sketch out a research program for future generations. Posterity, says Buffon, will remedy our ignorance of the laws of matter, and, "*à l'aide du calcul*," succeed in opening up "*ce nouveau champ de connaissances, et savoir à peu près de quelle figure sont les éléments des corps.*"¹⁷⁰ Spectacle thus acts as one discursive strategy among others, including mathematization, in the natural philosophy of generation. Yet, far from merely incidental to the thinking Buffon undertakes on the subject, it shapes the vision of deep time in which he imagines the succession of a species' individuals and enables him to formulate reflections on the living mechanics of Nature for the benefit of both learned and lay audiences.

The spectacle of Nature, however, is no more limited to fixist philosophies of generation than it is to dynamic ones. Where Buffon had proclaimed the absolute continuity of species forms (aside from individual variation) in "*tous les temps et sous tous les climats*,"¹⁷¹ Charles Bonnet (1720-1793) had at almost the very same moment animated a spectacular thought experiment on species' changeability. In Bonnet's profoundly providential vision of Nature, both the physical features of the globe and the bodies and souls of animals and humans were changing constantly for the better. Animal species and humans were gradually moving up the chain of being toward Divinity, transforming into more exalted organic forms. In this movement up the ladder of being, a given species did not capitulate its identity only to take on the form of another, an

¹⁶⁹ Ibid., 996.

¹⁷⁰ Ibid., 1001.

¹⁷¹ Ibid., 999.

oyster, for example, turning into a bird. Instead, the form under which a given species could be identified at a particular moment was always just a momentary guise in the history of its transformations, its past forms unrecognizable with regard to its present form, its future form probably unlike either, all of them particular to the species. Bonnet does not insist on the empirical truth of what he called his “palingenesis,” but rather positions it as the most plausible conclusion given a variety of constraints, including the assumption of a providential Nature and the thesis of the “*emboîtement*” of germs (where each germ contains an infinity of generations).¹⁷² Bonnet is not affirming his ideas on the future forms of animals as “true”; rather, he says, “*je présente aux yeux de mon Lecteur une Perspective étendue & variée, & que l’Esprit Philosophique ne dédaignera pas de contempler.*”¹⁷³ The rhetoric of spectacle enables him to depict what he calls “*cette ravissante Scene de Métamorphoses,*” or at least, given its entirely speculative nature, to evoke its absence. In fact, writes Bonnet, if this scene were to pass before our eyes, “*nous contemplerions un Monde tout nouveau, un Ensemble de Choses, dont nous ne saurions nous faire actuellement aucune Idée.*”¹⁷⁴ The spectacle of a dynamic Nature, that is, not only enables Bonnet to represent the consequences of his philosophical assumptions in the absence of any other means of forming an “Idea” of them, it also enables him to disclose them as an “*Ensemble de Choses.*”

If the “*choses*” remain recalcitrant to imagination, the “*ensemble*” does not. In the dynamic hermeneutics Bonnet imagines, the spectacle will disclose the presence of harmonies between the physical characteristics of the globe and the plant and animal forms which exist there. The metamorphoses of these nesting germs would not occur of their own volition but rather in response to the influence of the environment. Bonnet is less interested in changes in plant and animal form per se than in the links between these changes and those of the physical earth. “*Il ne faudroit pas s’imaginer que les Animaux auront dans leur État Futur la même Forme, la même Structure, les mêmes Parties, la même consistance, la même grandeur que nous leur voyons dans leur Etat actuel.*” Rather, these elements of animal bodies will one day be, he maintains, “*aussi différens de ce qu’ils sont aujourd’hui, que l’Etat de notre Globe différera de son Etat présent.*”¹⁷⁵ In the spectacle’s disclosure of natural wholes, Bonnet finds the means to articulate a theory of the situated relationships among living things and their milieu.

The spectacle that opens up in the contemplation of the globe’s deep past or remote future strains the providential framework of Bonnet’s conjectures even as it threatens to transform “*admiration,*” or gratitude for a legible Nature, into “*étonnement,*” the astonishment and confusion of the senses. Like Buffon, Bonnet invents a super-spectator who is capable of taking in the succession of species forms, but who, rather than recognizing the constant return of the same, as in Buffon, is overwhelmed by the strangeness of the spectacle:

¹⁷² The most comprehensive account of the debates around “generation” during the eighteenth-century probably remains Jacques Roger’s classic *Les Sciences de la vie dans la pensée française du XVIIIe siècle: la génération des animaux de Descartes à l’Encyclopédie*, (Paris: Colin, 1963).

¹⁷³ *La Palingénésie philosophique, ou Idées sur l’état passé et sur l’état futur des êtres vivans*, vol. 1 (Geneva: Chez Claude Philibert et Barthelemi Chirol, 1769), 196.

¹⁷⁴ *Ibid.*, 184.

¹⁷⁵ *Ibid.*

Les formes, si élégamment variées, des Végétaux & des Animaux qui ornent la surface de notre Globe, ne sont dans le Système de cette admirable préordination, que les derniers résultats d'une multitude de révolutions successives qu'ils ont subi avant que de naître, & qui on peut-être commencé dès la Création. Quel seroit notre étonnement, si nous pouvions pénétrer dans ces profondeurs, & promener nos regards dans cet abîme! Nous y découvririons un Monde bien différent du notre, & dont les décorations bizarres nous jetteroient dans un embarras qui accroîtroit sans cesse. Un REAUMUR, un JUSSIEU, un LINNEUS s'y perdroient. Nous y chercherions nos Quadrupèdes, nos Oiseaux, nos Reptiles, nos Insectes, &c. & nous ne verrions à leur place que des figures bizarrement découpées, dont les traits irréguliers & informes nous laisseroient incertains si ce que nous aurions sous les yeux seroit un Quadrupède ou un Oiseau.¹⁷⁶

In Bonnet's tableaux, the alien forms we encounter are only the outer "decorations" of species whose guise in our own earthly moment we would easily identify. Though lost in the "abyss" of past forms, we nevertheless exist in what Bonnet calls "*cette admirable préordination,*" a system whose providential arrangement persists whether it is apparent to our eyes or not. In the dynamic hermeneutics Bonnet imagines, the spectacle of Nature alone fails to educe the relationships among natural objects, yet their distortions take on the character of a visual riddle. Of the bizarre forms of the creatures before us, Bonnet writes:

Il en seroit de ces figures comme celles de l'Optique, qu'on ne parvient à reconnoître qu'en les redressant avec un Miroir. La Fécondation fait ici l'Office de ce Miroir; elle est le principe d'un Développement, qui redresse les formes & nous les rend sensibles.¹⁷⁷

In this account, the classifications of Réaumur, Jussieu or Linnaeus are wrong not only because they neglect the inherent dynamism of Nature; in their focus on form, they base natural history on what is only ever a momentary, contingent value. The spectacle of Nature itself presents us with the distortions of a fun house mirror, reflecting the sublimity of Nature without permitting us to identify the objects in it, still less the relationships which inhere among them. But for Bonnet, the science of "*Fécondation*" will serve as a key to the identification of organic forms in all their successive states, promising to reveal which organic forms can be linked to prior or subsequent ones, as well as, perhaps, to elucidate the mechanics of this succession. Thanks to the science of preformation, the distorted spectacle of the future snaps into legible form once more.

Yet the science of generation itself, the anamorphosis of species' physical transformations, was hobbled by the invisibility of its objects. As the article on "Génération" in d'Alembert and Diderot's *Encyclopédie* points out (1757), the physical operations of "*fécondation*" take place according to "*les moyens les plus secrets, les moins susceptibles de tomber sous les sens.*" The studies and experiments of physicists throughout history, reads the article, have failed to

¹⁷⁶ *Contemplation de la nature*, vol. 1 (Amsterdam: Marc-Michel Rey, 1764), 161.

¹⁷⁷ *Ibid.*

shed light on how fertilization takes place. “*Au contraire,*” we read, “*il semble que l'on ne fait que se convaincre de plus en plus, que le voile derriere lequel la nature se cache, est essentiellement impénétrable aux yeux de l'esprit le plus subtil, & qu'il faut ranger la cause de la formation de l'animal parmi les causes premieres, telles que celles du mouvement & de la pesanteur; dont nous ne pourrons jamais connoître que les résultats, sans-doute parce qu'il n'y a que cette connoissance qui nous soit utile.*”¹⁷⁸ The “eyes of even the most subtle mind” had always failed at forcing Nature to disclose the secrets of generation through experiment, and the invisibility of fertilization was precisely what had initially diverted Bonnet’s researches into animal generations into the ravishing spectacles of palingenesis. As a literary technology, the spectacle supplements the invisibility of fertilization by framing conjectures about species posterity and the movements that take place beyond the reach of the senses.

As Mary Terrall has pointed out, the spectacle commonly informs the social, material and literary technologies of eighteenth-century French natural history. These technologies entailed the disposition of witnesses and natural objects for the purposes of visualizing and verifying experiment, as well as the composition of written accounts that sought to relay the experiment to wider publics. “Rigorous experiments and impeccable witnesses,” Terrall argues, buttress the invention, for example, of the freshwater polyp as a “prodigy” of Nature at mid-century, in tandem with the rhetorical efficacy of a work like Maupertuis’ *Vénus physique*, where the polyp is proffered as “a Hydra more marvelous than that of the fable.”¹⁷⁹ Far from undermining the credibility of the experiment, the wonder spectacle was capable of generating helped anoint new scientific objects and promote the findings of those who deployed it. The famous polyps which the Dutch naturalist Abraham Trembley claimed could subdivide into distinct individuals posed a special problem, given their small size and the length of time it took them to subdivide. The presentation of the polyps by Réaumur at the Académie des sciences succeeded, however, in orchestrating a material spectacle for the benefit of the right kinds of onlookers. “[Réaumur] made the Academy a visual witness [*témoin oculaire*] to the discovery,” we read in the *Histoire de l’Académie royale des sciences*, “along with the Academy, the court and the city [*la Cour et la Ville*], which in our enlightened century hardly differ from savants in this regard.”¹⁸⁰

¹⁷⁸ Aumont, Arnulfe d’. “Génération.” In *Encyclopédie*, vol. 7, ed Denis Diderot and Jean le Rond d’Alembert (Paris: Briasson, 1757), 559-574, quoted in Mary Terrall, “Speculation and Experiment in Enlightenment Life Sciences,” in *Heredity Produced: At the Crossroads of Biology, Politics, and Culture, 1500-1870*, ed. Steffan Müller-Wille and Hans-Jörg Rheinberger (Cambridge, MA: MIT Press, 2007), 255.

¹⁷⁹ Quoted in Mary Terrall, *The Man Who Flattened the Earth: Maupertuis and the Sciences in the Enlightenment* (Chicago: University of Chicago Press, 2002), 219. The volume *Science and Spectacle in the European Enlightenment* also contains valuable contributions on the means by which spectacular logic informed experimental science during the period. Bernadette Bensaude-Vincent and Christine Blondel, eds. (Burlington, VT: Ashgate, 2008).

¹⁸⁰ *Histoire de l’Académie royale des sciences* (1741), 33, quoted in Terrall, *The Man Who Flattened the Earth*, 205.

The question of “access” in the orchestration of experimental spectacle is vividly elicited in another context by Diderot’s *Lettre sur les aveugles* (1749).¹⁸¹ There, Réaumur figures as a master of ceremonies once again, this time of an experiment for which Diderot’s text serves as an uninvited literary apparatus. It is precisely because Diderot has been barred from witnessing the experiment in question, a cataract surgery, that his letter magnifies the moment’s importance. Just as the impossibility of witnessing generation had diverted Bonnet’s thinking into the rhetorical mold of literary spectacle, so Diderot’s exclusion from the cataract surgery—for reasons of social access, this time—divert his thinking into spectacular forms. Indeed, Diderot addresses himself in the letter to an anonymous (or fictional) Madame to whom he had “*trop légèrement promis*,” he regrets, the “*spectacle*” of the surgery. He casts himself as the representative of the “*philosophes*,” who, along with “*des personnes de la première distinction ont eu l’honneur de partager*” Réaumur’s snub. “*Si vous êtes curieuse de savoir pourquoi cet habile académicien fait si secrètement des expériences qui ne peuvent avoir, selon vous, un trop grand nombre de témoins éclairés*,” Diderot ironizes, “*je vous répondrai que les observations d’un homme aussi célèbre ont moins besoin de spectateurs, quand elles se font, que d’auditeurs, quand elles sont faites*.”¹⁸² Diderot expertly limns here the socio-epistemic conditions of knowledge-making in his time. For actors like Réaumur, who already enjoyed immense credit in the world of savants and in *le monde*, the assembly of too many or too great a variety of witnesses could only detract from the promotion of his conclusions as fact. It sufficed to collect a small number of witnesses, “*quelques yeux sans conséquence*,” says Diderot, (in this case, those of the comte d’Argenson and Mme Dupré de Saint-Maur)¹⁸³ to verify the success of the experiment, and then, once guaranteed by these witnesses’ reputations, to disseminate an account of the event.

Denied the spectacle of the surgery, Diderot seeks out other empirical means of studying the relationship between the senses and the mind in the blind, testing metaphysical and sensationist theories against anecdotal evidence about blindness that he has collected from books, conversation and encounters with blind people themselves. The biography of the blind English mathematician Dr Nicholas Saunderson provides Diderot with a compelling source of information about the faculties of blind persons, yet the letter’s depiction of the life and works of this real historical figure soon cedes to a sentimental tableau of the moments immediately preceding his death. In this fictional scene, Diderot draws on the rhetoric of spectacle as a literary technology of admiration to speculate on the nature of blindness, contrasting a pious iteration of the

¹⁸¹ Shapin and Shaffer use the notion of access to call attention to the way the material disposition of the experiment acts to control the number of potential witnesses to the experiment and shape the sensory conditions under which they observe it. The use of elaborate and expensive equipment in a laboratory, as opposed, for instance, to the observation of Nature outdoors, drastically limited the number and kind of person authorized to produce “fact.” The social engineering effected by Boyle’s air-pump in Shapin and Shaffer’s account is accomplished in Réaumur’s case, however, through cultural capital alone. Réaumur enjoyed enough credit to claim priority over interesting experimental objects such as the blind woman and to exercise complete control over the witnesses in attendance. To the scarcity of Boyle’s laboratory equipment corresponds the rarity of the blind woman as a suitable object of study. *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life* (Princeton: Princeton University Press, 1985), 38-40.

¹⁸² *Lettre sur les aveugles, à l’usage de ceux qui voient* (Paris: Laffont, 1994), 139-40.

¹⁸³ *Ibid.*, 139n5.

spectacle of Nature with a materialist, atheist one, much as Rousseau had done in the passage about Julie and Wolmar's walks in the country.

This time, however, the mutual complicity of the spectacle's epistemic, ethical and aesthetic dimensions hovers on the point of dissolution. On his death bed, Saunderson evokes the image of a universe of "irregular agitations," a "*nouvel océan*" tossing with malformed bodies in the process of dissolving and coalescing. "*Ô philosophes!*" he entreats, "*transportez-vous donc avec moi, sur les confins de cet univers, au-delà du point où je touche et où vous voyez des êtres organisés; promenez-vous sur ce nouvel océan, et cherchez à travers ses agitations irrégulières quelques vestiges de cet être intelligent dont vous admirez ici la sagesse!*"¹⁸⁴ This anti-providential spectacle of deep space is joined in Saunderson's death-bed speculations by an anti-providential spectacle of deep time. Over his minister's objection that the great minds of Newton, Leibniz and Clarke had themselves lauded the spectacle of an intelligently designed universe, Saunderson undertakes a thought experiment about the succession of generations:

*Si nous remontions à la naissance des choses et des temps, et que nous sentissions la matière se mouvoir et le chaos se débrouiller, nous rencontrerions une multitude d'êtres informes, pour quelques êtres bien organisés. Si je n'ai rien à vous objecter sur la condition présente des choses, je puis vous demander, par exemple, qui vous a dit à vous, à Leibniz, à Clarke et à Newton, que dans les premiers instants de la formation des animaux, les uns n'étaient pas sans tête et les autres sans pieds? Je puis vous soutenir que ceux-ci n'avaient point d'estomac, et ceux-là point d'intestins; que tels à qui un estomac, un palais et des dents semblaient promettre de la durée, ont cessé par quelque vice du coeur ou des poumons; que les monstres se sont anéantis successivement, que toutes les combinaisons vicieuses de la matière ont disparu, et qu'il n'est resté que celles où le mécanisme n'impliquait aucune contradiction importante et qui pouvaient subsister par elles-mêmes et se perpétuer.*¹⁸⁵

The admiration typically invoked by the spectacle hesitates here on the verge of astonishment before the teeming masses of failing flesh, the parataxis which often evokes the elements the spectacle harmonizes expressing, in this case, the extreme disarray, the utter profusion of unviable bodies, the orderly succession of organic forms ceding to untold ages of annihilation. Before this "scene," Saunderson's conditional tense heightens the provisionality, perhaps the untenability of the position of the hypothetical spectator he has evoked, recalling Julie's and Saint-Preux's regrets regarding the "blindness" Wolmar suffers without faith in providential Nature. Literalized in Saunderson, blindness makes the providential vision of the spectacle of Nature contingent on organic form, rather than conditioning the problem of organic form on the visibility lent it by the spectacle. The dispersal of vision likewise disperses the security of a certain ethical standpoint, given the moral indifference of an arbitrary universe, and the pursuit of certain knowledge to boot. For although the spectacle has made possible the statement of a natural philosophical problem (the origins of organic forms and their means of self-perpetuation), it has

¹⁸⁴ Ibid., 169.

¹⁸⁵ Ibid., 168.

not provided a corresponding key for resolving it. Bonnet, as we have seen, also postulated the succession of alien organic forms, and thematized the stunned perception of these forms. But whereas the science of “*fécondation*” would one day act, Bonnet conjectured, as a corrective lens for the distorted forms evoked by the spectacle, recuperating the spectacle for admiration, restoring the possibility of gratitude to a providential God, rendering it legible to a hermeneutics of Nature once more, no such device emerges, in Diderot’s letter, to save the day.

If the prospect of all this hapless flesh articulates the rhetoric of the spectacle with the kind of speculation on generation we have witnessed in Buffon and Bonnet, the problem of spectacular vision is itself thematized in Diderot’s fictional tableau. Though Saunderson’s parataxis of monstrosity evokes an infinity of failing bodies, he himself becomes the most stunning evidence of monstrosity in Nature. “*Voyez-moi bien, monsieur Holmes,*” he says, turning pathetically to the minister, “*je n’ai point d’yeux. Qu’avions-nous fait à Dieu, vous et moi, l’un pour avoir cet organe, l’autre pour en être privé?*”¹⁸⁶ At the climax of this lachrymose scene, Saunderson dies entreating the “God of Clarke and Newton” to take pity on him. But contrary to the spirit of the doubts so vividly justified by Saunderson, Diderot now concludes the fictional tableau by reproving the sighted whose lack of faith blinds them to the admirable spectacle of Nature:

*Quelle honte pour des gens qui n’ont pas de meilleures raisons que [Saunderson], qui voient, et à qui le spectacle étonnant de la nature annonce, depuis le lever du soleil jusqu’au coucher des moindres étoiles, l’existence et la gloire de son auteur! Ils ont des yeux dont Saunderson était privé; mais Saunderson avait une pureté de moeurs et une ingénuité de caractère qui leur manquent. Aussi ils vivent en aveugles, et Saunderson meurt comme s’il eût vu. La voix de la nature se fait entendre suffisamment à lui à travers les organes qui lui restent, et son témoignage n’en sera que plus fort contre ceux qui se fermement opiniâtement les oreilles et les yeux.*¹⁸⁷

This pious declaration cannot quite recuse, one feels, the awful prospect Saunderson has previously evoked, given the intensity of the ethical and epistemic crisis he suffers on his death bed.

Just as the privation of vision compels Saunderson to question the nature of spectacle, Diderot’s exclusion from the scene of the cataract surgery, we sense, impels the elaborate staging of the letter’s alternative, discursively realized spectacles. The material and social technologies of spectacle implicit in the critique of Réaumur’s experimental practice give way in the *Lettre* to philosophical statements of spectacle as a technology of admiration, or perhaps only as a vision of astonishment: on the one hand, a natural theological iteration in which the spectacle of Nature articulates “*la gloire de son auteur*”; on the other, a materialist one which, in lending the eddies and flows of matter sensible form, likewise arouses the awe, if not the gratitude of an onlooker. In this second acceptance, spectacle serves as a rhetorical strategy for framing speculations about change and continuity in Nature, as in the still-providential versions of Buffon and Bonnet. This philosophical practice of reasoned conjecture about the inner workings of Nature differs significantly from the practice of a hermeneutics which seeks to discern the relationships among

¹⁸⁶ Ibid.

¹⁸⁷ Ibid., 169-70.

the things Nature puts on display. While the Abbé Pluche's *Spectacle de la nature*, for instance, had evoked the figure of a "Dieu Ouvrier," only to prefer a "Dieu Auteur," the spectacle as a technology of admiration could be articulated, as we have seen, with both. In Diderot's letter, however, spectacle is able to envision the work of the "Dieu Ouvrier" only at the cost of its own undoing. Its capacity to shape a vision of how bodies proliferate in deep time is ultimately ruptured by the unruliness of these bodies, the orderly ensemble of spectacle reduced to the contingent and partial perceptions of imperfect organic beings.

IV. Sentimental Earth: the Local Science of the Études de la nature

Though cursory, this genealogy of the spectacle exposes what it meant for Bernardin to advance a science of admiration in 1784. Amid the diversity of ends spectacle fulfilled in eighteenth-century natural history, Bernardin restores it as the index of an earthly hermeneutics, reproducing the discursive bloc that had constituted early eighteenth-century natural theology at a time when Lavoisier was decomposing water and Laplace was perfecting celestial mechanics. Like Chateaubriand in subsequent years, Bernardin persisted in advocating a science of natural sympathies while denigrating the exact sciences on the grounds of truth, morality and beauty. Nineteen years after the initial publication of the *Études de la nature* (1784), Chateaubriand's *Génie du christianisme* (1803) would defend the necessity of opposing a so-called "*Histoire Naturelle Religieuse*" to "*tous ces livres scientifiques modernes, où l'on ne voit plus que la matière.*"¹⁸⁸ Together, these works wielded enough cultural influence to provoke the rebukes of savants like Biot and Cuvier, feeling pressured, perhaps, to shore up their own form of scientific authority.¹⁸⁹ But while Chateaubriand's *histoire naturelle religieuse* sketches out just one aspect of a program to promote the influence of Christianity in every form of cultural production, Bernardin's *études* remain focused on transforming natural theology into a viable modern science. In the eyes of its proponents, this natural theology not only trumped the exact sciences in view of its ethical and aesthetic virtues, but generated, in keeping with these virtues, superior knowledge of Nature as well. Though Bernardin's discursive tools hark back to pre-Enlightenment times, he goes farther than perhaps any of his contemporaries in re-imagining natural theology as an epistemically viable alternative to the exact sciences.

How would what Bernardin calls "*la science à venir*" supersede the sciences of his day?¹⁹⁰ Which areas of natural philosophy would it develop, which curtail? Practices as various as animal experimentation, the triangulation of the stars, the collecting of specimens and the invention of classification systems all become, in Bernardin's view, symptoms of a same disen-

¹⁸⁸ *Génie du christianisme*, vol. 1 (Paris: Migneret, 1803), 231-32. Matter occurs here as a category associated with a discredited Enlightenment philosophism and in particular with the godless vision of a universe governed by chance (Chateaubriand's emphasis).

¹⁸⁹ Calculating this pressure precisely is of course one of the impossibilities of what Bourdieu calls the "*science des oeuvres.*" In the Introduction to this dissertation, however, I offer some hints as to the vectors and intensity of the cultural pressure exerted by figures like Bernardin and Chateaubriand on their contemporaries in the scientific establishment, including Cuvier and Biot.

¹⁹⁰ *Études de la nature*, 382 (my emphasis).

chanting methodology, grounded in representation. Yet in attempting to efface these practices, Bernardin's text ends up marked by their traces. Though the *Études* often take pride in their poetic remove from the every day business of science, the positive form assumed by the science of admiration they articulate is importantly shaped by Bernardin's impulse to outdo botany or mathematical physics at their own games. His criticism of botanical taxonomy, for instance, leads him to propose an alternative nomenclature that would allude to the affinities between a given plant and its animal clients rather than to a particular arbitrary structure, even as this nomenclature necessarily departs from a strict hermeneutics. Similarly, he contests the exact sciences' methods and conclusions regarding the shape of the Earth, resulting in a practice of quantification that, though complementary to the language of natural sympathies, nevertheless arises, one senses, in competition with the exact sciences' own quantifying bent. In each case, the science of the past enters into a haphazard dialectic with the science of the present, struggling to transform itself into something new.

This piecemeal effort to adapt natural theology to a new scientific age is just one reason for the *Études'* discursive heterogeneity. If the congruency of spectacle and hermeneutics seems to promise a relatively homogeneous text, the contrary, in fact, proves true. The infinite expansibility of the hermeneutic text lends itself to the assimilation of stray anecdotes and objects, engulfing whatever it finds in its path. Even as the spectacle continues to disclose the possibility of a hermeneutics of Nature in the *Études*, the adaptation of this hermeneutics to objects as widely divergent as the shape of the Earth and the relationships among terrain, plants, animals and humans produces a discursively uneven text. Bernardin himself rues his book's desultory character. "*Descriptions, conjectures, aperçus, vues, objections, doutes, et jusqu'à mes ignorances,*" he confesses, "*j'ai tout ramassé.*" In an attempt to subsume his hodgepodge of materials under a single conceit, he ultimately figures the experience of reading his work as a journey. "*Comme dans un long voyage on aperçoit quelquefois sur la route des îles fleuries au milieu d'un grand fleuve,*" he cautions, "*et des bocages enchantés sur le sommet d'un rocher inaccessible; de même les pas que nous ferons dans l'étude de la nature nous ouvriront, le long de notre chemin, des perspectives ravissantes.*"¹⁹¹

This evocation of a country journey links Bernardin's natural history rhetorically to that of his predecessors. As in the natural histories of Pluche, Réaumur or Buffon, the *Études* is strewn with "*perspectives ravissantes*" that take shape as discrete set-pieces spun from spectacular rhetoric. But in likening the text itself to a journey, Bernardin additionally claims that the rhetoric of the spectacle acts in the organization of the text as a whole, as it had in the work of these earlier authors. In Pluche, the country ambits of a society of aristocrats had subtended the natural histories of particular plants and animals. In Réaumur and in Buffon, the narrative conceit disappears, yet the form of the "walk" or the "journey" persists in organizing the sequence of animals encountered in their texts. Where spectacle shapes the form of these older natural histories, Bernardin's natural history, however, anatomizes the spectacle itself. In elaborating the sympathies which make the spectacle, in his view, cohere, Bernardin produces a conceptual vocabulary for describing the connections they reveal in Nature. The description of the "ensembles" the spectacle makes visible, the exposition of this vocabulary and the vocabulary's application to a

¹⁹¹ Ibid., 77.

welter of first- and second-hand observations displaces the descriptions of particular plants or animals. The spectacle no longer functions as an implicit organizational principle but is itself the real subject of the natural history, and the conceit of a country journey recapitulates the classic trope of Bernardin's predecessors without actually characterizing the text's discursive features.

However, the country walk remains a dominant trope in the work's epistemic stakes. For while the "*fureur de généraliser*," as Bernardin puts it, produces thinkers who construe local evidence as universal law, local evidence, he insists, can only ever produce knowledge about local circumstances. Under the influence of the existing sciences, he laments, we have been taught to subsume the evidence of Nature to a single pertinent law, imagining that Nature is capable of following only "*une seule route*" in producing its effects. But "*l'Auteur de la nature*" proceeds by other means, animating Nature through the production of laws "*aussi variées que ses vues [sont] inépuisables*." Knowledge-making thus becomes a question of acknowledging "*les petits sentiers où nous marchons*," valorizing the many sinuous paths which, in cutting through Nature, each produce a viable reading of it.¹⁹² In contrast, the elaboration of universal laws not only destroys the moral evidence Nature extends to us, but also disregards the singular nature of the physical evidence at hand.

For Bernardin, the solution to this two-fold problem is a science of and for the "local." The unit of this science is the ensemble of connections among plants, animals and terrain which constitutes a spectacle. Indeed, the exploration of the web of connections framed by the spectacle demonstrates Bernardin's affiliation with what Georges Canguilhem calls an "anthropo-geographic" tradition in the sciences. In the classic essay "Le vivant et son milieu," Canguilhem develops a genealogy in which milieu is understood, on the one hand, as "a centered, qualified space, where the *mi-lieu* is a center," and on the other, as "a decentered, homogenous space, where the *mi-lieu* is an intermediary field."¹⁹³ Bernardin belongs to the first tradition, where the projection of values from a center outward transforms milieu into "place," while Newtonian physics belongs to the second, where milieu is construed as pure, valueless in-between-ness. "What gives meaning to the geographical theory of milieu," writes Canguilhem, "is the theory of universal sympathy, a vitalist intuition of universal determinism."¹⁹⁴ In Bernardin, the universe is determined by precisely the kinds of sympathies and antipathies enumerated by Foucault in "La Prose du monde." Yet we must bracket the notion of "vitalism" here: crucially, the notion of life never enters into Bernardin's science of sympathies, where a providential universe governed by a hyperactive God displaces a hylozoic one, in which matter produces its own affinities. While Canguilhem ultimately imagines a science of milieu organized around the way individual living things project their values on the world around them, values which remain immanent to them, living things in Bernardin remain fundamentally determined by the sympathies and antipathies that bind them to the universe. Given the determinate influence of these sympathies, then, we find in Bernardin, in place of Canguilhem's "*le vivant et son milieu*," a "*milieu et ses vivants*."

¹⁹² Ibid., 247.

¹⁹³ *Knowledge of Life*, trans. Stefanos Geroulanos and Daniela Ginsburg (NY: Fordham University Press, 2008), 117.

¹⁹⁴ Ibid., 116.

This “anthropo-geographic” milieu is limited in scale in Bernardin only by the rhetorical capacities of the spectacle. The “local” is ultimately characterized in the *Études* less by the modesty of a given ensemble than by its capacity to designate a place, a “mi-lieu.” In the spectacle’s capacity to embrace a sliding scale of ensembles, from that of trees and their associated plants and animals to that of entire oceans, it becomes an effective technology for inflating the local to global dimensions, or for endowing global ensembles with the familiarity of a country park. Indeed, the technology of the spectacle actively participates here in what Mary-Louise Pratt calls the “construction of global-scale meaning” during the Enlightenment.¹⁹⁵ Though Bernardin rejects the universalizing epistemology of taxonomy and mathematization, the science of admiration he espouses takes shape within the context of his own global travels and readings of travel narratives.¹⁹⁶ Moreover, the spectacles Bernardin composes often draw together objects from places all over the globe, thanks to the spectacle’s synoptic powers, and the strategies he develops for reading the relationships which inhere among these objects turn out to have universal application. The sympathies that help us understand why things are proximal to each other in a particular place, that is, can help us understand why things are proximal to each other in a different place, as well. In Bernardin’s view, the science of admiration not only holds sway over the total set of objects belonging to natural history, it also constitutes the only legitimate methodology for studying them. In the far-flung travels recounted in his source materials as well as in the total application of his methodology, his work thus participates in a broader effort to imagine a “global” context for local meanings, actions or events.

What binds the local and the global together is the continuity of Nature’s text. Bernardin’s dissection of the spectacle discloses the existence of a terrestrial grammar and the hermeneutical tools necessary to decipher it. Essential to the task of interpretation is an awareness of the particular place and time in which a given object of natural history finds itself, and of the relationships into which it enters there. Bernardin blames his predecessors for the way they have “mutilé,” as he says, “*la plus belle portion de l’histoire naturelle, en rapportant, comme ils font la plupart, des descriptions isolées des animaux et de plantes, sans rien dire de la saison et du lieu où ils les trouvent.*”¹⁹⁷ In uprooting plants from their environments in this way, botanists, for example, only succeed in vandalizing the “*ordre végétal,*” or what Bernardin calls “*un livre immense dont les plantes forment les pensées, et les feuilles de ces mêmes plantes, les lettres.*”¹⁹⁸ These naturalists, laments Bernardin,

ressemblent à un certain housard qui, ayant trouvé une inscription latine en lettres de bronze, sur un monument antique, les détache l’une après l’autre, et les mit toutes ensemble dans un panier, qu’il envoya à un antiquaire de ses amis, en le priant de

¹⁹⁵ *Imperial Eyes: Travel Writing and Transculturation* (NY: Routledge, 1992), 15.

¹⁹⁶ In his youth, Bernardin travelled to Martinique, Poland, Russia, Finland and the Île-de-France. The “Avis sur cette édition” (1786) of the *Études* lists a few of the travelers whom Bernardin cites “*avec éloge:*” “*Christophe Colomb, Barents, Martens, Ellis Linschoten, Abel-Tasman, Dampier, Pennant, Rennefort, etc*” (43). The modern edition of the *Études* also includes an index of works consulted by Bernardin de Saint-Pierre (31-35).

¹⁹⁷ *Ibid.*, 303.

¹⁹⁸ *Ibid.*, 370.

*lui mander ce que cela signifiait. Ils ne nous font pas plus connaître la nature, qu'un grammairien ne nous ferait connaître le génie de Sophocle, en nous donnant un simple catalogue de ses tragédies, de la division de leurs actes et de leurs scènes, et du nombre de vers qui les composent. Ainsi font ceux qui recueillent les plantes, sans marquer leurs relations entre elles et avec les éléments; ils en conservent la lettre, et ils en suppriment le sens.*¹⁹⁹

What Bernardin objects to most here is not so much that the botanists in question should pay exclusive attention to the forms of the plant itself, but that they should neglect the role the plants' networks play in determining that form. Just as the isolated letter itself retains a modicum of sense, or the possibility of sense, the morphology of plants--the shape of a leaf, a flower or a fruit--may reveal the natural relationships into which it enters. Perhaps surprisingly, Bernardin defends "*les Tournefort, les Vaillant, les Linnaeus*" for this reason. For even if these precursors to "*la science à venir*" had failed to extrapolate the consequences of their careful plant morphologies, they had nonetheless identified the letters which the Bernardins of the world might re-assemble into legible form.

The tension between the local and the global in Bernardin plays out in the relationship between the singularity of a given object of study and the universal applicability of the rhetorical tools he develops. Though naturalists are wrong for producing discrete descriptions without regard for the "*saison*" or the "*lieu*" in which an individual plant finds itself, the means of connecting this description to the wider world, we discover, is a general grammar. The hermeneutics of natural sympathies reconstruct a grammar of connections among minerals, plants, animals and humans that spell out the relationships revealed among these objects wherever they occur. Though the prospect of a natural history based on the particular site and season of its objects verges on the writing of natural "biographies," the mastery of terrestrial grammars enables Bernardin to produce plausible spectacles without reference to observation. In a section entitled "*Suite de l'Étude XI: Harmonies Animales des Plantes*" Bernardin constructs one of several hypothetical spectacles in his work, a speculative venture whose expression in conditional mode flaunts his composition of spectacle as a form derived from the mastery of natural sympathies. As if watching a painter fill in the blank spaces of his canvas, we observe Bernardin composing a spectacle around the figure of "*un seul végétal.*" In order to study nature "*avec fruit,*" he writes, it would be necessary to select:

un vieux arbre antique dans quelque lieu solitaire. On jugerait aisément, aux caractères que j'ai indiqués, s'il est dans son site naturel, mais encore mieux à sa beauté et aux accessoires dont la nature l'accompagne toujours, quand la main de l'homme n'en dérange point les opérations. On observerait d'abord ses relations élémentaires et les caractères frappants qui distinguent les espèces du même genre, dont les unes naissent aux sources de fleuves, et les autres à leurs embouchures. On examinerait ensuite ses convolvulus, ses mousses, ses guis, ses scolopendres, les champignons de ses racines, et

¹⁹⁹ Ibid., 382. This passage forms the basis of a useful introduction to Bernardin's *Études* entitled "*Le hussard et l'inscription*" by Colas Duflo, the editor of the work's modern edition (7-30).

jusqu'aux graminées qui croissent sous son ombre. On apercevrait dans chacun de ses végétaux de nouveaux rapports élémentaires, convenables aux lieux qu'ils occupent et à l'arbre qui les porte ou qui les abrite. On donnerait ensuite son attention à toutes les espèces d'animaux qui viennent y habiter, et on serait convaincu que, depuis le limaçon jusqu'à l'écureuil, il n'y en a pas un qui n'ait des rapports déterminés et caractéristiques avec les dépendances de sa végétation. Si cet arbre se trouvait au milieu d'une forêt bien ancienne elle-même, il est probable qu'il aurait dans son voisinage l'arbre que la nature fait contraster avec lui dans le même site, comme, par exemple, le bouleau avec le sapin. Il est encore probable que les végétaux accessoires et les animaux de celui-ci contrasteraient pareillement avec ceux du premier. Ces deux sphères d'observations s'éclaireraient mutuellement, et répandraient le plus grand jour sur les moeurs des animaux qui les fréquentent. On aurait alors un chapitre entier de cette immense et sublime histoire de la nature, dont nous ne connaissons pas encore l'alphabet.²⁰⁰

In this curious passage, Bernardin disavows knowledge of the alphabet of Nature while re-assembling its letters into a full-blown spectacle. The passage's armature consists of the conjunctions Bernardin has discerned among natural objects, the concern for the "*relations élémentaires*," of the plants and the degree to which they are "*convenables . . . à l'arbre qui les porte ou qui les abrite*," the "*rappports déterminés et caractéristiques*" of the animals with the vegetation, the "*contraste*" between one spectacle and its neighbor, all alluding to the means by which assemblages of sites and living things take shape in Bernardin's philosophy. The "*harmonies animales des plantes*" of the chapter's title refers to the characteristics of plants which attract particular animals, while what Bernardin elsewhere calls the "*harmonies élémentaires des plantes*" can be defined as the features of a particular site which favor the growth of particular kinds of plants--the altitude, the climate, the sun, the quality of water and of air and so on. Likewise, the "*harmonies végétales des plantes*" govern the attraction of mosses, mistletoe and other vegetation to the ancient tree. Though this passage seems at first to sketch out the setting of a given tree, it pursues a predictive or heuristic mode that removes attention from the concrete to the schematic. Natural sympathies so strongly determine a tree's "accessory" plants and animals that observation is reduced to confirming their presence. The same goes for the "spheres" which define the borders of the spectacle of the tree: "*Si cet arbre se trouvait au milieu d'une forêt bien ancienne elle-même*," we read, "*il est probable qu'il aurait dans son voisinage l'arbre que la nature fait contraster avec lui dans le même site*." The tree in question is so fundamentally determined by these sympathies (and antipathies) that it loses its individuality. It finishes as an illustration of the hermeneutic order, even as the mastery of this order can predict the existence of the tree.

Knowing just where a given plant is growing proves crucial to this sort of prediction. A given tree is not always equal to its kind (one would hardly say its "species") but rather deviates from it in ways that depend on the location of its "*site naturel*." For Bernardin, a *site naturel* is not simply the "climate" in which a given thing can ordinarily be found, but rather the place where the right combination of circumstances permit it to flourish optimally. "*Lorsqu'on voit*

²⁰⁰ Ibid., 409.

végéter une multitude de plantes, de formes différentes, sur le même sol,” writes Bernardin, “*on est tenté de croire que celles du même climat naissent indifféremment partout. Mais il n’y a que celles qui viennent dans les lieux qui leur ont été particulièrement assigné par la nature, qui y acquièrent toute la perfection dont elles sont susceptibles.*” Just as the snails and squirrels of the oak-tree tableau enjoy “*rapports déterminés et caractéristiques*” with the vegetation around the tree and with the tree itself, the question of whether the oak tree is located at its “*site naturel*” can be answered by an examination of the *rapports déterminés et caractéristiques* of the tree with the elements around it--the terrain, the climate, the air, the moisture, the light, the animals and the other kinds of vegetation. The same, he remarks, is true of animals: “*On élève des chèvres dans des pays de marais, et des canards dans des montagnes; mais la chèvre ne parviendra jamais en Hollande, à la beauté de celle que la nature couvre de soie dans les rochers d’Angora; ni le canard d’Angora n’aura jamais la taille et les couleurs de celui qui vit dans les canaux de la Hollande.*”²⁰¹ In these passages, the *site naturel* introduces the problem of the norm into the determination of terrestrial sympathies. While the individual tree remains a token of universal sympathies, the ability to read the sympathies at work in a given place depends on knowledge about where the tree stands in relation to the norm of its kind. Two contradictory impulses are thus articulated through the notion of the *site naturel*, one that tends to define natural scenes as irreducible singularities, populated with things “*particulièrement assigné par la nature*” to be there, another that tends to define individual things as members of a population, abstracted from place. Nature has assigned goats, that is, not just to Angora but to the *mountains* of Angora, ducks not just to Holland but to the *canals* of Holland, because goats and ducks reach their respective acmes of picturesqueness in these locales. In spite of Providence, goat and duck existences elsewhere simply never reach the same degree of perfection.

Given the pre-eminence of “place” in this science, it is perhaps unsurprising that the chief tool in Bernardin’s rhetorical arsenal is the archaic *convenientia*. What Bernardin calls “*convenances*” describe the resemblances which inhere in neighboring things precisely because of their proximity. Identical to those *convenientia* which Foucault identifies as characteristic of Renaissance natural history, Bernardin’s *convenances* establish both the style of proximity in which objects find themselves as well as the similarities in properties which necessarily result. In principle, these *convenances* include not only the “*rapports caractéristiques et déterminés*” of the oak tree passage--the *harmonies animales des plantes*, the *harmonies élémentaires des plantes*, and the *harmonies végétales des plantes*--but also all other possible permutations of these terms, the *harmonies végétales des animales*, for example, or the *harmonies élémentaires des plantes*. Yet in practice, Bernardin’s focus is mostly limited to the world of plants, for reasons which have to do with the nature of *convenances* themselves. Static, plants offer a safe foundation for a science of place; mobile, animals flout the tyranny of place by creating their own locales wherever they go.

In spite of this crucial limitation, *convenances* remain Bernardin’s principal tool for realizing the science of admiration. Though other varieties of sympathy are named in the *Études*, the

²⁰¹ Ibid., 344.

most detailed passages of its hermeneutics are characterized by the tracing of *convenances*.²⁰² Bernardin's interest in botanical form arises not from a conviction about the importance of morphology *per se* (as in the work of systematic classifiers like Linnaeus and his followers) but from what it tells about the relationships into which the plant is destined to enter. The "*harmonies élémentaires des plantes*," for instance, is variously parlayed into the "*harmonies élémentaires des plantes avec le soleil, par les fleurs*," and the "*harmonies élémentaires des plantes avec l'eau et l'air, par leurs feuilles et leurs fruits*." In each case, Bernardin is interested in how the forms of flowers, fruit and leaves reflect the harmonies which govern plants' relationships with the elements. Their shapes disclose the networks of relationships which converge on them, ultimately rendering these relationships legible. The degree to which leaves, for instance, can be "read" depends on our ability to recognize them as objects designed to reflect or repulse sunlight and warmth, collect or wick away moisture, attract or repel animals, depending on their characteristically animal needs, and to strike we humans with their beauty, flavor or odor. "*Si on examine les feuilles, les tiges, les attitudes et les semences des plantes aquatiques*," Bernardin asserts, "*on y remarquera toujours des caractères relatifs aux lieux où elles doivent naître, et concordants entre eux; en sorte que si la graine a une forme nautique, ses feuilles sont sans aqueduc: tout comme dans les plantes de montagne, si la graine est volatile, le pédicule de la feuille ou la feuille entière présente une gouttière*."²⁰³ The plant's form reflects its needs relative to distinct environmental conditions, marsh plants shaped in indifference to water while producing seeds that float, mountain plants shaped to conserve water while producing seeds that sail. Bernardin's morphology here schematizes just two of the parameters which condition botanical form, but a complete exegesis of the plant's form would reveal the unlimited density of the networks at whose center it stands.

The status of morphology thus clearly distinguishes Bernardin's vegetal hermeneutics from the taxonomic botanics Foucault identifies with the eighteenth-century *episteme*. These very different sciences agree in prizing "superficial" objects of study: botany, argues Foucault, is the natural science *par excellence* of the eighteenth century precisely because its methodology matches the exteriority and stasis of the plant, as opposed to the interiority and dynamism of the

²⁰² The *Études*' tenth study, "De quelques lois générales de la nature, et premièrement des loix physiques," presents a battery of various terms for studying sympathies, including but not limited to *convenances*. These terms ("Des Couleurs," "Des Formes," "Des Contrastes," "Des Mouvements," "De la Progression," "Des Concerts" and so on) primarily refer to the "semiological" level of the sympathy and are consequently applicable, in principle, to multiple kinds of sympathy. (Bernardin does not himself distinguish between the semiological and hermeneutic dimensions of the science of admiration). In practice, however, Bernardin illustrates them with regard to *convenances*, rather than to some other hermeneutic mode. In many places in the *Études*, for example, the explanatory power of *analogies* is evoked, yet this alternative variety of sympathy remains marginal to Bernardin's project in its realized form.

In the next section, however, I show how Bernardin recasts such physical phenomena as attraction and heat as "sympathies" by construing them as local, irregular effects rather than as universal, constant ones, as the exact sciences did. Their unpredictable activity resists mathematization, binding them to certain times and places like tutelary deities. Though *convenances* are certainly physical in nature, these other sympathies seem to take on a more pronounced physical quality, introducing relations of causality into Bernardin's work. For while *convenances* describe the relations among more or less fixed elements, these other sympathies help to account for how things move from one place to another.

²⁰³ *Ibid.*, 373.

animal.²⁰⁴ This distinction holds true for Bernardin, as well, yet superficiality takes on quite other meanings in his work. No longer is the superficiality of the plant identical with the visibility of the plant's existence *per se*; instead, it manifests the invisible relationships which determine that existence. A potentially inexhaustible tally of relationships emerges in the plant's "thick" superficiality, each element of its form manifesting the pertinence of some proximal sympathy. "*J'ai donné par ces vues,*" declares Bernardin, in summarizing his work on plant morphology, "*le moyen de former des chapitres complets d'histoire naturelle, en montrant que chaque plante était le centre de l'existence d'une infinité d'animaux, qui ont avec elle des convenances qui nous sont encore inconnues.*" The reading of the plant's convenances alone would be an infinite task, the chapters of natural history in which they are written "complete" only in their acceptance as definite projects, their endings always deferred.²⁰⁵

This crucial difference between Bernardin's vegetal hermeneutics and taxonomies like Linnaeus' further emerges in Bernardin's scheme for a plant nomenclature. Rather than describing the specific differences of a plant's form relative to other similar forms, this nomenclature would describe the elements and animals with which a given plant most characteristically harmonized. In order to isolate these harmonies, Bernardin imagines a series of experiments linking plants to the places they grow best and to the animals in whom they arouse the strongest sympathies.

*Après avoir déterminé de la même manière les autres convenances humaines des graminées, avec différents sites de la terre, on chercherait les graminées qui ont des rapports marqués avec nos animaux domestiques, comme le boeuf, le cheval, la brebis, le chien. On les caractériserait par les noms de ces animaux. Nous aurions des graminées bovinum, equinum, ovinum, caninum. On distinguerait ensuite les espèces de chacun de ces genres, par les noms des différents lieux où ces animaux les retrouvent sur les bords des fleuves, dans les rochers, sur les sables, dans les montagnes, de sorte qu'en y ajoutant les épithètes, fluviales, saxatiles, arenosum, montanum, on suppléerait avec deux mots à toutes les longues phrases de notre botanique. On répartirait de même les autres graminées aux divers quadrupèdes de nos forêts, comme aux cerfs, aux lièvres, aux sangliers, etc."*²⁰⁶

²⁰⁴ *Les mots et les choses*, 289-91. Of course, the pursuit of many other kinds of natural science, some of them touched on in the genealogy of the spectacle above, suggests how much more varied the eighteenth-century sciences were than Foucault suggests. Mary Terrall and others have begun to work on the importance of "experimentation" during the Enlightenment in a way that promises to challenge the view engendered by Foucault. Much more remains to be done in the production of histories that are both discursively sensitive and encompass the broader scene of the eighteenth-century natural sciences.

²⁰⁵ *Études*, 576. The plant's materiality may additionally be thickened by other sympathies. "*On pourrait étendre sans doute leurs harmonies plus loin,*" Bernardin speculates, "*car beaucoup de plantes semblent avoir des relations, non seulement avec le soleil, mais avec les diverses constellations* (576)." Multiply determined by the *convenances* of its locale, the plant is also, here, determined by "analogies" with the stars.

²⁰⁶ *Ibid.*, 425-26.

In this nomenclature, the connections that an expert interpreter of Nature would be able to distinguish in plants' forms are spelled out in latinate names. The rudimentary expression of these connections in the nomenclature doubles the grammar of Nature, breaking up its continuous re-lays into a heuristic shorthand. Though Bernardin first stresses the particularity of grasses which enjoy a special relationship with humans, he goes on to posit various grasses' respective sympathies with oxen, horses, goats and dogs in a way that transforms them into norms. The strong sympathy a given grass shares with a cow, for example, becomes the standard according to which its sympathies with other animals are judged. Just as the idea of producing a nomenclature arises from the need to make the book of Nature useful, to name and norm its contents, the content of the nomenclature itself prizes utility over other concerns. Its anthropocentric character emerges in the precedence "human" grasses take over those enjoyed by other animals, as well the precedence grasses enjoyed by domesticated animals takes over those which share strong sympathies with wild animals.

Though the nomenclature in question encodes attractions rather than morphologies, the notion of elaborating a nomenclature at all betrays the influence of a natural history of "representation." Whether established on the basis of sympathies or structures, nomenclature makes possible the tabular display of similarities and differences which Foucault identified as characteristic of Enlightenment representation. The impulse to codify knowledge in this form occurs here, moreover, in conjunction with the impulse to make hermeneutics useful, for what counts in documenting the relationships condensed in a plant is eliciting the roles it might play in agriculture. Nomenclature thus instrumentalizes the links constituting a milieu, but the invention of a nomenclature is only one symptom of Bernardin's impulse to make knowledge useful. The science of milieu in which it participates undertakes the management of plant and animal populations on the face of the globe, conducing to the benefit of agriculture and occasionally of animals themselves. Bernardin proposes, we have seen, an importation of insect-eating birds from the Indian Ocean in order to supplement the faltering work of French field birds, and suggests that "*l'homme*" learn which insects wage war on other insects in order to multiply "*à son gré les familles d'insectes qui lui sont utiles, et parvenir à diminuer le nombre de celles qui font tant de ravages dans ses cultures.*" In learning how to manipulate milieux, says Bernardin, we might also eliminate the insects who torment Lapland reindeer by laying eggs in their skin, a phenomenon which Bernardin had himself witnessed in his travels and which suggests, he believes, that the providential balance of the reindeers' environment had been upset by man.²⁰⁷

As a technology of milieu, then, hermeneutics not only discloses the secret disposition of the globe as it is; it also permits us to re-organize the globe in new and useful ways. Having learned the logic according to which a thing occurs in a given place (its relationships with the "climate" as well as with the other living things around it) we can now predict where else in the world it might strike up productive sympathies. Even as Bernardin's science of admiration compels us to restore delight to the affects of Enlightenment-era sciences, this technology of milieu places the Enlightenment's ideal of progress through applied knowledge at the center of his science of admiration. In spite of Bernardin's own explicit aims, the hermeneutics of Nature which makes this redistribution of milieux possible hovers between a science of "sentiment" in pursuit

²⁰⁷ Ibid., 407.

of truth and beauty, and what he defines as its opposite, the science of “reason.” Summarizing his book, he writes, “*J’ai cherché . . . une faculté plus propre à découvrir la vérité que notre raison, qui n’est d’ailleurs que notre intérêt personnel. J’ai cru la trouver dans cet instinct sublime, appelé le sentiment, qui est en nous l’expression des lois naturelles, et qui est invariable chez toutes les nations.*”²⁰⁸ The exposition of a “hermeneutic” nomenclature is just one moment in the *Études* where the tension between a moral discourse on Nature and a progressive mode of natural philosophy becomes untenable. Latent in the anthropocentric perspective of the spectacle, the self-interestedness of admiration now comes to the fore.

The spectacle’s anthropocentric perspective is also, of course, a Eurocentric one. The admiration aroused by spectacle promotes affective mastery of the relationship between everyday European life and distant lands, occluding, in effect, the histories of exchange and exploitation mediating the metropole and the periphery. The spectacle furnishes the rhetorical tools to put otherwise far-flung objects in contact with one another in such a way that they can be read as naturally connected. This naturalization becomes admirable, paradoxically, precisely to the degree to which it strikes us as artificial. What gives pleasure is the spectacle’s capacity to coerce exotic elements into a “new” natural configuration, a function vividly realized in Bernardin’s proposal for a public park, where plants and animals from a diversity of climates might be assembled in a single place. In this proposal, the “*étude de la Nature*” is explicitly linked to the innovation of new “*jouissances*”:

*On pourrait trouver dans la France une montagne à glace qui aurait peut-être une vallée à réverbère à son pied. Ce serait une recherche très agréable à faire; on en pourrait tirer un grand parti. On en ferait un jardin public qui nous donnerait le spectacle de la végétation d’une multitude de climats, sur une ligne qui n’aurait pas quinze cents toises d’élévation. On pourrait y braver les ardeurs de la canicule à l’ombre des cèdres, sur le bord mousseux d’un ruisseau de neige; et peut-être les rigueurs de l’hiver au fond d’un vallon tourné au midi, sous des palmiers, et au milieu d’un champ de canne à sucre. On y naturaliserait les animaux qui sont les compagnons de ces végétaux. On y entendrait bramer le renne de Laponie, de la même vallée où on verrait les paons de Java faire leurs nids. Ce paysage réunirait à nos yeux une partie des tribus de la création, et nous donnerait une image du paradis terrestre, qui était situé, je pense dans une position semblable. En vérité, je souhaiterais qu’on étendît nos jouissances aussi loin que l’étude de la nature a portés ses recherches.*²⁰⁹

In tandem with a specific site--an ice-capped mountain with a light- and heat-reflective valley at its base--, the synoptic power of the spectacle forges the succession of seasons and the farthest reaches of the globe into a single, harmonious whole. The diversity of France’s climate becomes an argument in favor of mercantilist power, a place where the exotica of foreign lands--snow-covered moss and tropical sugarcane, cedars and palms, reindeer and peacocks--can find a new “home.” France, we sense, figures as the rare nation where such an experiment might be under-

²⁰⁸ Ibid., 461.

²⁰⁹ Ibid., 388.

taken, where extremes of cold and warmth are moderate enough to permit the coexistence of objects hailing from all over the globe and where the “tribus” of the world might be domesticated. The delight occasioned by the harmonization of such diverse objects derives in part from an intuition of the power that has effected it, particularly from the recognition that this power is the spectator’s own. Far from the passive tracing of local sympathies, Bernardin’s science of admiration reflects, here, the global reach of European exploration and colonization.

Key to sustaining this scenario is the spectacle’s capacity to elide agency from the things it represents or to privilege the representation of apparently passive things, like plants. Indeed, while plants form the center of an infinity of animal existences, as Bernardin affirms, nowhere do we read that animals likewise form the center of an infinity of plant existences. Foucault’s suggestion that the absence of “life” as an operative category in eighteenth-century natural history is expressed in the emblematic status of the plant during this period is echoed in Bernardin’s persistent botanism. Though the science of admiration differs discursively, I have argued, from Foucault’s sciences of representation, it nevertheless rejoins them in proliferating knowledge about the surfaces of things, not yet conceiving a notion of life “itself” as a flight line leading into the depths of the animal body. Bernardin’s claims that “*chaque plante était le centre de l’existence d’une infinité d’animaux, qui ont avec elle des convenances qui nous sont encore inconnues,*” highlights the ongoing inaccessibility of the animal. For if we are not yet aware of the *convenances* which shape the animal relative to the plant, we do know something, Bernardin has been striving to show, about how the plant is shaped relative to the animal.

In spite of the basic mystery animals continue to pose, skin, feathers, fur and scales proliferate in the *Études* as possible means of discovering animals’ affinities while suppressing the potential self-determination of their “tribes.” To the extent that this perspective on animals holds fast, they are no different than the plants whose fruits, flowers and leaves give away their own unchanging sympathies: “*Ce serait en rapportant les diverses tribus d’insectes aux diverses parties des plantes,*” affirms Bernardin, “*que nous verrions les raisons qui ont déterminé la nature à donner à ces petits animaux des figures si extraordinaires.*” One might match butterflies and flies with proboscis to the nectar of the flower, for example, bees and flies with hairy legs to the pollen, and flies with sharp, hollow spikes on their legs to the leaves whose surfaces they pierce and juices they imbibe.²¹⁰ Yet now and again animals’ vitality threatens the exegesis of Nature, re-writing the text before it can be read or spoiling its legibility altogether. Indeed, Bernardin’s claim that we do not yet know anything about animal sympathies sounds less like a call to explore their surfaces than an admission that reading these surfaces cannot really help us know the animal. Moments when vitality pierces through animal surfaces tend to throw the whole regime of sympathies into a state of contingency, revealing the world they knit together as just one milieu among many possible others, a milieu of human, or even, particularly, European values. Very rarely, Bernardin seems to embrace that contingency, as when his gaze settles on the flies buzzing around a potted strawberry plant resting on his sill.

*Les unes abordaient sur cette plante pour y déposer leurs oeufs;” we read,
“d’autres, simplement pour s’y mettre à l’abri du soleil. Mais la plupart y venaient pour*

²¹⁰ Ibid., 400.

*des raisons qui m'étaient tout à fait inconnues; car les unes allaient et venaient dans un mouvement perpétuel, tandis que d'autres ne remuaient que la partie postérieure de leurs corps. Il y en avait beaucoup qui étaient immobiles, et qui étaient peut-être occupées, comme moi, à observer.*²¹¹

In this passage, the flies are no longer determined by their milieu, their various styles of movement suggesting the distinctive ways they inhabit their environments and the many potential motives they may be pursuing there. The empathic style of observation Bernardin discovers here differs from the enjoyment of the spectacle's grand effects. What Bernardin succeeds in imagining is the kind of vision a flies' organs might induce, their capacity to see, thanks to the peculiar nature of their eyes, "*une distribution et un ensemble de parties que je ne pouvais observer que séparées les unes des autres,*" he says, "*et successivement.*"²¹²

Ultimately, flies' vision itself crystallizes the spectacle of Nature, because their eyes, we learn, are "*à la fois des microscopes et des télescopes*" and suited, therefore, to perceiving the small and the grand together in the synoptic style of the spectacle. Yet by considering the flies' vision as a function of their particular biological apparatus, Bernardin identifies them as beings who not only look but actually observe, and who may even be observing *back*. No longer fully determined by natural sympathies, the fly suddenly becomes an autonomous being, its action in its environment emerging, in Canguilhem's terms, as the potential of its particular kind of living. In this, it resembles the hedgehog which emblemizes Canguilhem's concern for the autonomy of "the living," where the living is conceived of as both a thing (either an ontogenetic or phylogenetic entity, individual or "species") and as a potential (the particular manner of living which the individual or life form is capable of). "Hedgehogs as such do not cross roads:" Canguilhem observes, "they explore, in their own hedgehog way, their own hedgehog milieu, on the basis of their alimentary and sexual impulses."²¹³ In the jostling of the fly's perspective, what flashes through Bernardin's text is a knowledge of living construed as the attempt to "grasp a becoming," as Canguilhem writes, "whose meaning is never so clearly revealed to our understanding as when it disconcerts it."

For Canguilhem, the goal of a science of life should be to know the potential of the living. Bernardin's own ideas about the kinds of knowledge that might be produced about animals sometimes teeter along the divide between a notion of milieu as a function of living and a notion of existence as a function of milieu. Like Canguilhem, Bernardin decries the experimental methods of vivisectionists for reasons that seem as much epistemological as they do ethical. In view of realizing that vegetable nomenclature, for example, Bernardin imagines experiments in which animals would be presented with a range of grasses and allowed to gravitate toward the one with which they felt the greatest affinity. "*Ces premières déterminations demanderaient quelques expériences à faire sur les goûts des animaux,*" he writes, "*mais elles seraient fort instructives et très amusantes. Elles ne seraient pas cruelles, comme la plupart de celles de notre physique*

²¹¹ Ibid., 53-55.

²¹² Ibid., 54.

²¹³ "Experimentation in Animal Biology," *Knowledge of Life*, 22.

moderne qui les écorche vifs, les empoisonne ou les étouffe, pour connaître leur naturel. Elles ne s'occuperaient que de leurs appétits, et non de leurs convulsions."²¹⁴ This proposal evokes a science of the "normal" in living things, in the spirit called for by Canguilhem, where the "originality of biological method" is valued in place of those methods (like vivisection, dissection and laboratory experimentation) imported from or influenced by the hegemony of the exact sciences.²¹⁵ In Bernardin's notion of an animal science that seeks to know the "*naturel*" of the living thing, we can hear anticipations of Canguilhem's appeal for a science that would take place outside the distorting confines of the laboratory in order to elicit, "within the organism itself," as he puts it, "the sense of the organism's choice--when free in its milieu--to seek sustenance in such and such species or essences while excluding others that could, theoretically speaking, procure it equivalent energetic provisions for its maintenance and growth."²¹⁶ In eliciting the *naturel* of the animal, Bernardin's notional experiment might well seem to verge on discovering something fundamental about the style of its "living," and perhaps secondarily about life itself. Yet Bernardin's own sympathies lie neither with the animals in question, nor even with the plants, but rather with the affinities between the two. The experiments are designed to determine what in the oak-tree spectacle Bernardin had named the "*rappports déterminés et caractéristiques*" of the snails and squirrels with the surrounding vegetation, the *naturel* of the animal expressing nothing more than the sympathies it enjoys with the anthropo-geographical milieu. In so doing, the experiments wish to construe animals as precisely that "crossroads of influences," to which Canguilhem insisted living things were not reducible, whether that crossroads be the play of sympathies or the physico-chemical environment. Without penetrating the animal body to see just how it transforms plant matter into flesh for our consumption, as a vivisectionist might, we can be content in Bernardin's scheme with having matched the cereal with the site and the animal with the cereal, watching in the evening as our animals abandon "*les différents sites de la végétation,*" to return to "*l'habitation de l'homme, avec des bêlements, des murmures et des cris de joie, en lui rapportant les doux tributs des plantes changées, par une métamorphose inconcevable, en miel, en lait, en beurre, en oeufs et en crème.*"²¹⁷

For Canguilhem, both the study of digestion and these magical transubstantiations omit the "sense" the animal projects along with its activity in its milieu, what he defines as "an appreciation of values in relation to a need."²¹⁸ In Bernardin's experiment, Canguilhem would want to know not just *that* the animal picks such and such a grass over another equally available one but also *why* it does so. Proposed in the context of a nomenclature that seeks to codify relationships useful to agriculture, the experiment places the elicitation of the animal's *naturel* quite clearly in the domain of human need. The capitalization of animals takes precedence here over the knowledge of life. Indeed, Bernardin's disinterest in the question of "life" as such is not only expressed

²¹⁴ *Études*, 426.

²¹⁵ "Experimentation," 21.

²¹⁶ "Introduction: Thought and the Living," *Knowledge of Life*, xx.

²¹⁷ *Études*, 427.

²¹⁸ "The Living and its Milieu," 120.

in the rarity of those moments where the potential of “*le vivant*” emerges (perhaps, indeed, just once in that exceptionally perceptive fly), but also in the almost total absence of attention to the problem of “*génération*” which had fascinated eighteenth-century experimental natural history.

Yet Bernardin’s science of the local does sometimes make space for the locale of the animal, if only to acknowledge how deeply lost it is to human experience. In exception, for instance, to animals’ dual submission to the charms of plants and the service of humans, there are moments when the radical strangeness of animal harmonies slips into the text. As with the flies on the strawberry plant, we sometimes get a sense of the unknowability of the motives animals pursue. We might be able to understand the “*amitiés*” and “*inimitiés*” which form among animals “*dans la société*,” Bernardin speculates, but not those which are “*innées*,” whose causes “*sont d’un autre ordre et d’un autre monde*.” Here at last he seems to peer into the recesses of life, identifying the animal’s instinct with the source of radically other values and needs, and the habitation of “*un autre monde*.” “*Comment tant d’animaux*,” he pursues, “*sont-ils entrés dans la vie avec des haines sans offense, des industries sans apprentissage, et des instincts plus sûrs que l’expérience?*” Yet the radical “elsewhereness” of the animal is quickly swept up again in the providential allure of the anthropo-geographic milieu. “*Comment la puissance électrique a-t-elle été donnée à la torpille*,” he asks, “*l’invisibilité au caméléon, et la lumière même des astres à une mouche?*”²¹⁹ Bernardin goes on to admire the water spider’s ability to travel “*à l’ombre des nymphaeas*” in a bubble resembling “*un globule de vif-argent*,” and occasionally to merge bubbles with potential mates, powers which, if imitated by a human inventor, he marvels, would vault him to the status of a god. In the fantasy of these submarine diversions we can distinguish the recuperation of the animal’s radical otherness by human technology, its assimilation to man as the center of the world milieu. The centrality of man is implied where the animals’ faculties are construed as “gifts,” characteristics providentially distributed by the Author of the world and expressive of the sympathies the animal shares with it.²²⁰ At the same time, it seems symptomatic that the problem of the animal should force Bernardin to rummage more deeply in the repertoire of sympathies than his work on plants had done. In the mirroring of starlight in fireflies’ bodies, Bernardin abandons *convenances* in favor of *analogies*.²²¹

²¹⁹ *Études*, 407.

²²⁰ Elsewhere, Bernardin conceives of human nature as a conflation of animal instinct and the sentiment of Divinity. Though Bernardin attributes something tantamount to “reason” to animals as well as humans, he protects humankind’s distinction by attributing the sentiment of admiration to it alone. Even without “*les sentiments ineffables de la Divinité*,” writes Bernardin, humans would have the same ability to recognize patterns in Nature as animals do. “*C’est à ce dernier instinct*,” he affirms of sentiments of Divinity, “*bien plus qu’à sa réflexion, qu’il doit le témoignage de l’existence de Dieu; car je suppose qu’ayant par sa raison la faculté d’apercevoir les convenances qui sont entre les objets de la nature, il trouverait les rapports qui existent entre une île et un arbre, un arbre et un fruit, un fruit et ses besoins, il se sentirait bien déterminé à la vue d’une île à y rechercher sa nourriture*.” Likewise, “*Un loup qui passe une rivière à la nage pour aborder dans une île où il aperçoit de l’herbe, dans l’espérance d’y trouver des moutons, conçoit également les chaînons de quatre relations naturelles entre l’île, l’herbe, des moutons, et son appétit; mais il ne se prosterne point devant l’être intelligent qui les a établis* (441).” In this passage, animals’ ability to recognize relations of proximity in Nature means that human and animal natures are deeply commensurable; both humans and animals must decipher the sympathies of Nature in order to sustain themselves.

²²¹ Bernardin does evoke the role of analogies in the existences of plants, as I have pointed out, but their appearance here, in a series of questions about the mysteries of animals’ bodies, seems symptomatic of the specific epistemic challenges animals pose to the regime of *convenances*.

In Bernardin's science of the local, knowledge traverses Nature by means of narrow paths, telling the biographies of the assemblages it encounters rather than reducing them to evidence for the telling of a single story, as he argues the exact sciences do. Where the mathematical formulae of the exact sciences mediate the resolution of the particular into the general, the spectacles of the science of admiration mediate only the oscillation between the local and the global. What the particular and the universal lack is the sense of "place" retained by the local and the global. Within the oscillation between these latter, the local is never entirely relieved of its global dimensions, and the global is always conceived of as localizable. This scenario departs considerably from that organized by the exact sciences, in which the result of an experiment, for example, is ultimately meant to give rise to or confirm a universal law. The condition of replicability means that the experiment has no meaning in itself, only the capacity to serve as evidence for a general rule. Yet it is precisely the discrete fascination exerted by the singular event in Nature, disclosing the activity of local sympathies, which underpins Bernardin's terrestrial hermeneutics.

Although the paths cleared by the science of admiration err across the globe, they never lead anywhere new. Plants come to emblemize this surprising stasis, for just as their superficiality serves as a proxy for natural history, a science devoid of the depth of "life," their rootedness serves as a proxy for a fixed, unchanging world. The magpie nature of earthly hermeneutics compels it to amass wonders which decenter that world, however, and set it, as if in spite of itself, in motion. We have already seen how the evocation of animal elsewhere disrupts the spectacular gaze, de-centering the human milieu in the sudden knowledge of "*un autre ordre et un autre monde*." Though the *convenances* of plants are mostly irreversible for Bernardin, explaining why animals and humans are attracted to them but not how or why plants might be attracted to animals and humans, we briefly encounter other, dynamic plants in the *Études*, cosmopolitan plants "*qui voyagent, et qui ne font que parcourir la terre*," "*apparitions végétales*" which like some birds or fish may only reappear after a lapse of a few days, or perhaps even a few years.²²² Definitely absent in Bernardin is anything like the mutual becoming of an orchid and a fly, as set in motion, for example, by Deleuze and Guattari.²²³ Yet we do likewise read an anecdote from the work of an anonymous missionary, who reports that "*les indiens*" believe coconut palms found at the bases of houses grow more beautifully than elsewhere, "*comme si ces arbres utiles se réjouissaient du voisinage des hommes*."²²⁴ This anecdote seems symptomatic of Bernardin's science, a tale culled from the global exploits of a traveler, the mutual becoming of palm and human recuperated by the anthropocentrism of the palms' "utility," the local knowledge of the "*indiens*" both embraced and distanced. In the mass of "*descriptions, conjectures, aperçus, vues, objections [et] doutes*" swallowed up by the hermeneutic text, spectacular vision is occasionally disturbed, the earthly text lightly interrupted, the admirable world briefly shaken into motion. In these antagonistic moments, perhaps, above all, the *Études de la nature* remains a "local" text.

²²² *Études*, 384.

²²³ *Mille plateaux* (Paris: Éditions de minuit, 1980), 17.

²²⁴ *Études*, 417-18.

V. *The Weight of the World: Engineering the Globe in the Études de la nature*

Bernardin's science of the earth achieves a global scope, but the science of the *globe* inevitably poses the problem of the "colossal." The globe's sheer enormity evades ordinary modes of visibility, defying any one spectator's attempt to witness it as a unified whole. While the concluding hymn of Bernardin's "Préambule" to *Paul et Virginie* evokes "*le spectacle infini*" of the cosmos, all witnessed "*dans un instant*," many passages of the *Études de la nature* strive to evoke the earth as a distinct, dynamic globe, one whose sheer enormity and capacity to change through time exceed the aesthetic virtues of the spectacle. In the "Préambule," the spectacle of the cosmos serves to refute the professionalized values of Newtonian astronomers, but in these passages of the *Études*, Bernardin's anti-Newtonianism takes the new form of a science of the globe. This shift from earth to globe implies a shift in the status of spectacle, as well. For while the spectacle remains an important element in the representation of the globe in Bernardin, the know-how of the engineer rushes in in those places where, faced with the problem of the colossal, the spectacle's virtues wane.²²⁵ With the advent of the problem of the colossal, the situated experience of the world implicit in the natural histories of Réaumur, Pluche and Buffon emerges into the open, the importance of "feeling" in this tradition encompassing, finally, not only the *sentiment* of admiration but also its touch. Indeed, Bernardin's attempt to bring the globe into view incites what might be called an "anthropometric" approach to the understanding of the earth's forms and patterns, in which the human body becomes the reference point for the measurement of colossal phenomena. While gauging the size of these phenomena through an implicit hexis of human body and global-scale masses departs from a strict use of spectacle as an instrument of sentimental *admiration*, it also departs from the Newtonian vision of the globe as a geometric form shaped by physical forces. In keeping with an anthropo-geographic bent, Bernardin shows instead that it is through an understanding of the connections that bind geological formations, tides, rivers, seas and clouds into a dynamic whole, and not through the calculation of abstract forces, that the earth can be envisioned as a "globe."

In these passages of Bernardin's "*science à venir*," one kind of appreciation, that is, makes room for another. Where the enormity of the globe dispels the spectacle's aesthetic virtues, the sentimental appreciation elicited by the spectacle gives way to the estimation of quantities. The physical character of these estimated quantities--of rainfall, elevations, distances--calls into doubt Bernardin's adherence in these passages to a science of pure "moral evidence." Instead, the sentiment of admiring Nature, which had itself signaled a providential sympathy be-

²²⁵ In *Colossal: Trancontinental Ambition in France and the United States during the Long Nineteenth Century*, Darcy Grimaldo Grigsby borrows definitions of the notion of the "colossal" from Aristotle and to Kant. For Kant, she writes, the colossal is the "presentation of a concept which is almost too great for presentation" and that therefore "borders on the relatively monstrous." For Aristotle, the colossal cannot be beautiful because it escapes the point of view of a single spectator: "As the eye cannot take it all in at once, the unity and sense of the whole is lost for the spectator; as for instance if there were one [entity] a thousand miles long." Grimaldo Grigsby documents the engineering feats of the nineteenth century as historically remarkable attempts to grapple with the conception of the colossal. In his notion of the globe, Bernardin, too, "engineers" a conception of an impossibly big object. As for Kant, Bernardin's globe figures as an object too big to coalesce as a concept, and as for Aristotle, it evades attempts to take it in from any one perspective. (Pittsburgh, PA: Periscope Press, 2012), 17.

tween the order of Nature and the human being, coexists with the impulse to quantify it. The evidence Bernardin cites in support of the theory of the globe is often strictly physical in character, but it nevertheless buttresses a vision of the world as an anthropo-geographic milieu. The values of “appreciation” in this second, quantifying sense correspondingly conflict with those of the “exactitude” practiced by the rational mechanical Newtonians whom Bernardin combats. Whereas the rough estimation of quantities suffices in the first, extreme precision becomes a desiderata and a source of increasing prestige in the second. (These aspects of exact science are further explored in Chapter Two). In this way, Bernardin’s science of the globe reiterates the determination to depict the world as a “centered, qualified” milieu, a place in which the projection of values generated by human living has been reified.²²⁶

Spectacle does not disappear from the portions of the *Études* devoted to the science of the globe. In places, it even continues to function as a semiological principle, inciting the spectator to decipher the accidents of the globe as entries in the book of Nature, just as it had also manifested, as we have seen, the sympathies ordering the ensembles of plants, animals, elements and terrain depicted in Bernardin’s science of plants. Bernardin’s gaze sweeps over the surface of the globe: “*Chaque fleuve remplit son urne, et chaque naïade sa coquille,*” he intones. “*Chemin faisant, ils déploient sur les plaines liquides de la mer la variété de leurs caractères. Les uns rient à peine la surface de ses flots; les autres les sillonnent en ondes d’azur; d’autres les bouleversent en mugissant, et couvrent d’écume les hauts promontoirs.*” The sea’s surface figures the page on which Nature’s “*caractères*” are inscribed, however ephemerally: ripples, furrows, surges, spume. “*Parcourez à votre gré un méridien ou un parallèle,*” he continues, “*vous y trouverez des montagnes à glace et des montagnes à feu, des plaines de toutes sortes de niveaux, des collines de toutes les courbures, des îles de toutes les formes, des fleuves de tous les cours; les uns qui jaillissent et semblent sortir du centre de la terre; d’autres qui se précipitent en cataractes, et paraissent tomber des nues. Cependant ce globe, agité de tant de mouvements, et chargé de poids en apparence si irréguliers, s’avance d’une course ferme et inaltérable à travers l’immensité des cieux.*”²²⁷ The bird’s eye survey launched by the incitement “*Parcourez*” draws on the rhetoric of spectacle to condense the globe’s expanses into imaginable form. Like other instances of the spectacle, this expansive tour emphasizes the plenitude of the globe by evoking the diversity of forms and events that can be observed on its surface, even as the passage’s parataxis enacts this profusion rhetorically.

Within this spectacle, the earth’s cataracts emerge as characters, just as do the ridges of its waves, the slopes of its hills, the contours of its islands, and the ribbons of its rivers. These characters take shape within an evocation of the spectacle’s absorptive properties, but the meaning of the characters is no longer evaluated according to the relationship between place and form suggested by *convenances*, as it had been in the natural history of plants. Instead, the characters register shifts in weight, proportion and place, manifesting an extraordinary profusion of forms and flows at the surface of the earth’s body. Just as the dense network of relationships out of which the plant is woven is manifested in the form of its leaves, the thick materiality of the globe is manifested in the shapes and events at its surface. But while the *convenances* the plant shared

²²⁶ *Knowledge of Life*, 116.

²²⁷ *Études de la nature*, 86.

with the plants, animals, elements and terrain around it sufficed to explain its form, no such principle serves to explain the shape of the globe. The forms of other planets, for example, do not enter into the calculation of the globe's "*poids irréguliers*." Though *convenances* appear in Bernardin's science of the globe, new sympathies of transformation and displacement emerge to account for the dynamism of the globe. The sun transforms the ocean's water, for example, into fantastic shapes, "*des voiles d'or et des pavillons de soie*," "*horribles dragons*," or "*lions rugissants*," which redistribute vapor such that "*chaque partie de la terre*," we read, "*n'en reçoit, tous les ans, que sa portion d'eau accoutumé*."²²⁸ The courses of these clouds are determined not simply by winds but also by forces like the "*attractions élémentaires*" emitted, Bernardin speculates, by metals enclosed in mountains. "*Les pitons des montagnes et leurs longues crêtes sont remplis*," he ventures, "*. . . de fer ou cuivre, mélangé d'un corps vitreux, de granit ou de quartz, qui attire les pluies et les orages comme de véritables aiguilles électriques*."²²⁹ Though Bernardin asserts that "*aucune loi de magnétisme, de pesanteur, d'attraction, d'électricité, de chaleur ou de froid ne gouverne le monde*,"²³⁰ this is not because he doubts their existence, it seems, but because he does not believe they govern *as laws*. In contrast to the roles they play in Newtonian physics, they exercise, in Bernardin's view, an unpredictable, strictly local agency, regulating the elements at one site of the globe but not another. Magnetism, gravity, attraction, electricity, warmth and cold: these fixtures of the exact sciences' explanation of physical mechanisms are subsumed under the local character of the science of admiration. Where Bernardin's own *convenances* seemed to give rise to a total global grammar, useful in predicting the connections between form and place at one site as at another, these other sympathies seem tailored to describe things that refuse to stay put, including the anthropo-geographic globe itself.

While the passage in which Bernardin urges us to peruse the earth's surface ends by asserting the regularity of the globe's movement in space, it makes no attempt to correlate this regularity of motion with the globe's irregularity of form. Indeed, Bernardin seems at a loss to explain why dramatic redistributions of the globe's weight do not ultimately throw it off course. The characters that emerge as legible within the spectacle seem to lose their legibility as elements of the whole globe here, powerless to reveal how the globe maintains its course. This disconnect seems rooted in the transition in this passage from the global vision achieved by spectacle and a vision of the globe as a whole. While the spectacle's ability to mediate between the local and the global had been predicated on its absorptive properties, the obtuseness of the globe seems to dispel them.²³¹ In Bernardin's science of natural environments, the spectacle brings together the globe and the spectator, making it possible to master the strangeness and profusion of

²²⁸ Ibid., 86.

²²⁹ Ibid., 325.

²³⁰ Ibid., 83.

²³¹ In *Absorption and Theatricality: Painting and Beholder in the Age of Diderot*, Michael Fried defines absorption as an aesthetic principle that acts to dissolve the distinction between spectator and image, eschewing overt theatricality and naturalizing the relationships it establishes between the spectator and the objects of the spectacle. This capacity to absorb the spectator into its recesses while naturalizing the perspective of the spectator characterizes the spectacle as a rhetorical set-piece in the *Études de la nature* as well. Formally speaking, the spectacle is "concave" while the globe is convex. (Berkeley: University of California Press, 1980).

earthly things from a single, perspectival vantage. This capacity emerges, as we have seen, in passages where Bernardin imagines exotica from the world over condensed into a single scene--mountains and lowlands, lichens and sugar cane, reindeer and peacocks all coexisting thanks to the virtues of spectacular vision. But in taking the globe itself as an object, Bernardin forfeits these very virtues.

Bernardin's theory of the globe will attempt to remedy precisely this disconnect. In the *Études*' science of the globe, Bernardin continually wavers between earth and globe, or between a vision of the globe as an aggregate of milieux and a vision of the globe as a form in space. In attempting to reconcile these two visions, Bernardin posits the globe's form and movement, in effect, as functions of its status as milieu, even as the conditions of its milieu likewise reflect, for him, the globe's form and movement. The spectacle acts powerfully here to bridge the divide between earth and globe, even if it cannot quite close it. In this role, it takes on a different epistemological status than the one it occupied in the science of environments. The evocation of a bird's eye tour of the globe places spectacular rhetoric at the service of an impossible perspective, functionally distinguishing it from the spectacles of plants and animals that elsewhere take shape from a plausibly human point of view. Given the fictive nature of this perspective, spectacle remains secondary to the actual observations that have been made by humans of the forms and events of the earth's surface. Though notional, it continues to cast the world's details as characters to be interpreted, linking them, this time, to the construction of global-scale meaning. In the science of the globe, spectacle serves to link the characters inscribed on the globe's surface with its movement as a whole, even when the means of witnessing these links remain elusive.

As this persistent gap suggests, the problems posed by the theory of the globe do not all lend themselves to this deployment of the spectacle and its attendant hermeneutics. As part of the attempt to link mobility on the earth's surface with the mobility of the globe itself, Bernardin calls on the questions and techniques of the pre-geological earth sciences, as well as the forces of Newtonian-style physics. Just as he recasts the weight, attraction, electricity and other physical phenomena of Newton-inspired physics as local effects, he also subsumes the methods of the so-called "theory of the earth" to the reading of the earth's activity in certain times and places.²³² Prior to the emergence of geology as a scientific discipline, the "theory of the earth" existed as a genre of scientific writing, preoccupied with causal explanations of the earth's physical characteristics.²³³ Like the savants who contributed straightforwardly to this genre, Bernardin attempts to develop a natural history of the earth itself. Yet the names and ideas of these writers remain conspicuously absent from the *Études*, an aloofness that registers Bernardin's social distance from the savants who were working to develop a science of the earth in his day, as well as, per-

²³² In this chapter, I refer to Bernardin's "science of the globe" to distinguish his work from the "theories of the earth" developed by many of his contemporaries.

²³³ In this case, the notion of a genre designates a common set of problems rather than a set of formal characteristics, for though the theory of the earth produced by Jean-André Deluc (1727-1817), for example, appeared in series of public letters (the *Lettres physiques et morales sur l'histoire de la terre et de l'homme, adressées à la Reine de la Grande Bretagne* or the *Lettres à Delaméthérie sur l'histoire de la terre*, and other series published between 1778-1798), the *Théorie de la terre* (1795, 1797) of Jean-Claude Delaméthérie (1743-1817), like the famous *Theory of the Earth* (1788) of James Hutton (1726-1797), unfolded in the form of a treatise. See Martin Rudwick, *Georges Cuvier, Fossil Bones and Geological Catastrophes: New Translations and Interpretations of the Primary Texts* (Chicago: University of Chicago Press, 1997), 5-6.

haps, the very different aims that inform his own study of the earth. For even as Bernardin, like Jean-André De Luc (1727-1817), Jean-Claude Delaméthérie (1743-1817) or James Hutton (1726-1797), “reads” the shapes of land formations and the distributions of rock and fossil strata, he is not chiefly interested, as they are, in determining how geological formations came about. He does not reconstruct the events that led to the presence of a rock outcropping in a field, for example, or to the stratification visible on a cliff face. Whereas writers on the theory of the earth generally assume no necessary connection between a geological event and the story of the globe as a whole, Bernardin’s interest in geological formations remains subordinated to the goal of determining the globe’s shape and movement. Bernardin expatiates in places on the revolutions of land and sea, but his focus remains squarely on the globe. What matters more to him than determining the history of a particular locale or explaining the origins of fossils for their own sakes is interpreting these histories as signs of the globe’s form and motion.

In spite of Bernardin’s reticence about the theory of the earth as it was practiced in his day, what links his work and that of Deluc or Delaméthérie is the method of “reading” common to them both. Writers on the theory of the earth interpreted patterns of mineral strata and fossil distribution to reconstruct the history of a locale or predict the likelihood of co-occurring minerals, and modern geology is still predicated on this practice of “stratigraphic correlation.”²³⁴ In a similar way, Bernardin interprets European geology as the result of a period in which “*couches horizontales*” consisting of “*les débris et les glutens d’une infinité de poissons, d’oursins, de fucus, de coquillages, de coralloïdes*” were deposited by the ocean. (Chinese geology, on the contrary, is characterized by “*des lits de terre végétale, de trois à quatre cent pieds de profondeur,*” deposited by the floods as they swept eastward over Eurasia).²³⁵ The presence of “elephant” fossils in Siberia likewise implies the flood that swept them there. These interpretations of the “*infinité de traces*” that can be discerned “*sur la surface et dans le sein de la terre*” are inductive in nature, construing physical particulars as evidence for a general theory. Insofar as this theory is a causal one, the style of “reading” practiced in these passages of the *Études* seems to differ from the hermeneutics in view elsewhere. The particulars comprehended in the hermeneutics of Nature are intended as evidence only for the basic harmony of a providentially organized world, not as evidence for a diachronic reconstruction of how the earth came to be as it is. The hermeneutics aims to show that in the order of the world a necessary relationship existed between one particular and another, while also revealing the nature of the relationship in question (*convenance*, analogy or antipathy, for instance). Rather than working as an exposition of what is already there, on the contrary, Bernardin’s mineralogical readings draw on the agency of causality to reconstruct historical events.

Both “reading” and “spectacle” take on different meanings, then, in Bernardin’s science of the globe. Natural signs are amenable to being read without the agency of the spectacle, and the speculations these natural signs inspire functionally precede it. Just as in Buffon’s theories of matter and generation the spectacle had made it possible to visualize independent assumptions

²³⁴ On stratigraphic correlation, see Noah Heringman, “The Rock Record and Romantic Narratives of the Earth” in *Romantic Science: The Literary Forms of Natural History*, ed. Noah Heringman (Albany, NY: State University of New York Press, 2003), 56-57.

²³⁵ *Études de la nature*, 129.

about physical causality, the spectacle works here to depict events reconstructed through the reading of the rock record.²³⁶ In these passages, spectacle merely dramatizes the inferences suggested by the distribution of mineral and fossil debris. Bernardin's speculations about the meaning of fossil strata trigger, for instance, the dramatization of a catastrophic flood: "*Des îles entières de glaces flottantes, chargées d'ours blancs, vinrent s'échouer parmi les palmiers de la zone torride; et les éléphants de l'Afrique furent roulés jusque dans les sapins de la Sibérie, où l'on retrouve encore leurs grands ossements. . . . Tout fut englouti dans les eaux: cités, palais, majestueuses pyramides, arcs de triomphe chargés des trophées des rois; et vous aussi qui auriez dû survivre à la ruine même du monde, paisibles grottes, tranquilles bocages, humbles cabanes, asiles de l'innocence!*"²³⁷ Like Hutton, Bernardin believes that "we must read the transactions of times past in the present state of natural bodies," though the "times past" which the spectacle bodies forth in Bernardin's natural history correspond to the short *durée* of natural theology rather than the long of Hutton's theory.²³⁸ The ruins of palaces and the displaced fossils of polar bears and African elephants alike bear witness to these catastrophic "transactions," the extraordinary spectacle of polar bears surfing southward and elephants tumbling northward only animating previously drawn inferences.

The references to floods in these passages not only work to situate Bernardin's natural history within the foreshortened duration of Biblical time, but also to foreground the mechanical agency of water in Bernardin's science of the globe. Bernardin's allusions to civilizations swept away willy nilly by the fury of the sea establish the Biblical flood as a point of reference for his own readings of minerals and fossils, even as he departs from strict adherence to Biblical lore by positing the advent of many such floods: "*Chaque couche de nos fossiles,*" he declares, "*fut le résultat d'une marée universelle.*"²³⁹ At the same time as water links Bernardin's natural philosophy to Genesis, it also emerges as the material entity that might replace the abstract forces of "attraction" in a non-Newtonian theory of the globe. Bernardin's contempt for the abstractions of Newtonian forces and implicit preference for the agency of a real, material substance correspond to the distinction between rational-mechanical and anthropo-geographic notions of milieu. For if

²³⁶ On the notion of the rock record, see Heringman, "Chapter Four: The Rock Record, Mineral Wealth, and the Substance of History" in *Romantic Rocks, Aesthetic Geology* (Ithaca, NY: Cornell University Press, 2004), 161-190.

²³⁷ *Études*, 129.

²³⁸ On Hutton's mode of reading rocks, see Noah Heringman, *Romantic Rocks, Aesthetic Geology*, 113-14.

²³⁹ In reconciling mineral and fossil interpretation with Biblical legend, Bernardin was not alone in his moment. Deluc similarly anchored his theory of the earth in Biblical lore, as the title of his *Lettres adressées à M. le professeur Blumenbach, renfermant de nouvelles preuves géologiques et historique de la mission divine de Moïse atests*. But Bernardin's use of Biblical legend is an odd mix of orthodoxy and originality. He takes great care, for instance, to reconcile his theory of universal floods with the forty days and forty nights of rain specified in Genesis. "*Cette pluie, comme nous l'avons dit,*" he insists, "*fut le résultat des vapeurs qui s'élevaient de la fonte des glaces, tant terrestres que maritimes, et de la zone d'eau que le soleil parcourait alors au méridien. Quant au terme de quarante jours, ce temps nous paraît suffisant à l'action vertical du soleil sur les glaces polaires, pour les mettre au niveau des mer, puisqu'il ne faut guère que trois semaine du voisinage du soleil au tropique du cancer, pour fondre une bonne partie de celles de notre pôle*" (130). At the same time, he insists that rain alone could not have caused the flood in question, and multiplies the number of such floods to account for the many layers of fossils found in the earth. For more on the role of the Biblical flood in eighteenth-century natural history, see Marie Susana Séguin, *Science et religion dans la pensée française du XVIIIe siècle: le mythe du Déluge* (Paris: Champion, 2001).

the medium of Newtonian physics is pure in-betweenness, as Canguilhem affirms, water figures a medium that, in its solubility, mimics that pure in-betweenness while also remaining present to sensation, accommodating the impurities of history, floating the ships of voyagers and, as we have already seen, embodying the pages on which Nature's own signs can be inscribed.

Like Buffon, Bernardin refers to two Newtonian forces, "attraction" and "projection," corresponding to centripetal and centrifugal forces. In Newtonian cosmology, these forces account for the relationships of celestial bodies among one another while also underpinning the prediction that the Earth, as a semi-solid rotating sphere, will be flattened at its poles. In spite of the seeming successes of universal gravitation in describing the relationships among the planets and the shape of the Earth, Bernardin rejects its very premise. "*Ces forces combinées,*" he asserts, in reference to "attraction" and "projection," "*ne sont pas plus les mobiles de la course des astres que les cercles de la sphère n'en sont les barrières. Ce ne sont que des signes qui ont, à la fin, remplacé les objets qu'ils devaient représenter.*"²⁴⁰ The "signs" by which the physical sciences represent the respective ambits of stars and earth omit what it is essential to know about them, namely, the uneven, irreducibly singular character of the spaces through which they pass. For Bernardin, science must reject languages of convention in order to elicit the natural language relayed all around us. Rather than expressing the character of space itself, however, the signs of mathematical computation signify only within a conventional system. In Bernardin's view, these forces remain inimical to the order of Nature because, in keeping with the mode of "representation" and in conflict with that of hermeneutics, they function only in an order which supposes a break between signifier and signified, the natural phenomenon and the mathematical symbol that describes it.

In response to Newtonian abstraction, Bernardin elaborates a "realist" theory in which the size and movement of the globe can be inferred by sensuous signs. This realist theory takes the human body as its primary point of reference both by establishing the sensible character of the signs according to which the globe can be known and by assuming the proportionality of globe and body. In attacking the abstraction of Newtonian forces, Bernardin characteristically shrinks the debate down to the scale of the human body. "*Il ne me paraît pas plus naturel de former le mouvement uniforme de la terre dans les cieux, des deux mouvements de projection et d'attraction,*" he objects, "*que d'attribuer à de pareilles causes celui d'un homme qui marche sur la terre.*"²⁴¹ Though Bernardin laments his inability to produce a whole cosmology, limiting his speculations to the size and shape of the Earth, he establishes an analogy of proportion here between the earth and the other celestial bodies, on the one hand, and "*un homme qui marche*" and the things he encounters on his walk, on the other. It would be a mistake to assume that because Bernardin likens the causes of the Earth's movements to those of the man's he is attributing "vitality" to the Earth here, for rather than extending human qualities to the globe, he is in fact reducing the globe to human scale. While reiterating a classic topos of *admiration*, the walking man also asserts that the size of the globe can be imagined in proportion to that of the human body and that movements at the scale of the whole globe can be understood in terms of the famil-

²⁴⁰ *Études*, 106.

²⁴¹ *Études*, 106.

iar experience of one's body in space. In a similar way, Buffon had gauged the relative importance of animals according to their size compared to man's.

Proportionate to the human body, the globe is thus made amenable to "anthropometric" measure. As Ken Alder points out in his history of the meter's invention, measures in the Ancien Régime were frequently anthropometric in nature. These units "sanctified man," Alder writes, "as the measure of all things," not only because they were sometimes calculated on actual physical features of the human body (such as the *pied* or the *pouce*), but also because they often expressed quantities of human work.²⁴² Prior to the invention of the metric system, measures in France defined time and space in relation to the limits and needs of the human body in ways that varied with local tradition. Land might be measured in terms of the "*homme*" or the "*journée*," the surface area a single person could work in a day, and coal in a "*charge*," a portion of a miner's daily output. These units not only made human bodies the measure of surface area or weight, but also differed from one locale to another. *Hommes* or *journées* were tailored to the fertility of a particular plot of land and expressed centuries of negotiation about what these units meant in a given place, "anthropometric" both in the sense that they were calculated on the work or the proportions of an individual human body and in the sense that they arose from community consensus about what a given unit meant. Bernardin's analogy between the globe and a walking man implies that whatever the causes of the Earth's motion might be, that motion could be measured in terms of human work. Like anything else, the measurement of the globe is a local affair.

In attempting to determine what the causes of the Earth's movement might be, Bernardin effectively extends the analogy between the movement of the Earth itself and a man walking on it, construing the Earth as a mechanical system that functions in space in more or less the same way that a reduced version of it would function on its own surface. What powers this system are the waters whose migration between the poles and periodic flooding of the continents Bernardin avidly documents. Over the course of the *Études*, Bernardin elaborates a theory in which the shape and motion of the earth in space is correlated with both the histories of extraordinary floods and the regular flux of the tides. "*Il y a en effet*," he notices, "*une concordance très singulière entre le mouvement par lequel la terre présente alternativement ses deux pôles au soleil dans un an, et les effusions alternatives des glaces polaires qui arrivent dans le cours de la même année.*"²⁴³ The testimony of voyagers and of the Bible, reasoning by analogy and rough estimation all suggest to Bernardin that the polar ice caps melt when closest to the sun, sending a rush of water through the channels of the Atlantic and Pacific oceans that ultimately freezes at the opposite pole.

Comme la glace de ce pôle, que sa pesanteur incline vers le soleil, se fond à mesure qu'elle s'en approche verticalement, et qu'au contraire la glace du pôle opposé augmente à mesure qu'elle s'en éloigne, il doit arriver que le premier pôle devenant plus léger, et le second plus pesant, le centre de gravité passe alternativement de l'un à

²⁴² *The Measure of All Things: the Seven-Year Odyssey and the Hidden Error that Transformed the World* (NY: Free Press, 2002), 132. See also J. L. Heilbron "The Measure of Enlightenment" in *The Quantifying Spirit in the 18th Century*.

²⁴³ *Études*, 125.

l'autre; et que de ce balancement réciproque doit naître ce mouvement du globe dans l'écliptique, qui nous donne l'été et l'hiver."²⁴⁴

Thanks to shifts in the weight of the water on its surface, the earth tips back and forward along the "ecliptic" plane, the plane described by the movement of the Earth's poles toward and away from the Sun. Ultimately, Bernardin restricts his account of the globe's motion to its oscillation in this plane, without attempting to derive the revolutions of the Earth around the Sun or the rotation of the Earth on its axis. As he himself laments, his rewriting of Newtonian cosmology remains incomplete. Though he attempts, for example, to elide the attraction of the Moon as a factor in tides, he remains surprisingly content to rely on the notion of "attraction" as a force that mediates among celestial bodies: "*En admettant, avec les astronomes,*" he concedes, "*les lois de l'attraction parmi les astres, la terre doit certainement présenter au soleil qui l'attire, la partie la plus pesante de son globe.*"²⁴⁵ Bernardin's use of attraction in a Newtonian sense here is not only surprising because he rails against it elsewhere, but also because he consistently disputes its capacity, as predicted by Newton, to generate a globe with flattened poles. The poles must be pointed instead, he affirms, given the massive mountains of ice that encrust them, mountains so massive, he estimates, that they weight the Earth's poles toward the Sun and influence the overall shape of the globe itself.

Though this unorthodox vision of the globe and its motion emerges far from the center of scientific power in late eighteenth-century Paris, it revisits important aspects of an earlier debate among academicians over the earth's shape while challenging the means of transmitting scientific authority which that debate helped to establish. Bernardin's science of the globe emerges between two crucial moments in the history of institutional science in France: first, the expeditions that sent Charles Marie de La Condamine (1701-1774) and Pierre Bouguer (1698-1758) to South America and Pierre-Marie Moreau de Maupertuis (1698-1759) to Lapland (modern day Sweden) in the 1730s, and second, the measurement of the meridian from Dunkirk to Rodez from 1792 to 1798. Sponsored by the *Académie des sciences*, both undertakings cemented the consensus that Newtonian rules and the empirical operations associated with them successfully predicted the shape of the globe. Bernardin's anti-Newtonian bent and preference for an elongated globe revisits the terms of the debate that raged within the *Académie des sciences* at the time of the expeditions to Peru and Lapland. This polemic pitted Jacques Cassini (Cassini II, 1677-1756), the scion of France's chief family of astronomers, against a younger generation of savants led by Maupertuis. Maupertuis and others contested the exactitude of Cassini's survey of the meridian in France, as well as his prediction that the Earth's poles were elongated. In so doing, they were challenging not only Cassini's results but also the techniques he used and the tradition he represented, foregrounding the greater precision of newly invented English instruments and locating scientific authority in the precision of these instruments, rather than in traditional techniques and

²⁴⁴ Ibid.

²⁴⁵ Ibid., 125. Earlier, Bernardin writes, "*Il me suffirait d'en avoir dit assez pour prouver que toutes les marées ne viennent pas de la pression ou de l'attraction du soleil et de la lune sur l'équateur; j'aurais démontré l'insuffisance de nos systèmes, qui les attribuent à ces causes: mais je vais remplacer ce que je viens de détruire, par d'autres observations, et prouver qu'il n'y a aucune marée, sur quelque rivage que ce soit, qui ne doive son origine aux effusions polaires* (116)."

the body of an astronomer consecrated by heredity and royal favor. Cassini's prediction of an elongated globe conflicted with Newton's depiction of a slightly flattened one, and this polemic therefore came to be viewed as a test of Newtonian physics more generally, with proponents of Cartesian physics advocating an elongated globe and those of Newtonian physics a flattened one.

As Mary Terrall shows in her biography of Maupertuis, however, the crystallization of these positions--Cassini-Descartes-elongated globe, on the one hand, and Maupertuis-Newton-flattened globe on the other--was incited as much by the contingent assumptions made by the polemic's actors and audiences as by rigorous necessity. There was no physical reason, for example, that a Cartesian would be obliged to endorse an elongated globe.²⁴⁶ Ultimately, the measurements performed in France by Cassini, those performed in Peru by La Condamine and Bouguer and those performed in Lapland by Maupertuis all proved discrepant with regard to one another. But while these measures failed to produce a consensus about the shape of the globe, no one seemed to speculate that the Earth itself might be irregular in shape. Instead, Maupertuis successfully sustained the superiority of his own measures through a rhetoric of precision and a mastery of polemic, foregrounding the novelty and exactitude of the English zenith sector while casting doubt on the older, French-made sector of Cassini. In both the *Académie* and *le monde*, the conviction that Maupertuis' measures were superior came to correspond to the conviction that the flattened globe was superior to an elongated one, as well as that, more generally, Newtonian physics had vanquished the Cartesian variety. Ultimately, the Maupertuis-Cassini polemic over the shape of the Earth marked the last gasp of Cartesian physics in learned circles in France.

In espousing an elongated globe, then, Bernardin implicitly revives the polemic during which Newtonian physics had cemented its grip on public and learned opinion, while also calling into question the means by which scientific authority in France had come to be transmitted over the course of the eighteenth century: "*L'autorité des grands noms*," he objects, "*ne sert que trop souvent de rempart à l'erreur: c'est ainsi que, sur la foi des Maupertuis et des La Condamine, l'Europe a cru, jusqu'à présent, que la terre était aplatie aux pôles.*"²⁴⁷ It was only because of the "faith" placed in the reputations of Maupertuis and La Condamine, Bernardin believes, as well as in the wider tradition for which they stood, that consensus about the flattened character of the globe could be perpetuated. Rather than a science predicated on the "authority of great names," then, Bernardin advocates a science predicated on the authority of personal sensation and sentiment. In spite of the objections of Bernardin and others, the question of the shape of the globe was not revisited in learned circles until the inception of a campaign to devise a universal system of measurements. The anti-Newtonianism of Bernardin and others during the 1780s and 90s had done nothing to shake the pre-eminence of Newtonian theories and techniques among the savants of the *Académie des sciences*, and the campaign to measure the meridian that was

²⁴⁶ As Terrall contends, "Cosmological or theoretical positions were no more essential to the dispute than were claims about authority and expertise, the role of analytical mathematics in astronomy and cosmology, the design and use of astronomical instruments, and the appropriate presentation of quantitative results. . . . Far from being self-evident, the assessment of precision and error drew on many different intellectual, mathematical, instrumental, political, and textual resources (130)." *The Man who Flattened the Earth: Maupertuis and the Sciences in the Enlightenment* (Chicago: University of Chicago Press, 2002). See also Alder, *The Measure of all Things* for a short history of geodesy (the measurement of the Earth), including the Cassini II-Maupertuis polemic, 92-96.

²⁴⁷ *Études*, 39.

pursued in the 1790s could therefore re-examine the question of the Earth's shape without calling into question the validity of Newtonian physics, as well.

This second campaign combined the effort to establish an internationally viable unit of length with an effort to produce a more exact measurement of the globe than had previously been possible. In the waning years of the Ancien Régime, several of the most powerful members of the *Académie des Sciences*, including Marie-Jean-Antoine-Nicolas de Caritat, marquis de Condorcet (1743-1794), Antoine Laurent de Lavoisier (1743-1794) and Pierre-Simon Laplace (1749-1827), lobbied for a system of standardized measures to replace France's existing patchwork of local ones, while arguing that the best way to guarantee the truly universal character of a new measure of length would be to base it on the length of a degree of the meridian.²⁴⁸ Using the new repeating circle invented by Jean-Charles, chevalier de Borda (1733-1799), academician and naval commander, the expedition members were charged with identifying the exact length of what was to be termed the "meter," defined as one ten-millionth of the distance from the North Pole to the equator. In this way, the expedition contravened the values of Bernardin and others like him not only because it calculated its standard unit of length on the basis of a Newtonian conception of the shape of the Earth but also because it sought to replace anthropometric measures with abstract, standardized ones.

When an International Commission convened by Pierre-Simon Laplace (1749-1827) and Napoleon Bonaparte (1769-1821) confirmed the meter in 1793, it enshrined the wrong length. This error was not only due to mistakes on the part of Pierre François André Méchain (1744-1804), one of the two main leaders of the expedition with Jean-Baptiste Joseph Delambre (1749-1822), but also due to the meter's character as a strange amalgam of measurement and theory.²⁴⁹ The length of the meter was calculated as a portion of the total length of the meridian from the North Pole to the Equator, and this total length was extrapolated from the length of the portion of the meridian that ran from Dunkirk to Barcelona. Since this extrapolation was performed in light of a Newtonian conception of the shape of the globe, it reflected the proportions of a regular geometric form rather than the highly irregular form we know the Earth to be. (Today the meter is defined in relation to the speed of light, in recognition of the impossibility of calculating a universal measure on the basis of an irregular globe). Even Laplace, the meter's most powerful proponent, granted that the Earth seemed likely to be irregular in shape. Though consensus about the Earth's basic shape remained unchanged, Laplace observes, the particularities of that shape remained to be defined. In "De la figure de la terre, et de la variation de la pesanteur à sa surface," a chapter from the *Exposition du Système du Monde* (first edition, 1796), Laplace draws on existing measurements of the Earth's meridian to speculate on the Earth's shape. "On nomme aplatissement ou ellipticité d'un sphéroïde elliptique l'excès de l'axe de l'équateur sur celui du pôle, pris pour unité," writes Laplace. "Or, les degrés du nord et de France donnent 1/153 pour l'ellipticité de la terre, que les degrés de France et de l'équateur

²⁴⁸ A concurrent plan would have based it on the length of a pendulum beating once per second. For an account of how this plan was defeated in favor of a unit based on the half-meridian, see Alder, *The Measure of All Things*, 87-96.

²⁴⁹ Alder notes that Méchain slightly altered data to obtain the results he expected. See "Chapter Eleven: Méchain's Mistake, Delambre's Peace," in *The Measure of All Things*, 291-324.

donnent égale à 1/312; il paraît donc que la terre est sensiblement différente d'un ellipsoïde."²⁵⁰ Depending on where the meridian is measured, Laplace notes, a different ratio between the earth's radius at the pole and its radius at the equator is established. Calculated from measurements made in the north, the earth's radius at the pole was predicted to be 1/153 shorter than its radius at the equator. Based on more southerly measurements, it was predicted to be a slightly smaller 1/312 shorter than the radius at the equator. When predicted in keeping with Newtonian models, the precise shape of the globe, that is, depended on the location at which these measurements were taken. "*Il y a même lieu de croire,*" adds Laplace, "*n'est pas un solide de révolution et que ses deux hémisphères ne sont pas semblables de chaque côté de l'équateur.*"

In speculating that the northern and the southern hemispheres might amount to different shapes, Laplace effectively concedes that the forces associated with the Earth's rotation alone cannot adequately predict the shape of the Earth. The human mind's penchant for attributing regular form to the objects it envisions serves us poorly in this case, Laplace asserts. "*Infiniment variée dans ses effets,*" he declares, "*la nature n'est simple que dans ses causes, et son économie consiste à produire un grand nombre de phénomènes souvent très-compliqués, au moyen d'un petit nombre de lois générales.*"²⁵¹ These forces might be, from this perspective, just one of the natural causes that contribute to the real shape of the earth, and the mathematical models available to the astronomers of his own moment are therefore inevitably incomplete. But faced with the earth's irregularity, Laplace justifies the mathematization of its form in principle by allowing that a minimum number of other causes might participate in shaping it. In the meantime, as he adds in a subsequent edition (1798), "*La figure de la terre étant fort compliquée, il importe d'en multiplier les mesures dans tous les sens, et dans le plus grand nombre de lieux qu'il est possible.*"²⁵² The incommensurability of mathematical models and the earth's real shape does not prevent Laplace from espousing the cause of the meter, however. Indeed, the very same chapter of the *Exposition* in which these difficulties are revealed concludes with a stirring call for the necessity of a common set of weights and measures, including a measure of length grounded in the shape of the earth.²⁵³

The Newtonian tradition represented by Laplace values exact measurements and the mathematization of the relationships among measured quantities. In contrast, Bernardin, in his

²⁵⁰ *Exposition du système du monde* (Paris: De l'Imprimerie du Cercle-Social, 1796), 104. In the 1798 edition, these numbers change without explanation to 1/146 and 1/334, respectively. *Exposition du système du monde* (Paris: De l'Imprimerie de Crapelet, 1798), 56.

²⁵¹ *Exposition* (1796), 101.

²⁵² *Exposition* (1798), 57.

²⁵³ See Alder, *The Measure of All Things* for an account of the meter expedition finished by confirming the irregularity of the Earth's surface. Not only did the expedition's data indicate that the earth was more plump at the equator than originally supposed, but it also suggested, as Alder puts it, that "the surface of the earth did not . . . follow a regular arc, but shifted with every segment." The expedition's leaders, Delambre and Méchain, had discovered, Alder writes, that "we live on a fallen planet, a world buckled, bent, and warped. . . . Examined from a great enough distance the earth appeared to be a sphere. Move in closer and it appeared flattened at the poles. Closer still--at the stunning level of precision achieved by Delambre and Méchain--and the earth was not even symmetrical enough to be approximated by a curve rotated through space. Delambre and Méchain had discovered that not all meridians were equal." 249-252.

study of the shape of the earth, practices the estimation of quantities and a so-called “middle epistemology” characteristic of the engineer as opposed to the geometer. Where the Newtonian style mathematization practiced by Laplace and others reached for the definition of “universal laws,” the engineer’s middle epistemology embraces trial-and-error experimentation in view of making a system “work.” As Alder puts it in his study of late eighteenth-century military engineers, a middle epistemology aims “to blend the universal knowledge of the savant with the particularistic knowledge of the skilled craftworker,” embodying a distinctive blend of practice and theory, touch and thought, functionality and truth.²⁵⁴ What counts, after all, for the military engineers Alder studies, is the innovation of a gun that reconciles the design needs of a particular place and moment, negotiating among the conditions set, for example, by ballistics, terrain, enemy technology, manufacturing limitations, and user skill. These engineers aim to build a machine, not refine the laws of ballistics. In the effort to build a machine those laws may in any case model only a dubious approximation of the material world, establishing a range of values within which the machine might work as hoped but no precise ones.²⁵⁵

Bernardin applies a similar approach to the study of the earth’s shape and movement, treating the whole earth like a machine encountered at its surface. In spite of the globe’s singular enormity, Bernardin proceeds as though he were describing a system whose parameters could be adjusted in search of a “region of optimal gain.”²⁵⁶ The rough estimation of the earth’s physical quantities allows him to eschew the rigorous limits that would be set by exact measurements in favor of loose parameters whose limits can be shifted. Whereas the effort to determine the relationship among exact quantities could only ever have one possible solution, the relationship between rough estimates takes shape within a matrix of combinations. Given the impossibility of determining the exact volume of ice at the poles or the weight of the water on the globe, for example, Bernardin leaves these variables open for adjustment within the bounds set by the reports of voyagers and his own sense of just proportion. In challenging the academicians’ picture of the globe, Bernardin attempts to elaborate what is in effect only a plausible alternative, not a “true” one. In Bernardin’s view, this plausibility ought to suffice to undermine consensus about the

²⁵⁴ *Engineering the Revolution: Arms and Enlightenment in France (1793-1815)* (Chicago: University of Chicago Press, 2010), 60.

²⁵⁵ Chapter Three of the present study further explores the relationship between this so-called “middle epistemology” and the high epistemology of the Newtonian geometers at the *Académie des sciences*, in light of Alessandro Volta’s consecration at the *Académie* in 1801. Volta’s work on electricity resulted in the development of “mid-range conceptualizations,” as his biographer, Giuliano Pancaldi, puts it, rather than the universal laws valued by the most powerful academicians. Volta’s experiments resulted in the invention of machines like the electrophorus and the pile, which demonstrated new aspects of how electricity worked without defining what it was or arriving at a general theory of electricity. As Pancaldi shows, Volta’s reception at the *Académie* in 1801, at the behest of Napoleon, Premier Consul, took place only once the committee charged with evaluating his work had transformed his “mid-range conceptualizations” into mathematical laws. Though Bernardin was not an experimental natural philosopher like Volta, his practice of estimation arises, I am arguing, from a similar notion of “design.” For Pancaldi’s notion of “mid-range conceptualizations,” see the chapters “Volta’s Science of Electricity: Conception, Laboratory Work, and Public Recognition” and “The Battery” in *Volta: Science and Culture in the Age of Enlightenment* (Princeton: PUP, 2003). See also John Heilbron’s notion of the role of “analogy” in Volta’s work for a complementary account of “mid-range conceptualization.” “Analogy in Volta’s Exact Natural Philosophy,” *Nuova Voltiana: Studies on Volta and his Times*, vol. 1, Ed. F Bevilacqua and L. Fregonese (Milan: Hoepli, 2000).

²⁵⁶ *Engineering the Revolution*, 60.

means of the academic astronomers. It thus reflects both a sense of strategy and the virtues of a middle epistemology. As a style of quantification, estimation aims for what is plausible, not what is exact, appearing in this guise as a positive strategy for quantifying the globe, however convincing, rather than as merely the absence of exactitude.

While Bernardin's approach to the natural philosophy of the globe reflects the general epistemic values of engineering versus those of the exact sciences, it also reflects the particular values associated with Bernardin's own engineering training. Prior to his departure for the *Île-de-France* as a military engineer, Bernardin attended the *École royale des Ponts et Chaussées*, where he was trained in mathematics and drafting.²⁵⁷ As Antoine Picon, Bruno Belhoste and Joël Sakarovitch have suggested, the *École des Ponts et Chaussées* produced a particular kind of student formed in the mold of a so-called "*ingénieur-artiste*," in contrast to the more mathematically savvy and theoretically prone students produced by the *École de Génie de Mézières* and, later, by the *École polytechnique*, crystallized in their study by the personae of the "*ingénieur-géomètre*" and "*ingénieur-savant*," respectively.²⁵⁸ The curriculum of the *École des Ponts et Chaussées* mixed mathematical training with hands-on manipulation of materials and exercises in drafting landscapes and decorative building elements. Though mathematical ability remained one potential path to success at the *École*, Picon's study shows that few of its students mastered infinitesimal calculus or mechanics.²⁵⁹ Instead, the school formed students whose skills resembled those of architects or garden planners, including not only drafting and stereotomy (the cutting of sections in solids) but also the ability to design with taste and imagination.²⁶⁰ The important competitions in figure, ornament and landscape initiated at the *École* in 1775, for instance, tested students' inventiveness as well as their technical skills, in keeping with the school's traditional emphasis on artistry. Precisely this image of the *École*'s training emerges in a letter Condorcet addressed to Anne-Robert-Jacques Turgot (1727-1781) on Bernardin's behalf, during Turgot's ministry. "*Mademoiselle de Lespinasse est toujours souffrante*," writes Condorcet,

elle n'en est que plus ardente pour tirer les malheureux de peine; elle m'a reparlé du chevalier de Saint-Pierre. Tâchez donc de faire quelque chose pour lui, quand ce ne seroit que de lui assurer les cent pistoles qu'on lui donne. Il sait d'ailleurs assez de

²⁵⁷ Malcolm Cook, *Bernardin de Saint-Pierre: A Life of Culture* (London: Legenda, 2006), 32.

²⁵⁸ Bruno Belhoste, Antoine Picon and Joël Sakarovitch, "*Les exercices dans les écoles d'ingénieurs sous l'Ancien régime et la Révolution*," *Histoire de l'éducation* 46 (1990), 53-109. As a note in the article specifies, Picon was responsible for the section on the *École des ponts et chaussées*. The *École des Ponts et chaussées* was founded in 1747, the *École royale de Génie de Mézières* in 1748. The *École de Génie* was abolished in 1794, the year in which the *École polytechnique* was founded.

²⁵⁹ *Ibid.*, 55. "*Bien que l'on trouve en majorité des hommes de projet sans grande culture scientifique*," writes Picon, "*on recense tout de même parmi ses anciens élèves quelques ingénieurs mathématiciens comme Prony ou Girard (61)*."

²⁶⁰ "*Le caractère peu théorique de l'enseignement dispensé par l'École*," writes Picon, "*trouve sa contrepartie dans les qualités pratiques qu'elle développe au cours d'une scolarité assez longue, puisqu'il faut entre cinq et sept ans pour former un ingénieur. Centrée sur l'apprentissage du projet, une telle scolarité rappelle beaucoup l'inténaire que suivent les élèves de l'Académie de l'Architecture. Les ingénieurs des Ponts et Chaussées, au siècle des Lumières, ne songent nullement à dissimuler cette parenté; ils se veulent encore des "artistes" au même titre que les architectes ou les concepteurs de jardins (55-56)*."

mathématiques pour conduire des travaux, pour lever des plans, et vous pourriez l'employer. Car vous ne devez avoir aucune confiance aux gens des ponts et chaussées; Peyronnet vouloit, l'autre jour, faire l'aqueduc de l'Yvette en forme d'escalier."²⁶¹

Condorcet's condescension to both Bernardin and the corps of the *Ponts et chaussées* at the time emerges vividly in the faint praise he accords the writer's mathematical abilities, as well as in his dismay at the prospect of an aqueduct in the form of a staircase. Bernardin's mathematical skills are adequate to surveying and construction work, Condorcet implies, but not to undertaking the complex calculations increasingly prized at the *École de Génie*.²⁶²

The values expressed in the persona of the engineer as developed at the *École des ponts et chaussées* differ starkly from those promoted at the *École de Génie* and, at its inception in 1794, the *École polytechnique*. The stronger accent on theory characteristic of these latter schools is apparent in the curriculum established at each by the geometer Gaspard Monge (1746-1818). At these institutions, Monge made mastery of the "descriptive geometry" he himself had invented one of the chief criteria for success. Monge's descriptive geometry made it possible to represent transformations in three-dimensional figures in two dimensions, without the need for actual physical manipulation. This new technology had important consequences in both the style of representation practiced in engineering and in the social order coordinated by these representations. To the sentimental spectator presupposed by the perspectival landscapes produced at the *École des Ponts et Chaussées* corresponded the "view from nowhere" implied by the projective drawings of descriptive geometry. The explicit aesthetic virtues of landscape drawing ceded to an order of representation whose aesthetic virtues were all negative. These projective drawings not only suppressed sentiment in favor of rationalized geometric form, but also, in denying perspective, suppressed the possibility of a spectator altogether.²⁶³ The plans also marginalized the figures charged with realizing them in the material world. "For millenia," writes Ken Alder, "architects had drawn buildings in plans, elevations, and facades. And artisans (especially masons and carpenters) had long possessed secret stereographic methods for calculating the various block faces needed to build, say, a Gothic vault In Monge's descriptive geometry, however, these views were rigorously interrelated, consistently laid out, and coupled to the world of mathematical analysis."²⁶⁴ By fixing the relationships among all potential points of view on the object in question, descriptive geometry increased the control of the engineers who did the planning while

²⁶¹ Condorcet's letter has variously been dated to 1774 or 1776. Julie de Lespinasse, *Lettres, suivies de ses autres oeuvres*, ed. Eugène Asse (Genève: Slatkine, 1971 [1876]), 319.

²⁶² Ken Alder's work on the history of professionalization in engineering reveals how mathematics came to constitute a measure of merit in the engineering schools, even when it had only a tangential bearing on the work members of the engineer corps would eventually do. See "French Engineers Become Professionals, Or, How Meritocracy Made Knowledge Objective," in *The Sciences in Enlightened Europe*, ed. William Clark, Jan Golinski and Simon Schaffer (Chicago: University of Chicago Press, 1999).

²⁶³ Alder, *Engineering the Revolution*, 140.

²⁶⁴ *Ibid.*

reducing the discretion of the craftspersons who realized the plans. Ultimately, the new “ordering of pictures,” as Alder puts it, “resulted in reconfigurations of the “social order,” as well.²⁶⁵

Bernardin’s globe captures the tension among the values associated with these different varieties of engineering, expressed in the recurring metaphor of “habitation.” “*Pour se former une idée de l’ordre de la nature,*” he asserts,

il faut perdre nos idées circonscrites d’ordre humain. Il faut renoncer aux plans de notre architecture, qui emploie fréquemment les lignes droites, afin que la faiblesse de notre vue puisse embrasser d’un coup d’oeil tout notre domaine, qui symétrise toutes nos distributions, qui met dans nos maisons, des ailes à droite et des ailes à gauche, afin que toutes les parties de notre habitation soient à notre portée, lorsque nous en occupons le milieu, et qui nivelle, met à plomb, lisse et polit les pierres qu’elle y emploie, afin que nos monuments soient doux au toucher et à la vue. Les convenances de la nature ne sont pas celles d’un sybarite, mais elles sont celles du genre humain et de tous les êtres. Quand la nature élève un rocher, elle y met des fentes, des anfractuosités, des carnes, des pitons. Elle les creuse et l’exaspère avec le ciseau du temps et des éléments; elle y plante des herbes, des arbres; elle y loge des animaux, et elle le place au sein des mers et au foyer des tempêtes, afin qu’il y offre des asiles aux habitants de l’air et des eaux.²⁶⁶

In this passage, Bernardin imagines two kinds of habitation, a château corresponding to the milieu of rational mechanics and a ruined rock corresponding to that of the anthropo-geographical tradition. Figuring the milieu of rational mechanics as a house might seem odd, since that milieu is necessarily purged of the values of “place,” let alone those of home. But in populating this structure with a single “*sybarite*” Bernardin distances it from the values implicit in the home that Nature sculpts for the “*genre humain*” and “*tous les êtres,*” while also describing its “*distributions*” in a way that assimilates them to the conventions of Newtonian space. The château be-

²⁶⁵ Lorraine Daston’s article “The Physicalist Tradition in Early Nineteenth Century French Geometry” argues that though Monge belonged to a scientific elite heavily patronized by Napoleon and characterized by the valorization of “exactitude,” his descriptive geometry nevertheless suffered a kind of institutional marginalization at the hands of the *physiciens-géomètres* in the *Académie des Sciences*. Daston situates this institutional dynamic within a broader rivalry among proponents of “analytic” and “synthetic” mathematization during the last few decades of the eighteenth century and the first few of the nineteenth. While the novelty of the exact sciences under Laplace lay in its ambition to bring Newtonian methods of mathematization from the cosmos down to the microcosmos, synthesis in particular represents what Daston calls a “physicalist” tradition because of its emphasis on extrapolating theoretical constructs from real material shapes. The contrary impulse would be a “formal” one content with the possibilities of solving physical problems through manipulations of mathematical symbols alone (289). Within an overall push toward the increasingly tight alignment between mathematization and the physical world in the exact sciences of the late eighteenth century, the synthetic character of descriptive geometry also lent a kind of ontological integrity to the practice of reasoning theoretically on the basis of real objects, as opposed to the purely mathematical representations of analysis. Daston’s interpretation suggests the extent to which the values of exactitude associated with the elite grouped around Laplace and Claude-Louis Berthollet (1748-1822) triumphed, going so far as to sideline the institutional prestige of a figure who in other respects shared their epistemic values. “Analysts were attracted to problems in celestial mechanics, optics, elasticity, heat theory and electricity,” Daston writes. “Synthetic geometers expended the larger part of their polemical and mathematical energies in the more pedestrian realm that had given descriptive geometry its original stimulus, namely instructing craftsmen and engineers (290).” *Studies in History and Philosophy of Science* 17.3 (1986), 269-295.

²⁶⁶ *Études*, 111.

comes an allegory, as it were, of this shapeless expanse. Its “*milieu*,” we learn, stands at the center of such a perfectly symmetrical disposition of wings that one might calculate the character of any point in the château on the basis of any other. In this symmetrical, orthogonal structure, the location and form of any one place can be extrapolated from any other, just as the astronomers who calculated a stretch of the meridian claimed to be able to extrapolate from it a picture of the whole globe. The “*milieu*” of the castle brings space under “*notre portée*,” that is, by rendering it perfectly equal to itself. In contrast, the milieu of the ruined rock is defined first and foremost as a home, its form multiply determined by the shapes and needs of the many beings who occupy it. Bernardin fuses the values of the *ingénieur-artiste* with those of the admirer of Nature, representing Nature itself as the talented drafter of “pre-romantic” scenes, arranging the ensembles of plants and animals that might most picturesquely lodge there. At the same time, Nature also takes on the quality of a craftsman, carving, scoring, eroding its medium with the instruments of time and the elements, leaving its irreducibly singular marks on a object so irregular that no part can be extrapolated from any other. In this passage, the figure of a *Dieu Ouvrier* coalesces with that of a *Dieu Artisan*.

In the contrast between the neo-classical château and the ruined rock lies a conflict not only between aesthetics and epistemologies but also between different visions of material production in society. For the smooth, standardized forms of the château and the idiosyncratic forms of the rock embody very different notions of the role of the artisan. The “*plans de notre architecture*” that Bernardin cites are the blueprints that mediate between the architect and the workmen, and the notion that they are elaborated in such a way that “*notre vue puisse embrasser d’un coup d’oeil tout notre domaine*” associates them with drawings performed in the manner of descriptive geometry. Such a scenario contrasts with one where perspective drawings require artisans to extrapolate what is represented from what is not, leaving a modicum of discretion in the realization of the plans. The kind of crafting Bernardin evokes, moreover, seems to proceed without any plan whatsoever, implying a kind of labor that is innocent of standardization as well as a commensurably dignified social status.

Though Bernardin persistently gropes for means of representing the globe as a distinct whole, the metaphor of architecture returns us to the description of the earth as a habitable milieu. In the natural philosophy of the *Études*, Bernardin himself produces a structure, as it were, whose interior spaces and exterior elevation, its earthly concavity and spheric convexity, cannot quite be reconciled. Indeed, while Bernardin’s evocation of the “interior” relies on the sentimental virtues of the spectacle, his evocation of the “exterior” relies on an experience of touch associated with the middle epistemology of an engineer. What assimilates this latter aspect of Bernardin’s natural philosophy to a science of *admiration* is the persistence of a notion of the earth and its cosmos as an anthropo-geographic milieu. Within this scheme, the notion of “feeling” plays an important role, for while the sentiment evoked by the spectacle differs materially from the sensations of weight and texture that participate in generating an account of the whole globe, the embodied orientation that characterizes Bernardin’s science of the globe only elaborates, in a sense, the *hexeis* of self and world already implicit in the natural histories of Pluche, Réaumur and Buffon.

This double meaning of “feeling” is captured in a passage from the *Études* where Bernardin distills both what his science stands for and what it combats: “*Nous ne pouvons con-*

naître que ce que la nature nous fait sentir,” he writes, *“et nous ne pouvons juger de ses ouvrages que dans le lieu et dans le temps où elle nous les montre. Tout ce que nous nous figurons au-delà, ne nous présente que contradiction, doute, erreur ou absurdité.”*²⁶⁷ These propositions spell out in a nearly schematic way, I think, the assumptions at the heart of Bernardin’s anti-Newtonian science, and perhaps of anti-Newtonian science in general. For Bernardin, the sentiments that Nature invokes are not distractions from an objective representation of the world but themselves figure as “characters” signifying the basic commensurability of man and Nature. Our ability to feel admiration for the spectacle of Nature, that is, signals the legibility of the world. The notion that we can only know what Nature makes us feel, reaffirms, moreover, the valorization of touch in Bernardin’s science of the globe. In making man the measure of the globe, Bernardin posits the human individual as a kind of instrument for gauging the relative enormity of the globe itself, the body’s ability to register proportions among colossal phenomena implying a kind of knowledge in which bodily sense acts as both means and end. The sense of proportion embodied in Bernardin’s *hexeis* of self and globe, that is, does not subsequently give rise to more straightforwardly “theorized” accounts of these relationships. Rather, the science of the globe entails, for Bernardin, learning to appreciate the relationships that spring up between the situated human being and global-scale phenomena, a kind of appreciation that consists both in “recognizing” and “estimating on the basis of” the bodily sense that intimates these relationships.

This emphasis on the situated character of human knowledge emerges in the second part of Bernardin’s formulation, in the assertion that Nature reveals itself to us at particular times and places. In the science of plants, the spectacle signals the place-bound and timely disclosure of natural truths, but in the science of the globe, the globe’s very immensity dispels the power of spectacle as a mode of visualization. The phenomena of the earth--displaced fossils, the directions of clouds, the migrations of icebergs, changes in seasons, cold days in summer--emerge as the basis for inferences about global-scale conditions without the help of spectacular rhetoric. Where spectacular rhetoric intervenes in the science of the globe, it typically serves to dramatize the events these inferences had already evoked. In tandem with these inferences about the workings of the globe in times present and past, the *convenances* characteristic of the science of plants are joined by a host of other sympathies. While *convenances* play an important role in the science of the globe, as the principle which fixes, for instance, the forms of continents with the needs of fish, they are joined by sympathies of displacement and transformation, including those, like attraction or magnetism, which made up the repertoire of forces investigated by the exact physical sciences of Bernardin’s time. As sympathies, these phenomena’s efficacy is bound in time and place, acting as erratic, local principles rather than as the constant, universal forces assumed by the exact sciences. For Bernardin, becoming the subject of a natural truth requires being in a given place at a given time precisely because Nature, in his view, is not economical. Whereas the exact sciences assumed that one natural cause could explain a multitude of phenomena, Bernardin assumes that a single phenomenon can be explained by at different times by a multitude of causes. This is why the anecdotes of travelers play such a prominent role in Bernardin’s natural philosophy; their reports articulate irreproducible experiences of Nature at a particular intersection of time and place.

²⁶⁷ *Études*, 83.

The “contradiction, doubt, error or absurdity” perpetuated by the exact sciences, on the contrary, proceeds from the extraction of a “fact” from the time and place at which a given phenomenon has been observed. In the methodology of the physical sciences, experiments act to make Nature divulge its truths in a way that holds true everywhere on the globe and for all time, not just at the place where it was performed or at the moment at which a given result appeared. Abstracting a given result from its particular time and place and formulating its relationships with other such results meant, for Bernardin, that the sciences were no longer describing Nature as it continued to reproduce itself all around, but were only constructing an internally coherent yet imaginary edifice, a language that had lost its referent. The abstraction of facts entails the mode of “representation” which Bernardin vociferously combats, a factitious strategy which he construes, once more, in the language of architecture: “*Quelque ingénieuses que soient ces lois,*” Bernardin writes, in reference to those of universal gravitation, “*ce ne sont que des échafaudages imaginés par des hommes de génie pour élever l’édifice de la science, mais qui ne servent pas davantage à pénétrer dans le sanctuaire de la nature, que ceux qui servent à construire nos temples ne nous aident à pénétrer dans celui de la religion.*”²⁶⁸ For Bernardin, the sanctuary of Nature only appears at those moments when Nature allows itself to be read, through characters that reveal the mutual influence of form and proximity or the transformations and displacements of water and land. Whereas the sciences generalize the relationships these kinds of readings can reveal, such characters remain inseparable for Bernardin from the phenomena that constitute them. Bernardin likens the discourse of the exact sciences to a scaffolding encasing a building because, in the exact sciences, the world remains distinct from the discourse produced about it. In Bernardin’s brand of science, on the contrary, the world itself is discursive.

If Bernardin’s globe could not quite dissolve into what Foucault calls “*la prose du monde,*” the relays of sympathies which make the earth legible, this comes as little surprise. The globe still escapes our means of representing it, new expanses of its surface continually coming into focus only to disappear again, the whole impossible to hold in the mind all at once. The stretch of Indian Ocean that may or may not have swallowed Flight MH370, for instance, astonishes us as a place that hovers at the point of emerging into view, while eluding precise identification. This ocean that Bernardin knew better than most Westerners in his day or our own might even be imagined, in its singularity, to figure the globe’s capacity to trouble a sense of our own places in it. Its remoteness to Western minds and its disruption of the neo-classical symmetry of the Atlantic and Pacific oceans, stretching like columns from pole to pole, limns the globe’s capacity to be larger than we expect it to be, as well as to slip past the modes of representation we apply to it, those “*idées circonscrites d’ordre humain*” that Bernardin exhorts us to abandon in appreciation of the irreducible singularity of any place to any other. Like others in his day, Bernardin wanted to conceive of every site on the globe as something more than the extrapolation of a general mathematical principle. Instead, he attempted to develop a means of documenting the globe’s sites as places whose irreducible singularity could matter to experience, could be construed as “moral evidence”--that is, be made to acknowledge in some part of its thick materiality that the moral *was*. What interests us about the point where Flight MH370 may have disap-

²⁶⁸ *Études*, 107.

peared is its sudden emergence as just such a “place,” a previously unsuspected locale possibly consecrated by lived experience.

Just as Bernardin’s *études* express the difficulty of attaining a sense of proportion between oneself and the globe, they also struggle to correlate human action or locally observable effects with global-scale meaning. James Watt’s steam engine came into the world in the very same year as Bernardin’s *Études*, as it happens, triggering the processes we have been asked to understand as global warming. While Bernardin decries the human capacity to spoil the harmonies among plants and animals--killing off birds, for instance, who eat the insects who torment reindeer--he does not yet imagine the possibility that human action might disrupt the history of the globe itself. Yet in his continual insistence that local signs express global conditions, he strives to develop a framework for linking the local and the global. This framework remains starkly absent from the works of the geometers and astronomers of his day, preoccupied as they were with sublimating local phenomena into universal laws rather than scanning the local for signs of the global, or vice versa. While these figures assumed that direct links could be established between any place on the globe with any other, thanks to the absolute equality of points in space, they did not imagine means of gauging the powers of local phenomena relative to the globe as a whole. What stands out in Bernardin is the conviction that every act takes on global-scale meaning, even when we lack the means to know just how.

Chapter TWO

The Virtues of Exactitude: Alessandro Volta and the Emergence of Scientific Autonomy in Napoleonic Paris

I. The Vertiginous Thrill of Exactitude

November 1801 changed Alessandro Volta forever. Invited to Paris that winter, the Italian professor made several major presentations at the *Institut de France*, detailing his recent work on electricity to a crowd of ambivalent French academicians. Given his relationships with many of these figures, the success of the trip was uncertain. During a previous visit to Paris, Volta had collaborated with Antoine Lavoisier (1743-1794) and Pierre-Simon Laplace (1749-1827) on experiments related to “electrical atmospheres,” a venture that left him embittered for having been acknowledged only for the desire, as his counterparts put it, “to be useful to us” in the manipulation of the experimental apparatus.²⁶⁹ Volta’s work on electricity was seen by many of the Parisians, moreover, as competing with that of Charles-Augustin de Coulomb (1736-1806), the leading expert on electricity then working in the city; for if the Frenchman practiced precision measurement and sought equations of Newtonian rigor, the Italian had a penchant for rough estimation and the invention of useful or spectacular machines.²⁷⁰ Since his last stay in the capital, however, Volta’s polemic with Luigi Galvani over the nature of “animal spirits” had been decided in his favor, and his invention of the “pile,” or battery, had earned him Europe-wide fame. How would Volta be received in Paris on *this* occasion? As a mere inventor, the creator of an ingenious device, the pile, that could conduct electrical current? As a purveyor of *amusements électriques*, not unlike the showmen who arranged spectacular demonstrations for *mondain* or even popular audiences? Would he, on the contrary, be honored as a natural philosopher whose work advanced the leading edge of pure knowledge about electricity?

Volta’s uncertain reception speaks to the changes agitating the institutional sciences in France during the last years of the eighteenth century, the very same changes which provoked the anti-Newtonianism of Bernardin de Saint-Pierre, explored in Chapter One, and ultimately the hyper-Newtonianism of Balzac and many of his contemporaries, explored in Chapter Three. In the *Études de la nature* and other writings, Bernardin de Saint-Pierre was not reacting against

²⁶⁹ ²⁶⁹ Giuliani Pancaldi, *Volta: Science and Culture in the Age of Enlightenment* (Princeton: PUP, 2003), 159. See also the “*Éloge historique d’Alexandre Volta, lu à la séance publique du 26 juillet 1831*” by François Arago for another account of the dispute between Lavoisier, Laplace and Volta. http://www.academie-sciences.fr/activite/archive/dossiers/Volta/Volta_pdf/Volta_Arago.pdf, accessed 15 May 2014, lxxvi-lxxvii.

²⁷⁰ Even Volta’s status as the inventor of some of the devices for which he was best known was contested by members of the French establishment. The powerful *physicien* R.J. Haüy wrote in his *Exposition raisonnée de la théorie de l’électricité et du magnétisme d’après les principes de M. Aepinus* (Paris 1787) that “*Nous devons observer ici, que c’est M. Aepinus qui, le premier, a employé un appareil construit sur le même plan que l’Electrophore . . . On voit, par cet exposé, combien il restoit peu à faire, pour arriver de cet appareil à l’électrophore.*” quoted in Pancaldi 309n4. As Pancaldi notes, “echoes of Haüy’s criticism could still be detected in France in 1801, the year of Volta’s triumphant presentation of his newly discovered electric battery in Paris.” *Volta*, 111.

science per se; rather, he was reacting against the particular brand of science newly emergent among the powers of the *Académie royale des sciences* and later the First Class of the *Institut de France*.²⁷¹ In many ways, Bernardin belonged to the same intellectual culture as that sustained by the institutional sciences of the Ancien Régime, predicated on the value of spectacular demonstrations of physical effects, the primacy of sense evidence and an orientation toward “utility.” The sudden anti-scientific bent of Bernardin de Saint-Pierre, Chateaubriand, or Mercier cannot be understood, I believe, without reference to the sudden pro-Newtonian turn of the Parisian scientific powers. This pro-Newtonianism entailed not just the depreciation of what Chateaubriand had called the “moral evidence” relative to physical evidence, but also a very particular orientation to the investigation of physical nature. The Newtonian physical science of the academic elite presumed the independence of knowledge-making from aesthetic and ethical concerns, in contrast to the ideal of “admiration,” which had insisted on the identity of aesthetic, ethical and epistemic concerns. No longer would notions about what was true be bound by the assumption that “right” knowledge was inherently beautiful or conduced directly to moral edification. At the moment of Volta’s sojourn in Paris, the rhetoric of “spectacle” that had informed both the discursive natural philosophy of Bernardin de Saint-Pierre and the descriptive and experimental practices of natural philosophers like Réaumur, Buffon or Nollet was in the process of giving way to a rhetoric of precision that mistrusted the senses altogether.

Despite his ambivalent status, Volta’s trip to Paris succeeded beyond his wildest hopes.²⁷² At his presentation to the *Institut* on the 7 November, Napoleon Bonaparte, First Consul and member of the *Institut*, proposed that an extraordinary medal be struck in his honor, a mark, as we read in the session’s minutes, of the Institute’s “*estime particulière pour ce professeur*.”²⁷³ The enormous prestige conveyed by such a gesture secured Volta’s reputation for posterity, investing such an enormous fund of cultural capital in him that its dividends continue to pay out in his enduring fame and in the transubstantiation of his name into everyday speech. In his own lifetime, moreover, it primed a flood of material rewards and further honors bestowed by Bonaparte in subsequent years: among them, a gratuity of 6000 francs in 1801, the award of the Legion of Honor and the promise of a pension in 1805, as well as the titles of Knight of the Iron Crown in 1806 and of Senator and Count of the Kingdom of Italy in 1809 and 1810.²⁷⁴ Though these acts putatively rewarded Volta’s scientific merits, the political motives behind them shine through in even so succinct a document as the minutes of the *Institut*. The entry for the November 7th session does not neglect to mention that this motion had been made by the First Consul, an honorary member, rather than by one of the practicing savants themselves. And even as

²⁷¹ The *Académie royale des sciences* was dissolved by the Convention in 1793. Two years later, the *ancien régime* academies were rehabilitated in the new form of the *Institut de France*. As a measure of the sciences’ relative prestige, they constituted the *Institut*’s First Class.

²⁷² Alessandro Volta, *Epistolario*, ed. F. Massardi (Bologna: Zanichelli, 1949-55), 4:85, 92-93. Pancaldi writes of Volta’s “reaction of genuine wonder, recorded in letters home from Paris, following the conferment of the magnificent rewards on him in 1801,” 176.

²⁷³ Académie des sciences, *Procès verbaux des séances de l’Académie* (Paris: Imprimerie de l’Observatoire de l’Abbadia, 1910-1922), 2: 425. 1801-1804, 425.

²⁷⁴ Pancaldi, *Volta*, 319n126.

the entry marks the body's "particular esteem" for Volta, it also specifies that the medal emblemizes something more, its "*empressement à accueillir les travaux de tous les savans étrangers*" during the ongoing peace negotiations between England and France.²⁷⁵ These motives quite clearly reflect the cultural policy of the First Consul as much as they do the acclaim of the *Institut*. For if the call to foreign savants acted to cultivate the scientific networks running through Paris at the expense of those running through London, Volta's honors and gratuities also worked to integrate the loyal elite of France's recently conquered Italian territories into the new Republic.²⁷⁶

In approving Napoleon's motion, the *Institut* effectively sacrificed its autonomy from state power to the advantages of state protection, allowing its integrity as a self-regulating ensemble to be breached by the head of state himself.²⁷⁷ Given this breach of autonomy, the situation of the sciences as an emergent "field" of cultural production in the lead up to the First Empire resembles that described by Bourdieu in his examination of the literary field under the Third. Under Napoleon III, writes Bourdieu, "*les détenteurs du pouvoir politique visent à imposer leur vision aux artistes et à s'appropriier le pouvoir de consécration et de légitimation qu'ils détiennent,*" while "*les écrivains et les artistes, agissant en sollicitateurs et en intercesseurs ou même, parfois, en véritables groupes de pression, s'efforcent de s'assurer un contrôle médiateur des différentes gratifications matérielles ou symboliques distribuées par l'État.*"²⁷⁸ Bourdieu's own

²⁷⁵ Negotiated through much of 1801, peace negotiations between England and France concluded with the signing of the Treaty of Amiens in March 1802. Bonaparte's cultural imperialism emerges among other places in the letter of thanks he addressed to the *Institut* following his election as a member: "The true power of the French republic," he wrote, "must henceforth consist in not allowing there to be new ideas which do not belong to it." Napoleon I, Emperor of the French, *Correspondance générale* (Paris: Fayard, 2004) 3:2392, quoted in Maurice Crosland, *The Society of Arcueil: A View of French Science at the Time of Napoleon I* (Cambridge: HUP, 1967), 13. Famously, he likewise insisted that all men of arts and science "are French, whatever the country of their birth." *Correspondance I*: 491, quoted in Crosland, 13.

²⁷⁶ For more on the political import of Volta's medal, see Pancaldi, 168-172. Napoleon's patronage of Volta reflects Bonaparte's policy of protecting Italians working in a variety of cultural domains, including Paisiello and Paer in music, Visconti in archaeology or Canova in sculpture. The mixed success of Napoleon's musical imports suggests a parallel with the *académiciens'* resistance to Volta. Just as Volta's practices jarred with those of the exact natural philosophers, so Paisiello aroused the hostility of French musicians and left French audiences cold. As Michel Noiray writes, Napoleon's "*efforts pour acclimater le goût du chant italien relevaient d'un volontarisme qui apparaît aujourd'hui d'une grande naïveté. En effet, ce n'est pas en convoquant à Paris une poignée de compositeurs italiens, traités à la fois avec magnificence et avec un humiliant autoritarisme, que Napoléon pouvait influencer sur le goût dominant.*" In the case of music the reasons for this resistance lay in profoundly ingrained differences in the approach to words and music, for instance, or vocal technique and instrumentation, all "*éléments identitaires profondément enracinés dans les usages et les modes de pensée.*" In the case of the sciences, as we shall see, these profoundly ingrained elements regarded epistemic ideals, experimental practices and other factors. "Le nouveau visage de la musique française," *L'Empire des Muses: Napoléon, les Arts et les Lettres*, edited by Jean-Claude Bonnet (Paris: Éditions Belin, 2004), 204-05.

²⁷⁷ This action takes place on the background of the much more erratic relationship that set in between the State and French scientific institutions during the Revolution, most strikingly the dissolution of the *Académie royale des sciences* by the Convention. Napoleon's gesture seems especially pertinent as a symptom of the relationship between the State and the sciences following the founding of the *Institut* and the resumption of normalized relations between the two. As I shall argue at greater length in the chapter's third section, some degree of direct intervention on the part of the First Consul, later the Emperor, was a rule, not an exception in the history of the sciences in France during this period.

²⁷⁸ *Les Règles de l'art: genèse et structure du champ littéraire* (Paris: Éditions du Seuil, 1998), 91.

work on the specificity of the scientific field assumes a scenario of relative autonomy, examining the field's internal dynamics in a state in which they are untouched by the unmediated influence of political or economic power. Yet like the literary field during the Third Empire, the scientific field in Volta's time articulated itself through a careful dance with state power. In his proposal to medal Volta, Napoleon breaks with the tradition of aristocratic patronage that had shaped the *Académie des sciences* under the *Ancien Régime*. As a member of the First Class of the Institut, Napoleon behaves not like the aristocratic members of the former *Académie royale des sciences*, not merely as a representative of a social and political elite, but as *the* representative of the State itself, empowered both to apportion the State's symbolic and material resources unilaterally and to control their distribution within the scientific field. Yet the structural subordination of the sciences under Napoleon is a two-way street. If Napoleon assumes the savants' powers of "consecration and legitimation," as Bourdieu puts it, the leading savants of the *Institut* actively solicit control over the distribution of the State's symbolic and material benefits in turn. In so doing, they consolidate their own position within the ensemble of scientific institutions, acquiescing in the occasional infringement of the sciences' autonomy in order to control at other times the flow of "*gratifications matérielles ou symboliques*" distributed by the State.

This subordination had concrete effects on scientific speech. Placed in a false position, the First Class officially acquiesced in the First Consul's motion only after the Commission appointed to parse Volta's discovery had met several times. The Commission deferred the award until it had ensured not only that Volta's work could be replicated, but also that it could be assimilated into its own idiom of experimentation, quantification and mathematization.²⁷⁹ As Giuliani Pancaldi, Volta's biographer, puts it, "the Paris philosophers who had rejected Volta's request for recognition for twenty years came under pressure . . . to grant the Pavian professor a place in the history of electricity," though only at the cost of assimilating him into a "tradition," headed by Coulomb, with which "he could not easily identify."²⁸⁰ As Pancaldi argues, Volta's experimental practice betrays what has been called the "middle epistemology" of the engineer in its concern to achieve physical effects through the variation of experimental parameters and the invention of new machines. For Volta, the goal of a given experiment might well be a rough characterization of the relationships among the physical entities at stake, or the perfection of the experimental apparatus itself. The Paris academicians, on the other hand, disparaged approximate quantitative descriptions and the invention of machines in favor of a high epistemology based on exact measurement and the mathematization of universal laws. As the *Institut*'s official report on Volta's work remarks, more work needed to be done to establish "*le calcul*" of Volta's experimental effects, "*sur des données exactes*," and in so doing "*s'élever . . . à la véritable loi que suivent, dans l'appareil du citoyen Volta, la distribution et le mouvement de l'électricité.*"²⁸¹ Just as Newton

²⁷⁹ This Commission consisted of some of the First Class's most prestigious members: Biot, Laplace, Coulomb, Hallé, Monge, Fourcroy, Vauquelin, Pelletan, Charles, Brisson, Sabatier, and Guyton de Morveau. The Commission met four times before it endorsed Bonaparte's proposal that a medal be conferred on Volta and Biot penned its report on Volta's discoveries. See Pancaldi, 240.

²⁸⁰ *Ibid.*, 241.

²⁸¹ Jean-Baptiste Biot, "Rapport sur les expériences du citoyen Volta," *Mémoires de l'Institut National des Sciences et Arts. Sciences mathématiques et physiques* (August 1804), 208.

had discovered the law of universal gravitation, these academicians hoped to discover a universal law of electricity, and to this end, Volta's approximations would not do. In the commission's view, it would be necessary to transform what Volta had evaluated "*pour ainsi dire, par approximation*" by determining the physical relationships revealed in his experiments "*d'une manière rigoureuse*." Only by refining these approximations numerically and devising a mathematical law that fit them would it be possible to complete "*l'explication de tous les phénomènes que cet appareil présente*." If the academic Commission ultimately negotiated a compromise between Volta's work and the experimental idiom it espoused, it was nonetheless forced to grant the originality of Volta's machine and the value of the concepts it suggested, as far as they went, and to elaborate a new research program to extend them. Pre-empted by Napoleon, the powers of the *Institut* momentarily lost their ability to distribute scientific authority as they saw fit, and succeed in saving face only by assimilating Volta's work to their own research idiom.

As specialists in the science of Revolutionary France have shown, the idiom of "exactitude" was itself a relatively new phenomenon, dating to the rise of Antoine Lavoisier, Condorcet, Pierre-Simon Laplace and other proponents of mathematization in the seventeen-seventies and seventeen-eighties.²⁸² Their increasing control over scientific production as a whole rapidly and radically reshaped conditions for producing authoritative speech about Nature, sustaining the superiority of experimentation over other modes of inquiry and even breaking with older experimental traditions. Though these efforts coincide with the rise of modern science, the role of the rhetoric of "exactitude" in establishing the prestige of quantification and the autonomy of the sciences as a form of cultural production remains to be theorized. As I shall argue in this chapter, exactitude can be understood as an "epistemic virtue" in the terms delineated by Daston and Galison, one that sought to displace the virtue of "admiration" I described in Chapter One. Just as "admiration" maximized some aspects of the knowledge of Nature and minimized others, so exactitude exerted its inevitably partial virtues on the study of Nature, prescribing its own distinct mode of how to know and bodying forth the distinctive objects of knowledge that corresponded to this mode. The rise of this virtue is intimately linked to the reception of Newtonian science in France. In the *Opticks*, Newton had hinted at the possibility of describing the action of the terres-

²⁸² Efforts to understand the changing "values" of quantification during this period include Thomas Kuhn's essays on the historiography of experimental physics, "Mathematical versus Experimental Traditions in the Development of Physical Science" and "The Function of Measurement in Modern Physical Science" in *The Essential Tension: Selected Studies in Scientific Tradition and Change* (Chicago: University of Chicago Press, 1977). Many of the essays in the volume *The Quantifying Spirit in the 18th Century*, ed. Tore Frangsmyr et al (Berkeley: University of California Press, 1990), offer hints about how quantification changed in a variety of settings at the end of the eighteenth century. But other work on quantification in the sciences has focused on the particular nature of "exactitude," especially its emergence as a collaboration between experimentalist physicists and mathematicians. See, for example, Jan Golinski, "'The Nicety of Experiment': Precision of Measurement and Precision of Reasoning in Late Eighteenth-Century Chemistry" and W. Norton Wise, "Precision: Agent of Unity and Product of Agreement, Part I—Traveling" in *The Values of Precision*, ed. M. Norton Wise (Princeton: PUP, 1995), and J. L. Heilbron, *Weighing Imponderables and Other Quantitative Science Around 1800* (Berkeley: University of California Press, 1993) and "Analogy in Volta's Exact Natural Philosophy" in *Nuova Voltiana: Studies on Volta and His Times I*, ed. Fabio Bevilacqua and Lucio Fregonese (Pavia and Milan: Hoepli, 2000). In addition, see Christian Licoppe, *La Formation de la pratique scientifique: le discours de l'expérience en France et en Angleterre* (Paris: La Découverte, 1996) and Eugene Frankel on the physicist Jean-Baptiste Biot in "J. B. Biot and the Mathematization of Experimental Physics in Napoleonic France," *Historical Studies in the Physical Sciences* 8 (1977): 33-72, and "Career-making in post-revolutionary France: The Case of Jean-Baptiste Biot," *British Journal for the History of Science* 11.1 (1978): 36-48.

trial world's small particles in much the same way as he himself had already described the celestial world's large bodies, minutely observing them, quantifying their positions, and codifying their relative movements in the form of mathematical equations. Thwarted through much of the eighteenth century by the contentions of Cartesian physics, the visual bias of spectacular experimentation, and the absence of suitable measuring instruments, this ambition ultimately transformed the terms according to which such "imponderable" phenomena as light, heat, electricity and magnetism could be authoritatively described in France. In matching Newtonian means to imponderable ends, Laplace and others incited the emergence of a new kind of physical science, an "exact" science that corresponded to new practices of quantification and changes in perceptions about the epistemic value of quantitative methods. But what makes exactitude more than just a local ideal is the way that it came to orient the production of knowledge in fields beyond the physical sciences, relative to objects of knowledge that could not be directly mathematized. For even as the original proponents of exactitude confined themselves principally to the study of physical nature, their institutional pre-eminence gave them the power to arbitrate the study of living things, as well. As the naturalist Georges Cuvier (1769-1832) wrote in his *Rapport historique sur les progrès des sciences naturelles depuis 1789, et sur leur état actuel* (presented to the Emperor in 1808), "*quoique les sciences naturelles échappent aux applications du calcul, elles se font gloire d'être soumises à l'esprit mathématique.*"²⁸³ Cuvier's *Rapport* enforces the hegemony of an "*esprit mathématique*" that operates even in disciplines impervious to calculation, evaluating the achievements of the natural sciences according to their conformity to this criteria. Diffused as the "*esprit mathématique*" Cuvier describes, the virtues of exactitude blanket scientific production as a whole in late eighteenth- and early nineteenth-century France, settling broadly if unevenly over the gamut of scientific pursuits.

Volta's consecration affords a snapshot of the process by which one experimental culture superseded another, condensing the many decades over which the rhetoric of exactitude supplanted spectacular experimentation and the middle epistemology of the engineer into a single historical episode. But it also emblemizes exactitude's power to shape the study of living things, for Volta's triumph was inextricable from his success in showing that the "animal electricity" identified by his rival Galvani was merely physical, not vital, in nature. Volta's discoveries about electricity had arisen in the heat of a polemic with his compatriot Luigi Galvani (1737-1798) over the nature of "animal" electricity. Using electrical currents to induce movement in the limbs of dead frogs and other animals, Galvani argued for the special vital character of the electricity in question and endeavored to reveal its connections with locomotion and other animal phenomena. But Volta showed that Galvani's electricity was none other than the very same kind of electricity that operated in the non-vital world, as well: even the electricity of the electric eel, he found, was identical to this purely physical electricity. Given these dynamics, the polemic's effects were incommensurable with its grounds. Volta had shown only that Galvani's electricity was non-vital,

²⁸³ Cuvier, *Rapport* (Paris: Imprimerie impériale, 1810), 389-90.

without definitively disproving the existence of a special vital electricity and without endeavoring to show that vital functions could be explained by other means. Yet in practical terms, the polemic legitimized the study of the animal body as a strictly physical entity, while pushing the study of animals' vitality *per se* toward the outer limits of reputable science.

While for a time the prospect that "Galvanic fluid" might eventually explain the nature of life itself set minds afire all over Europe, Volta's ultimate triumph was taken by many as proof that animal electricity *per se* did not exist, or at least that it could be disregarded as a factor in future physiological research. Given its reception, the polemic participated in the emergence of "life" in this period as what Foucault called "*ce point de fuite souverain*" into the animal body, "*indéfiniment éloigné mais constituant*."²⁸⁴ As I sought to show in Chapter One, no such notion of life *per se* inheres in Bernardin de Saint-Pierre's natural philosophy, linking him in this respect to the natural history tradition Foucault associates with Linnaeus and Buffon. Privileging the specific differences of plants' and animals' exteriors, eighteenth-century natural history in general, Foucault argues, remains devoid of a notion of life "itself." But if Foucault rightly observes that a notion of life itself emerges in the natural sciences for the first time sometime between Linnaeus and Cuvier, he does not tell us where or how this notion emerges. Volta's consecration helps us link the appearance of a notion of life itself in the natural sciences to the specific institutional dynamics of the sciences. For if Galvani's science had "manifested" life itself in the otherwise non-living animal body, Volta's suitability as a bearer of the French institutional sciences' gift of cultural capital depended in some sense on his dexterity in dispelling this peculiar effect. No longer expressing itself in and through the animal, no longer confused with a particular kind of matter, life henceforth retreated, as Foucault puts it, into the "*obscur de l'organisme*."²⁸⁵

Life remains "*indéfiniment éloigné mais constituant*," in Foucault's phrase, not only for the organism itself but also for the disciplines that would eventually arise to study it. "*Il y a histoire naturelle*," he writes, "*lorsque le Même et l'Autre n'appartiennent qu'à un seul espace; quelque chose comme la biologie devient possible lorsque cette unité de plan commence à se défaire et que les différences surgissent sur fond d'une identité plus profonde et comme plus sérieuse qu'elle*."²⁸⁶ The conditions of possibility of something like biology arise, however, not only with the emergence of this "deeper identity" but also with the imperative to leave this identity in the wings of positive knowledge, never directly manifested. As Foucault's mentor Georges Canguilhem observed, the notion of a science of life ironically corresponds to the banishment of life itself from scientific inquiry. The emerging sciences of life, Canguilhem writes, failed to develop a methodology adapted to studying living things *as* living, instead taking the form of "satellite" disciplines, characterized by their "submission" to the means and ends of "physico-chemical sciences."²⁸⁷ Just as the reception of Volta's pile at the *Institut* offers an abridged glimpse at how the ideal of exactitude reshaped physical science in France, so Volta's polemic

²⁸⁴ Michel Foucault, *Les Mots et les choses: une archéologie des sciences humaine* (Paris: Gallimard, 1966), 290.

²⁸⁵ *Ibid.*, 280.

²⁸⁶ *Ibid.*, 277.

²⁸⁷ Georges Canguilhem, *Knowledge of Life*, trans. Stefanos Geroulanos and Daniela Ginsburg (New York: Fordham University Press, 2008), xx, 59 and 120.

with Galvani offers an abridged glimpse at the process by which vital phenomena per se came to be banished from scientific investigation. Significant in itself, this episode also emblemizes the much longer process through which “life” became positive science’s constitutive other.

For Canguilhem, this submission was both methodological and institutional in nature, determining the shape of biology as a discipline through the twentieth century. Cuvier’s *Rapport historique sur les progrès des sciences naturelles depuis 1789, et sur leur état actuel*, commissioned by Napoleon, gives us a sense of the grounds for this submission. As we have already seen, Cuvier insists that even sciences not amenable to “*le calcul*” must be submitted to “*l’esprit mathématique*,” but a closer look at his text indicates what precisely these notions mean to him as well as where the boundaries between sciences of calculation and sciences of a more general “mathematical” orientation lie. “*L’expérience seule*,” writes Georges Cuvier,

*l’expérience précise, faite avec poids, mesure, calcul et comparaison de toutes les substances employées et de toutes les substances obtenues, voilà aujourd’hui la seule voie légitime de raisonnement et de démonstration. Ainsi, quoique les sciences naturelles échappent aux applications du calcul, elles se font gloire d’être soumises à l’esprit mathématique; et par la marche sage qu’elles ont invariablement adoptée, elles ne s’exposent plus à faire de pas en arrière: toutes leurs propositions sont établies avec certitude, et deviennent autant de fondemens solides pour ce qui reste à construire.*²⁸⁸

Situating “*les sciences naturelles*” between “*les sciences physiques*” on the one hand and “*les sciences morales*” on the other, Cuvier defines them as taking up where “*les phénomènes ne sont plus susceptibles d’être mesurés avec précision, ni les résultats d’être calculé avec exactitude*,” and leaving off “*lorsqu’il n’y a plus à considérer que les opérations de l’esprit et leur influence sur la volonté*.”²⁸⁹ On the one hand, he seems to mean that chemistry, for example, may be subject to precise, quantifiable experimentation but that we do not yet know enough to codify the movements of material particles in mathematical laws. On the other hand, he seems to mean that living or once-living things not only do not lend themselves to description by mathematical formula but that they may also often prove inimical to quantification of any kind. Though in both cases these sciences therefore enjoy only “*le second rang pour la certitude de leurs résultats*,” as Cuvier writes, they must nevertheless adhere to what he calls the new “*esprit général*” of the sciences. In other hands, the terrain might have been mapped differently; the “natural sciences” might have been construed as encompassing moral, mental or voluntary phenomena, whether mathematized or not. For Cuvier, however, the message is clear: though the natural sciences may

²⁸⁸ Cuvier, *Rapport*, 389-90.

²⁸⁹ *Ibid.*, 5-6.

only ever hope to attain a lesser degree of certitude, even this achievement hinges on imitating the exactitude of the physical sciences wherever and however possible.²⁹⁰

But what exactly does it mean to “calculate with exactitude,” and how does this penchant for exactitude suffuse the “*esprit général*” of the sciences? The *Institut*’s official report on Volta’s presentations sheds more light on the power and versatility of this ideal. Though Volta had shown that “galvanic fluid” and other apparently diverse electric phenomena could be reduced to a single kind of electric current, the “*véritable loi*” that governed “*la distribution et le mouvement de l’électricité*,” as we have seen, remained, in the commission’s view, unknown.²⁹¹ “*S’il reste encore quelque chose à faire pour déterminer avec exactitude les lois de cette action singulière*,” the report reads, “*et les soumettre à un calcul rigoureux, du moins les faits principaux qui doivent servir de base paroissent invariablement fixés*.” The rhetoric of exactitude pervades the report. In prior experiments, we are told, the commission itself had attempted to determine “*avec exactitude les conditions propres à développer et à modifier les effets galvaniques*,”²⁹² and in the present conjuncture it takes care to testify to “*la vérité et l’exactitude*”²⁹³ of Volta’s experiments. Moreover, the report tells us that we do not yet know “*assez exactement*”²⁹⁴ how electrical currents circulate between different fluids, since most experiments had been confined to the conductive properties of solids. More experiments must be done to determine “*les données exactes*” at work in electrical conduction and to determine “*avec exactitude les lois*” governing the conduction of electricity from one material to another.²⁹⁵ In the commission’s *Rapport*, then, “exactitude” characterizes experimental procedure, the facts that arise from experiment, and the determination of natural laws. *Exacte, exactement, exactitude*: each of these lexical permutations hints at the breadth and adaptability of the notion, and perhaps, given their ubiquity, at the intellectual glamour of the discourse to which it belongs.

Opposed to the mode of experimentation, data-gathering and reasoning practiced by Volta, exactitude otherwise remains ill-defined in the report, marking out a mode of doing science that becomes all the more powerful, perhaps, for being implicit. Yet the very pliability of the word may be a sign that something more than a mere concept is at stake. Writing on the experimental practices of late eighteenth- and early nineteenth-century French savants, Christian Licoppe goes so far as to identify a “culture of exactitude” on the rise in the sciences of the time. In this culture, the universality of experimental results is constructed through a rhetoric in which the

²⁹⁰ The Emperor commissioned this report from Cuvier in his capacity as Secretary of the physical sciences section of the First Class of the *Institut*. It was ceremonially presented to the Emperor at meeting of the *Conseil d’État* in February 1808, along with a complementary report by Jean-Baptiste Delambre on the “*progrès des sciences mathématiques depuis 1789, et sur leur état actuel*.” According to the account by Maurice Crosland, the report was presented by “a deputation of the First Class of the Institute headed by the elderly Bougainville . . . and the two permanent secretaires, Delambre and Cuvier, . . . also including Lagrange, Monge, Berthollet, Haüy, Lacépède.” *Society of Arcueil*, 44-45.

²⁹¹ Biot, “Rapport,” 208.

²⁹² *Ibid.*, 196.

²⁹³ *Ibid.*, 197.

²⁹⁴ *Ibid.*, 207.

²⁹⁵ *Ibid.*, 208.

very different elements of experimental protocol, measurement and reasoning coalesce in “exactitude.” As Licoppe writes of the experimental memoirs of Lavoisier, Coulomb and others, “*la rhétorique de l’exactitude est le principal ressort persuasif interne au texte en ce qui concerne la certitude du discours théorique lui-même.*” The rhetoric of exactitude might extend, as Licoppe points out, to the sensitivity of an instrument, as in the chemist Lavoisier’s observation that “*Je m’étois muni . . . d’une balance très exacte,*” or to the measurements of which such an instrument might be capable. But it also expresses the match between measurement and theory, as in a statement about the resistances of fluids by the academician Jean-Charles, chevalier de Borda (1733-99): “*On voit à la seule inspection de cette Table,*” notes de Borda, “*que les résistances suivent fort exactement la proportion des carrés des vitesses.*” “*D’une qualification de la manière dont l’expérience est redoublée par la loi,*” concludes Licoppe, “*l’exactitude peut ensuite venir s’attacher au statut de vérité de la théorie elle-même.*” Writing of his experiments on combustion, Lavoisier, for instance, skips from one of these acceptations to the other: “*Cette quantité est exactement celle des matériaux qui ont été employés,*” he affirms, “*et il en résulte une confirmation frappante de l’exactitude de la théorie.*”²⁹⁶

If the rhetoric of exactitude remains malleable, the goal of experimentation for those who adhered to it remains fixed. For the proponents of exactitude, Newton remained the scientific hero par excellence, as much for what he had achieved as how. Just as Newton had mathematized the relationships among celestial bodies, they themselves would seek to mathematize the particles of the world’s matter. Newton’s law of universal gravitation has its corollary in the “*loi véritable*” that the *Institut* sought for electricity. As the author of the report, Jean-Baptiste Biot (1774-1862), insists elsewhere, “*le véritable objet des sciences physiques,*” is “*la recherche des lois suivant lesquelles les phénomènes sont produits,*” laws which he does not hesitate to identify with the “*principes de mouvements*” of invisible, imponderable particles. Like Newton describing the revolutions of the planets, the *physicien* must mathematize the movements that inhere in varieties of “matter” as divergent as electricity, light or air. These matters’ different styles of movement must be characterized, Biot insists, “*numériquement et avec la dernière précision,*” the extrapolation of such laws to cover the extent of relevant phenomena constituting, he writes, “*le dernier degré de perfection de la philosophie naturelle.*”²⁹⁷

Though this language of natural “laws” might sound unexceptional to modern ears, it broke with the physics of the immediate past and clashed with the expectations of many of the Parisian savants’ contemporaries. As Pancaldi shows, Volta himself pursued experimentation on electricity without seeking a universal law, content to characterize the motion of electricity in general terms. Licoppe similarly differentiates the ambitions of Lavoisier and his collaborators from French experimentalists who emphasized the practical application of their results or the spectacular qualities of their demonstrations, as well as from the French savants’ British contemporaries, much less prone to mathematize their findings. Contrary to the irregular world inhabited by Bernardin and even to the world of spectacular effects and practical applications affirmed by many French experimentalists and their British compatriots, the universe assumed by the pro-

²⁹⁶ Licoppe, *La formation de la pratique scientifique*, 256.

²⁹⁷ Biot, “Sur l’esprit de système,” *Mélanges scientifiques et littéraires* (Paris: Michel Lévy Frères, 1858), 2: 112. Emphasis his.

ponents of exactitude constituted a perfectly regular system. The aim of arriving at a given natural law presupposed the unchanging nature of what we might call, modifying Chateaubriand, the “physical evidence.” Laplace’s presupposition of a perfectly determinate universe is perhaps the most famous expression of this ideal. For Laplace, everything that happens in physical Nature can be described by natural laws, true everywhere and for all time. In past eras, he writes in the *Essai philosophique sur les probabilités*, ignorance of how particular events related to the “*système entier de l’univers*” led people to attribute them to “*des causes finales, ou du hasard, suivant qu’ils arrivaient et se succédaient avec régularité, ou sans ordre apparent.*”²⁹⁸ But Newton’s mathematization of the planetary system provides a model of what can equally well be done with all the universe’s physical components. “*Une intelligence qui, pour un instant donné, connaîtrait toutes les forces dont la nature est animée,*” Laplace famously speculates, “*et la situation respective des êtres qui la composent, si d’ailleurs elle était assez vaste pour soumettre ces données à l’analyse, embrasserait dans la même formule les mouvemens des plus grands corps de l’univers et ceux du plus léger atome: rien ne serait incertain pour elle, et l’avenir comme le passé, serait présent à ses yeux.*”²⁹⁹

Like Cuvier, Biot affirms that even sciences which cannot give rise to mathematical laws must be subordinated to the mathematical imagination. Yet Biot’s sense of the rightful domain of exactitude is even more expansive than that of Cuvier, his sense of the ways in which this notion can be creatively deformed in contact with new objects and new problems even more gymnastic. How can exactitude govern sciences whose objects resist description as mathematical laws? The lens is turned on Cuvier himself in a passage in which Biot discerns this spirit in the activities of measurement and observation, as well as calculation. In this passage, part of a public speech Biot delivered on the “*esprit d’invention et de recherche dans les sciences*” at the *Institut* in 1814, a succession of *tableaux vivants* animate the triumph of the modern sciences, dramatizing the labors of famous living savants. The sciences are guided, Biot asserts, by “*l’esprit observateur et géométrique,*” a mode of inquiry characterized by “*une attention scrupuleusement exacte et minutieuse en apparence, mais guidée par l’invention et l’imagination.*”³⁰⁰ Biot touches on the labors of the astronomers who fix “*avec une précision presque idéale*” the eclipse of stars and who measure “*avec une égale exactitude*” their position in the sky, as well as on the work of the geometers, like Newton, Lagrange or Laplace, who forge equations to express the relationships among bodies celestial and terrestrial. But he also animates portraits à *clef* of the crystallographer René Just Haüy (1743-1822) and the comparative anatomist Georges Cuvier, the first absorbed in measuring the angles of a crystal’s faces, seemingly fearful, we read, that “*l’instrument dont il se sert n’ait pas, à son gré assez d’exactitude,*” the second examining a fossil bone whose “*contours*” he draws “*avec exactitude*” while measuring “*minutieusement les sommets et les cavités.*”³⁰¹ The rhetoric of exactitude adapts itself here to objects as diverse as minerals and an-

²⁹⁸ Pierre-Simon Laplace, *Essai philosophique sur les probabilités* (Paris: Mme Ve Courcier, 1814), 2.

²⁹⁹ Ibid.

³⁰⁰ “Discours sur l’esprit d’invention dans les sciences,” *Mélanges scientifiques et littéraires* (Paris: Michel Lévy Frères, 1858), 2: 89.

³⁰¹ Ibid., 90-91.

imal remains, specifying a certain mode of measurement whose degree of precision is “*presque idéale*” while also characterizing a mode of drawing informed by a minute attention to detail. Even though these forms of scientific activity are not directed toward articulating mathematical “laws,” their means of observation and representation effectively subordinate them to the spirit of exactitude. And their assimilation to a particular institutional framework, the one identified by Biot as belonging not just to the *Institut* but to a particular cadre within the *Institut*, co-opts the otherwise rather trivial word “exactitude” in such a way as to identify it with the epistemic presumptions of this group.

In distributing the benefits of exactitude, Biot, as we have already seen, did not stop at crystallography or comparative anatomy. His article on the influence of “*idées exactes*” on literary works goes so far as to apply the ideal of exactitude to works of fiction and poetry, as well.³⁰² In Biot’s article, the notion of exactitude annexes literary production into a single cultural formation crowned by the physical sciences. In justifying this annexation, he deforms the virtues of exactitude as they might pertain to the composition of fiction, theater and poetry, just as he had with crystallography or comparative anatomy. Never explicitly defined, Biot’s “*idées exactes*” remain as fungible in his article as they would in his *Rapport* on Volta. On the one hand, they refer to the true facts about Nature that appear in literary works, in contrast to facts about the physical world which contravene what the sciences know to be true. On the other, they define the economy of expression typified by classical works and *grand siècle* writers like Racine, as well as the representation of universal moral phenomena, including emotions like Dido’s grief which are, Biot asserts, “*de tous les siècles et de tous les pays.*” Characterizing the factual content of literary works, the language in which they are written and the moral phenomena they convey, the notion of exactitude had enabled Biot to combat writers like Chateaubriand and Bernardin on their own terrain. But this sally in the culture wars over Newtonianism was only an extreme expression of a tendency that played out more intensively within the institutional sciences themselves. At its most expansive, exactitude was imagined to preside over verbal, visual and mathematical modes of description, and to assume rightful control over the description of both physical and moral objects in pursuits as far-flung as mathematical physics, literary writing, and natural history.

In spite of the almost irreconcilable variety of these different modes of representation, what unites them under the rhetoric of exactitude is the possibility of increasing “precision,” the possibility of arriving at ever finer quantities or visual representations. In matters of observation, this possibility expressed itself as a mistrust of sensory impressions alone. If the spectacle of Nature produced aesthetic effects both in its capacity to bring the world to the senses and to exhibit the world’s beauty, the proponents of exactitude dissociated certain knowledge from the category of the “aesthetic” altogether, denying both spectacular wonder and bare sense perception as viable scientific data. The suppression of sense data as a basis for scientific reflection comes through quite clearly in a report on Lavoisier’s decomposition and recomposition of water that

³⁰² See the exploration of Biot’s article “*De l’influence des idées exactes dans les oeuvres littéraires*” in the Introduction to this dissertation.

appeared in the *Journal Polytype* (26 February 1786).³⁰³ The report remarks that the water produced by the combination of “*gaz hydrogène*” and “*air vital*” was acidic to the taste, and takes care to explain away this anomaly by recalling that “*l’acide nitreux*” is produced from a combination of “*gaz azote*” and “*air vital*” when stimulated with electricity. Yet it concludes by calling attention to the inadequacy of sense evidence alone as material for scientific reflection. “*Nous terminerons cet extrait par une courte réflexion sur l’exactitude qu’on doit apporter dans les expériences de chimie,*” we read. The methods of past chemistry “*ne saurait être sûre,*” the passage continues, “*puisque nos sensations ne nous rendent un compte exact de ce qui nous affecte, qu’autant qu’elles nous offrent des rapports susceptibles de précision. Or, de tels rapports ne se manifestent point entre des saveurs, des odeurs, etc.*” In yet another expression of an increasingly common hierarchy of the disciplines, we are told that the exactitude in question must be achieved through imitation of “*la physique générale.*” “*Cette science,*” we read of chemistry, “*séparée longtemps de toutes les autres, crut pouvoir se passer des poids et des mesures auxquels la physique générale était redevable de ses plus belles découvertes.*” Conscious of making a methodological intervention, the passage also makes a historiographical one in arguing for the subsumption of chemistry under the quantitative ideals at work in reasoning, observation and experimentation in such areas of “general physics” as astronomy.

For Lavoisier, sense data remain inexact not because the senses can fool us but because they are not “*susceptibles de précision.*” They somehow lack a quality that numbers inherently possess, the capacity to be refined on a single scale, along an asymptote toward infinity. Though it might be possible to observe more attentively or more acutely, a given sense datum can never grow more refined relative to itself in quite the same way that one measure of a physical effect can be superseded by a still more delicate one. As Lavoisier asserts, moreover, the relationships among “flavors, smells, etc.” are no more subject to description in certain terms than the individual flavor or smell itself might be. Yet data that conduce to the kind of “*compte exacte*” that Lavoisier has in mind are characterized both by their capacity for refinement and for their commensurability with one another, affording the possibility of fixing the relationship between one datum and another as one can do when comparing one measurement with another can do but not when comparing a taste, for instance, with a smell. For Lavoisier the capacity for numerical refinement underpins the possibility of defining the “law” of a given physical effect, not just a rough approximation of the physical relationships in question but a mathematical definition rigorous enough to stand for all time. In disciplines that could not hope to give rise to mathematical laws, this valorization of precision is construed as a quest for the “detail.” As Biot imagines, Cuvier’s fossil drawings achieve unprecedented exactitude because of their faithfulness to the original and their minute attention to the particularities of a given bone. But even here, the exactitude of the rendering is guaranteed by the careful measurements of the bone’s proportions. The natural sciences’ submission to the “*esprit mathématique*” occurs through such compromises and adaptations, the translation of numbers’ capacity for refinement to a more general rhetoric of the detail.

³⁰³ “Développement des dernières expériences sur la décomposition et la recomposition de l’eau,” *Oeuvres de Lavoisier*, ed. J.-B. Dumas et al. (Paris: Imprimerie Nationale, 1892), 5:332-34. Published without author, this article nevertheless appears in Lavoisier’s collected works. The editor remarks that though the article refers to Lavoisier in the third person “*il est probable qu’il en a rédigé la plus grande partie.* (320)”

In the rhetoric of exactitude this notion of “detail” signals true knowledge’s independence from evidence based on sensory estimation. But if the virtue of exactitude confirms the autonomy of epistemic from “aesthetic” concerns (in both this term’s expansive and restrictive senses), it also asserts the autonomy of epistemic from moral concerns. Laplace’s insistence that the revolutions of the comets tell us nothing about “final causes” expresses the divorce of God and Nature for the purposes of the physical sciences. We no longer know nature thanks to the legibility of the “moral evidence” but rather through the isolation of moral meaning from physical fact. But while moral discourse no longer participates directly in constituting knowledge of Nature in the physical sciences, it continues to inflect the discourse of exactitude in more implicit ways. No longer integrated with the right knowledge of Nature, moral ideals nevertheless continue to saturate notions about the right kind of knower. In this respect, exactitude can be understood as an “epistemic virtue” in the same way that the virtues documented by Daston and Galison can be. As we shall see, the notion of exactitude fills an important historiographical gap in Daston and Galison’s account of the transition from eighteenth-century modes of representation to the nineteenth-century practice of “objectivity.” Like each of the epistemic virtues they describe, exactitude comports both a purely epistemic element, favoring some kinds of knowledge about Nature over others, as well as an ethical element, prescribing the moral qualities understood to correspond to such knowledge.³⁰⁴

If “exactitude” characterizes the epistemic dimension of this virtue, as it perceived itself, at least, then “rectitude,” we might say, characterizes its ethical dimension. As Germaine de Staël declares in *De la littérature*, “*C’est à l’étude des sciences physiques que l’on doit cette rectitude de discussion et d’analyse qui donne la certitude d’arriver à la vérité lorsqu’on le désire sincèrement.*”³⁰⁵ It is no accident that rectitude and certitude rhyme in de Staël’s formulation; even for her, the physical sciences model the virtues that correspond to certain knowledge, offering examples of both moral integrity and method to other forms of philosophy. In this way, the moral virtues of “exactitude” trickle down from the physical sciences to other disciplines in much the same way that its strictly epistemic virtues do, as well. For de Staël, the purely physical nature of the evidence in question guarantees the savant’s integrity, establishing the conditions for a kind of certainty that other fields of inquiry can never quite enjoy. “*C’est donc en appliquant, autant qu’il est possible,*” she continues, “*la philosophie des sciences positives à la philosophie des idées intellectuelles, que l’on pourra faire d’utiles progrès dans cette carrière morale et politique dont les passions ne cessent d’obstruer la route.*” As Ken Alder writes, physical nature constituted an impersonal proving ground for the virtues of the savant. “The pursuit of precision was a moral quest as much as a scientific one. Its consummation proved that the inves-

³⁰⁴ Daston and Galison present the notion of the “epistemic virtue” in *Objectivity* (New York: Zone Books, 2007), 39-42. In Chapter One I argue that eighteenth-century natural philosophy is guided by the virtue of “*admiration*” which probably coexists with and competes against the “truth-to-nature” approach Daston and Galison identify. This chapter argues that a discrete ideal of “exactitude” emerged during the early nineteenth century, distinct from “objectivity,” and Chapter Three identifies the rise of the virtue of “synthesis” that emerged to counter the professionalized practice of exactitude. Determining the historical and conceptual relationship between exactitude and objectivity lies outside the bounds of the present study, though it would likely be enormously useful in elucidating the historical epistemology of the nineteenth century.

³⁰⁵ Germaine de Staël, *De la littérature considérée dans ses rapports avec les institutions sociales* (Paris: Flammarion, 1991), 364.

tigator possessed the patience, skill, and rectitude to reveal nature's predictability and lawfulness."³⁰⁶ In Alder's account of the invention of the meter, the astronomer Jean-Baptiste Joseph Delambre stands as a paragon of such virtues. To confirm Laplace's theory of Uranus, Delambre observed the night sky for eight hours at a time, "then spent equal time," Alder reports, "on daytime calculations."³⁰⁷ As an illustration of the kind of credit such virtues obtained, Alder cites Alexander von Humboldt commenting on Delambre's work on the meter. "*Le caractère personnel de Delambre inspire certainement autant de confiance que l'excellence des instruments employés à cette opération,*" writes von Humboldt. "*Il faut ce tempérament calme, cette gaieté tranquille, cette persévérance pour finir un travail, qui rencontre tant d'obstacles physiques, moraux et politiques.*"³⁰⁸ If Delambre's equanimity could certify the value of his results in von Humboldt's view, this was because it disposed him to pursue the physical evidence to its most minute degree, undistracted by outward turmoil or the vagaries of imagination.

The savant's "rectitude" is not only sharpened by the challenge of refining physical measures but is preserved, moreover, by the solitude commonly imagined to suit the scholarly life. Absorbed by labors, indifferent to self-interest, the savant embraced solitude as his natural milieu. "*C'est pour obtenir du crédit ou du pouvoir qu'on étudie la direction de l'opinion du moment;*" writes de Staël, "*mais qui veut penser, qui veut écrire, ne doit consulter que la conviction solitaire d'une raison méditative.*" For de Staël, the savants of the physical sciences epitomized this indifference to "credit," "power," and "opinion" and a capacity to be captivated exclusively by the "*plaisir de découvrir des idées nouvelles:*" "*dans les sciences exactes surtout,*" she asserts, "*il y a beaucoup d'hommes à qui ce plaisir suffit.*"³⁰⁹ In de Staël's view, the autonomy of the exact sciences from the moral and political spheres and from other forms of intellectual production is precisely what justifies their broader influence. If "we owe a certain rectitude of discussion and analysis" to the "study of the physical sciences," as she puts it, then, "*c'est . . . en appliquant, autant qu'il est possible, la philosophie des sciences positives à la philosophie des idées intellectuelles, que l'on pourra faire d'utiles progrès dans cette carrière morale et politique dont les passions ne cessent d'obstruer la route.*"³¹⁰ No less than Biot, de Staël promotes the distribution of epistemic ideals associated with the exact physical sciences to other forms of cultural production. The rectitude of these men, the influence they might justly exercise over political philosophy, and their moral and intellectual greatness even give them, for de Staël, a certain right

³⁰⁶ Ken Alder, *The Measure of All Things: The Seven-Year Odyssey and the Hidden Error that Transformed the World* (New York: Free Press, 2002), 60.

³⁰⁷ *Ibid.*, 82.

³⁰⁸ Alexander von Humboldt "Au baron de Zach, Paris, 3 juin 1798," *Lettres américaines d'Alexandre de Humboldt*, ed. E. T. Hamy (Paris: Librairie Orientale et Américaine, 1905), 2. Quoted in Alder, 219.

³⁰⁹ De Staël, *De la littérature*, 320.

³¹⁰ *Ibid.*, 364.

to power per se. “*Nous possédons dans les sciences, et particulièrement dans les mathématiques,*” she affirms categorically, “*les plus grands hommes de l’Europe.*”³¹¹

Yet the savant’s solitude could take on multiple valences, constituting the appropriate setting for disinterested truth-seeking at one moment, leaving the truth-seeker vulnerable to the deviations of imagination the next. This tension between retirement and influence structures Cuvier’s formulation of the savant’s persona in the funeral elegies he delivered as perpetual secretary of the *Académie des sciences* (or of the First Class of the *Institut de France* prior to the reestablishment of the *Académie*.)³¹² If solitude often underwrites the authority of the savants Cuvier eulogizes, corroborating their disregard for wealth or “glory,” it can also figure as proof of a chimerical “*esprit de système.*”³¹³ Cuvier condemns the late Jean-Baptiste Lamarck (1744-1829) as a fanciful speculator in these very terms: “*Sa vie retirée, suite des habitudes de sa jeunesse, sa persistance dans des systèmes peu d’accord avec les idées qui dominaient dans les sciences, n’avaient pas dû lui concilier la faveur des dispensateurs des grâces.*”³¹⁴ For Cuvier, Lamarck’s solitude is not a sign of his rectitude but a cause of his eccentricity, an explanation for his failure to take part in the style of knowledge-making then ascendant in the sciences.

Moreover, the link Cuvier draws between Lamarck’s style of natural philosophy and his inability to please the “*dispensateurs des grâces*” insinuates the degree to which the natural philosopher’s disinterestedness was a myth. Lamarck’s economic precarity attends his refusal to align himself with “*les idées qui dominaient dans les sciences,*” including those espoused by Cuvier, a domination that was as much material as intellectual. As Bourdieu might say, the “objective” state of the persona of the exact natural philosopher differed from its depiction in contemporary discourse, entailing as it did the active pursuit of Napoleonic patronage or the favor of figures like Laplace or Cuvier himself, who served as intermediaries in the distribution of the

³¹¹ Laplace and Berthollet come under criticism for their “flattery” of Napoleon in the memoirs of some of those close to him (Bourienne, Mme de Rémusat); it is a curiosity that they and their ilk retain the reputation of disinterestedness in the writing of someone estranged from the regime.

³¹² Cuvier was secretary for the physical sciences section of the First Class of the *Institut* from 1799-1801, then again from 1803-1822. The First Class of the *Institut* became the *Académie des sciences* once more in 1816. “Secrétaires perpétuels de l’Académie des sciences de 1666 à nos jours,” accessed 13 October, 2014, http://www.academie-sciences.fr/academie/membre/liste_sp.htm.

³¹³ As Outram points out, Cuvier’s many posts, especially his secretaryship at the *Académie des sciences*, gave him a powerful platform from which to articulate the persona of the savant given his official positions. He also delivered funeral *éloges* at the important private *Société Philomatique* after 1795 and at the *Académie française* following his election in 1818. “Cuvier became the main agent of biographical evaluation,” Outram writes, “not only for the two major bodies of official French culture, but also for one of the most important Parisian private scientific societies.” n. 4 p 162. Cuvier’s *éloges* were widely diffused in print and he also contributed forty-two articles on savants for the *Biographie universelle*. Dorinda Outram, *Georges Cuvier: Vocation, Science and Authority in Post-Revolutionary France* (Manchester, NH: Manchester University Press, 1984), 156.

³¹⁴ Georges Cuvier, “Éloge de Lamarck, lu à l’Académie des sciences le 26 novembre 1832,” *Mémoires de l’Académie des Sciences* 13 (1835): xxix. This funeral elegy was intended to be read immediately after that of Volta by François Arago in the 27 June 1831 session, but Cuvier’s death in the cholera epidemic that ravaged Paris that year delayed the reading and made it posthumous to them both. We shall return to Arago’s *éloge* of Volta over the course of this chapter.

State's material and symbolic rewards.³¹⁵ While Napoleon was capable of exposing the scientific field directly to state power, as Volta's medal attests, he also influenced the shape and content of the scientific field indirectly, through the mediation of figures like Cuvier. These Janus-like figures exploited their pre-eminence in the sciences to achieve the status of notables, and exploited their status as notables to control the legitimation of scientific speech. Though Cuvier memorializes Lamarck from a putatively neutral vantage point, he was himself one of the very scientific patrons whom Lamarck had failed to court over the course of his career. In Cuvier's mouth, the phrase "*dispensateurs de grâces*" obscures a false position; for if on the one hand it seems to refer to the largesse of the Emperor and later of the Bourbon kings, figures to whom Cuvier himself was subject, it also refers to those figures, like Cuvier himself, who through their preeminence in both the emerging scientific field and the chambers of state power were uniquely poised to mediate the distribution of symbolic and material resources among their scientific peers.³¹⁶ Member of Napoleon's *Conseil d'État*, commissioner of Public Instruction and eventually baron and Grand Officer of the Legion of Honor under the Restoration, Cuvier not only rose to dominance within the sciences but also joined the ranks of Empire notables. In this respect, the relationship between material and symbolic capital exhibited in the emergent scientific field contrasts absolutely with that exhibited in the literary field described by Bourdieu. As the careers of figures like Cuvier indicate, a direct, rather than inverse, relationship inhered between the material and symbolic resources disposed of by the members of the emergent scientific field. Under the Consulate, Empire and much of the Restoration, the most powerful actors within the scientific field were also powerful notables, and the least powerful actors within the scientific field disposed of little outside power.

Far from eschewing the quest for "credit and power," then, to which de Staël claimed the mathematical physicists were especially indifferent, the principle figures of the culture of exactitude avidly pursued it. If savants like Volta, Cuvier or Laplace (Chancellor of Napoleon's Senate, Count of the Empire and eventually Marquis and Peer of France under the Restoration) found that, thanks to Napoleon's largesse, their cultural capital as scientific producers paid handsome dividends in money and honors, they also found that these money and honors translated back into influence in the realm of scientific production, helping to achieve unrivaled sway over the defini-

³¹⁵ For an account of how what I am calling the discourse of rectitude informed debates about the compensation of savants at the formation of the Institut, see Crosland, *Science under Control*, 62-66.

³¹⁶ The degree to which Cuvier's contempt for Lamarck puts him in alignment with the scientific ideas of Napoleon (or on the contrary, to which Napoleon's scientific ideas ended up selecting for figures like Cuvier) is illustrated in an anecdote recounted by the astronomer François Arago. Presented to the Emperor upon his election to the Institut in 1809, he witnesses a lamentable exchange between the Emperor and Lamarck: "*Le vieillard présent un livre à Napoléon,*" writes Arago. "*Qu'est-ce que cela? dit celui-ci. C'est votre absurde Météorologie, c'est cet ouvrage dans lequel vous faites concurrence à Matthieu Laensberg, cet annuaire qui déshonore vos vieux jours; faites de l'histoire naturelle, et je recevrai vos productions avec plaisir. Ce volume, je ne le prends que par considération pour vos cheveux blancs. — Tenez !* » Et il passe le livre à un aide de camp.

Le pauvre M. Lamarck, qui, à la fin de chacune des paroles brusques et offensantes de l'Empereur, essayait inutilement de dire : « C'est un ouvrage d'histoire naturelle que je vous présente », eut la faiblesse de fondre en larmes." *Histoire de ma jeunesse*, 152.

Napoléon's contempt arises from what he perceives as Lamarck's perpetuation of an early modern mode of science, in the style of Matthieu Laensberg's *Almanach de Liège*, even as the naturalist was attempting to present his celebrated *Philosophie zoologique*.

tion of research programs and the careers of other savants. The list of these Janus-like figures is extensive, though few maintained their positions for as long as Cuvier or Laplace or translated their prestige into scientific standing as successfully. At various times Claude-Louis Berthollet (1748-1822), Gaspard Monge (1746-1818), Bernard Germain, comte de Lacépède (1756-1825), Antoine François, comte de Fourcroy (1755-1809), Jean-Antoine, comte Chaptal de Chanteloup (1756-1832) and other savants of the same generation were appointed to political or honorary positions at the heights of their scientific careers.³¹⁷ Napoleon's status as a patron of the sciences has long comprised part of his myth, and these figures' elevation to prominence is a well-known feature of Empire culture. Yet by a curious effect, perhaps of the very discourse of rectitude that was generated at the time, the savants' status as seekers of patronage has been comprehensively neglected. Little has been written about how they themselves went about courting and retaining Napoleon's favor. Nevertheless, a crucial element of the Empire-era savant's "objective" persona clearly emerges through these relays between the scientific field and the political beyond, bending to the pursuit of *grâces* on the one hand while condescending to the distribution of posts and honors on the other.

Though the leaders of the culture of exactitude were all men, women, too, participated in it anonymously, sometimes publicly, and often "privately" as assistants to male savants. The conditions under which women could fittingly participate in exact science parallel those which governed women's capacity to assume the status of "author" in the case of non-scientific texts. The career of the mathematician Sophie Germain exhibits many of the interdictions marking women's participation in exact science. Germain obtained an education in mathematics from the *École polytechnique* thanks to a male pseudonym, corresponded with famous mathematicians as a male and submitted mathematical memoirs anonymously. She ultimately won a prize competition held by the *Académie des sciences* on elasticity theory and became a personal and professional contact of the mathematicians Joseph-Louis Lagrange (1736-1813), Adrien-Marie Legendre (1752-1833) and Joseph Fourier (1768-1830); yet she never married. The tensions riving the possibility of a female exact natural philosopher emerge in a review article written by Biot, on the publication of an anonymous instruction book entitled *Conversations sur la chimie* (1809). Having discovered that the author of the book is none other than a woman, Biot incidentally attempts to forge a plausible persona for female scientific authors. In striving to identify just how a learned woman might fit into the social status quo, Biot effectively limits her to the status of an author of books rather than envisaging the possibility that she might undertake original experimental research or join scientific institutions. Just as women were typically associated with the production of novels and other relatively low genres, female scientific authors are implicitly suited, in Biot's view, to writing only teaching manuals or popularizations. "*Sans doute il est mille choses qu'une femme a bonne grâce d'ignorer*," writes Biot. "*Il est plusieurs études auxquelles il serait inutile et même dangereux de la livrer, parce qu'elles pourraient ternir la pureté*

³¹⁷ See Roger Hahn, "Chapter 8: The Politics of Science," *Pierre Simon Laplace, 1749-1827: A Determined Scientist* (Cambridge, MA: Harvard University Press, 2005), 120-39, for an account of Laplace's official duties. Crosland's biographical sketches of Berthollet and Laplace in *The Society of Arcueil* indicate the extent to which administration, taxation and legislation all became part of these savants' portfolios (72-73, 100). See also Nicole et Jean Dhombès, "Les scientifiques au service du pouvoir," *Naissance d'un nouveau pouvoir: sciences et savants en France (1793-1824)* (Paris: Editions Payot, 1989), 691-772.

de son imagination sans aucune utilité bien réelle Par exemple, il serait certainement inutile qu'un femme allât passer ses journées dans un laboratoire de chimie; mais s'il est possible . . . de lui présenter les principaux phénomènes chimiques, d'une manière simple, abrégée, et cependant exacte, elle en retirera de très-grands avantages pour l'intelligence d'une multitude de productions de la nature, ou de procédés des arts, qui s'offrent partout à ses yeux."³¹⁸ Biot's commentary on the status of women in the culture of exact knowledge intervenes, in effect, in more general debates on the education of women. Male experts mete out the knowledge of Nature to which it seems appropriate that women have access, and this access is fundamentally limited, moreover, by what is likely to be "useful" to her in a domestic capacity. "On ne voit pas comment une femme serait moins aimable pour savoir que le principe qui entretient la flamme entretient aussi la vie," writes Biot with implausible sentimentality; "ou moins vertueuse pour avoir appris comment le sang se forme dans ses veines, et le lait dans son sein; ou moins bonne mère de famille pour connaître les caractères et les propriétés des sels qu'elle devra peut-être présenter un jour comme médicaments à ses fils."³¹⁹

Minimizing aesthetic data and maximizing measure, re-defining the persona of the savant and re-ordering the social space in which he functions, exactitude takes on the shape of an epistemic virtue over the last few decades of the eighteenth-century and the first few decades of the nineteenth. As an epistemic ideal, exactitude shapes quantification and mathematization in ways that conflict with and seek to displace modes of inquiry associated with both spectacular and practical-minded experimentation. But if "exactitude" clearly differs from the virtue of "admiration" and from the middle epistemology of savants influenced by the worlds of engineering and manufacturing, what distinguishes it from the "objectivity" which Daston and Galison identify as the overarching epistemic virtue of the nineteenth century?

For Daston and Galison the "high moral tone" of the discourse of objectivity arises in censure of personal subjectivity and its potential excesses. The moral discourse of objectivity, they argue, incited the self to a kind of "willed willessness," in which the individual and necessarily partial subjectivity of the observer had to be sacrificed in pursuit of impersonal truths. This negation of the self marks both the production of scientific images and the philosophy of the sciences under the regime of objectivity, Daston and Galison contend, producing what they call a "mechanical objectivity" modeled on the impersonal representations of machines, as well as a "structural objectivity" predicated on formal logic. "Nonintervention--not verisimilitude--lay at the heart of mechanical objectivity," they write, "and this is why mechanically produced images of individual objects captured its message best."³²⁰ Like the visual representations of mechanical objectivity, moreover, the philosophical statements of structural objectivity designate a kind of truth that lies beyond and sometimes in opposition to the faculties and interests of the subject.

³¹⁸ "Conversations sur la chimie," *Mélanges scientifiques et littéraires* (Paris: Michel Lévy Frères, 1858), 2: 98-99.

³¹⁹ Women had long since served as assistants and even collaborators to prominent savants, usually if they already belonged to his household in one capacity or another. See M. Orr, "Keeping it in the family: the extraordinary case of Cuvier's daughters," *Geological Society, London, Special Publications* 281 (2007), 277-286. But this phenomena was not limited to the culture of exactitude. Mary Terrall's recent work on Réaumur details his collaboration with a family friend, Hélène Dumoustier. See *Catching Nature in the Act* (Chicago: University of Chicago Press, 2014), 53-78. Lamarck's family too was famously employed in his scientific work.

³²⁰ *Objectivity*, 187.

As Daston and Galison write of the scientific self under structural objectivity, “only that small sliver of the thinking being counted, purified of all memories, sensory experience, excellences and shortcomings, individuality *tout court*--everything except the ability “to provide an argument which is as true for each individual mind as for his own.”³²¹ Each of these facets of “objectivity” emerge within a moral economy in which the negation of self primes the search for the truth.

What distinguishes the discourse of exactitude from both mechanical and structural objectivity is not only the total absence of “objectivity” and “subjectivity” as words or operative categories within it, but also the absence of this radical impulse toward self-negation. While proponents of exactitude warned against the excesses of the self, they draw an opposition between attention to detail and the seductions of imagination, not between objectivity and subjectivity. The *Éloge* delivered by the astronomer and perpetual secretary of the *Académie* François Arago (1786-1853) after the death of Volta captures this dichotomy. Of scientific beginners Arago intones, “*si une imagination impatiente devait leur faire abandonner la voie lente, mais certaine de l’observation, pour de séduisantes rêveries, peut-être seront-ils arrêtés sur ce terrain glissant, en voyant un homme de génie qu’aucun détail ne rebutait.*”³²² Along with Cuvier’s damning “*éloge*” of Lamarck, intended to be delivered the very same day, this speech illustrates the generality of the discourse of exactitude. Arago’s moral discourse turns on the virtues of a man capable of doing successful battle with “detail,” manipulating instruments and protocol in such a way as to guarantee the rigor of experiment, never giving in to the “seductive rêveries” of pure speculation. In lauding Volta’s rigor, Arago praises him not for suppressing his “self” but for avoiding the temptations of speculation.

A corresponding passion for detail emerges in Lavoisier’s censure of sensory impressions as experimental data. This censure is motivated not by an identification of sense perception with personal subjectivity or mistrust of the senses per se, but rather by an emphasis on the special quality of numbers, their capacity for refinement. For the proponents of exactitude, the ideal remained a progressively more fine-grained fit between the physical world and the representations that could be made of it, an ideal of verisimilitude, to borrow Daston and Galison’s terms, and not of “non-intervention.” If the virtues which abetted this project were sometimes, in a sense, “passive,”--the patience and fortitude to bear long periods of observation, for example, or to set aside physical discomfort in the manipulation of delicate instruments--they were not “negative” for all that. For von Humboldt, after all, the personal qualities of Delambre— “this calm temperament, this tranquil joy, this perseverance”—guaranteed the value of his results as much as did the precision of his instruments. In place of objectivity’s “willed willessness” the rhetoric of exactitude affirms the will to achieve ever finer detail.

In this light, the naturalist Étienne Geoffroy Saint-Hilaire was perhaps right to have identified the preoccupation with “detail” as emblematic of the age. Geoffroy frequently retold an anecdote dating back to his service in Napoleon’s Egypt expedition, pitting Napoleon himself against the geometer Gaspard Monge. In Geoffroy’s anecdote, Napoleon is holding court at the

³²¹ Ibid., 301.

³²² “Éloge historique d’Alexandre Volta, lu à la séance publique du 26 juillet 1831” *Mémoires de l’Académie royale des sciences de l’Institut de France* (Paris: Firmin Didot Frère, 1833): lxxiii.

Academy of French savants he had established in Egypt, and expresses regret at having sacrificed his earlier ambitions in physics to a military career, abandoning a rivalry with Newton to pursue one with Alexander. In response, recounts Geoffroy, “*Monge fit valoir la portée de ce joli mot de Lagrange: Nul n’atteindra à la gloire de Newton: il n’y avait qu’un monde à découvrir.*”³²³ But, retorts Napoleon, Lagrange is wrong, for there *is* more than one world to discover, if not *le monde astronomique* mastered by Newton then a “*monde de détails*” that had yet to be explored. If Newton had succeeded in mathematizing “*le système planétaire,*” Geoffroy records Napoleon as having asserted, he himself had dreamed of discovering “*comment s’opère le mouvement qui se communique et se détermine par l’intervention des plus petits corps.*”³²⁴ It was Napoleon, writes Geoffroy, who invented this expression “*le monde de détails,*” thereby bearing witness to a concern for “*les vrais intérêts de l’humanité*” more immediate than the pure philosophical speculations of Newton’s cosmology, and championing the benefits that might accrue “*de l’appréciation, du contact et de l’actualité de la vie sensuelle, de la connaissance des relations et du jeu des détails.*”³²⁵

Foucault cites this anecdote in *Surveiller et punir* as evidence of the ever-finer units of control achieved by the powers of the late eighteenth and early nineteenth-centuries. In so doing, he offers a means of understanding the geometer’s dream of taming material particles on the same grounds as the powers’ dreams of taming individual bodies. During this period, writes Foucault, these powers pioneered “*tout un ensemble de techniques,*” for achieving detailed control, “*tout un corpus de procédés et de savoir, de descriptions, de recettes et de données.*”³²⁶ We know that the great *physiciens géomètres* of the Napoleonic era ultimately failed to codify the movements of imponderable particles, and that, in any case, this ambition itself could never have done justice to the complexities of an “atomic” world. Yet if Foucault is right, their attempts belong to the same cultural impulse that led to the development of the bureaucratic apparatus of the Empire.

In observing that the Emperor “*a voulu aménager tout autour de lui un dispositif de pouvoir qui lui permette de percevoir jusqu’au plus petit événement de l’État qu’il gouvernait,*” and wished to embrace “*l’ensemble de cette vaste machine sans néanmoins que le moindre détail puisse lui échapper,*” Foucault himself offers in *Surveiller et punir* a hint at how to bring the emergence of the nineteenth-century positivities described in *Les Mots et les choses* into the everyday dynamics of social and political history.³²⁷ In the figure of Cuvier as we encounter him in *Les Mots et les choses*, we find the transition from a natural history of living things to a natural science of “life” already complete. But in the distinctive cultural landscape of early nineteenth-

³²³ Étienne Geoffroy Saint-Hilaire, *Notions synthétiques, historiques et physiologiques de philosophie naturelle* (Paris: Dénain, 1838), xxiv. As we shall see in the next chapter, Geoffroy Saint-Hilaire ultimately co-opts the notion of “detail” for his own purposes. Embracing both living and non-living matter, Geoffroy’s notion of detail will be consistent with his reaction against Cuvier’s mode of adapting “*l’esprit mathématique*” to the life sciences and his embrace of a vital materialist “synthetic” science.

³²⁴ *Ibid.*, xxviii.

³²⁵ *Ibid.*, xxvi.

³²⁶ Michel Foucault, *Surveiller et punir: Naissance de la prison* (Paris: Gallimard, 1975), 166.

³²⁷ *Ibid.*, 165.

century France, the transition from one science to another reflects the preponderant influence exercised by a few powerful individuals, Cuvier among them. Cuvier's comparative anatomy and the novel acceptance of life it implied emerged in "submission," as the naturalist put it in the *Rapport*, to the physical sciences and, ultimately, to Napoleon himself. As a naturalist, Cuvier himself did not, of course, practice the "exact" methods of the physical sciences per se. But in adhering unconditionally to the hegemony of the physical sciences, he helped, powerfully and individually, to set the conditions of possibility for the emergence of a science of "life." Without reducing epistemic change to the effects of individual agency, we can correlate the growth of the discourse of "life" which Foucault associates with Cuvier with the naturalist's capacity to mediate between the *dispensateurs des grâces* and the community of savants. Given the tight centralization of the institutional sciences in France and the pre-eminence of a handful of figures within them, Cuvier among them, epistemic change during this period may well descend to the scale of individual historical action, pursued by those who were best placed to mediate between state power and the legitimation of scientific speech.

Though the scientific uses of "detail" may well do more than parallel its bureaucratic uses, it would be much too simple to claim that political causes resulted in scientific effects. Like Foucault, Daston and Galison avoid grounding epistemic change in socio-historical circumstances. They seek, they write, an "intrinsic, homogeneous answer to the question "Why objectivity?," balking at ascribing its rise to historical events like the French Revolution, the Industrial Revolution or the Second Scientific Revolution. Yet by linking the articulation of epistemic ideals to the "virtues" imagined to favor them, Daston and Galison themselves offer a means of correlating epistemic change and material history without reducing the one to the other. As Schaffer and Shapin have long since shown, the contours of scientific personae reflect not just the explicit moral discourse that shapes a given mode of knowing but also the much more quotidian ensemble of behaviors and conventions that designate the social status of the knower.³²⁸ A given period's problematization of the virtues a knower must practice may not tell us everything we need to know about the persona of the knower; the "pastoral" virtues of savants as described by de Staël or Cuvier clash, as we have seen, with the worldly realities of their time. Yet insofar as the virtues of the knower inform the persona he or she inhabits, they contribute powerfully to our knowledge of the social coordinates of a given epistemic ideal. In spite of Daston and Galison's reticence about the social correlates of objectivity, the notion of the "epistemic virtue" lends itself to an illumination of the social history of epistemic ideals.

As Cuvier's deference to the *"dispensateurs des grâces"* suggests, moreover, the persona of the savant responds to social pressures exerted both from within and from beyond the sciences proper, influences productively described in terms of the dynamics inhering in Bourdieu's notion of the "field." By treating the "field" as a tool for historical analysis, we can ask how the rise

³²⁸ See Steven Shapin and Simon Schaffer's *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life* (Princeton: PUP, 1986) for an account of the persona of the "gentleman" in the natural philosophy of Boyle's time. See also Lorraine Daston and H. Otto Sibum, "Introduction: Scientific Personae and their Histories," *Science in Context* 16.1-2 (2003), 1-8 for the notion of the "persona." Among the growing literature on scientific personae are works by Martin Rudwick, *The Great Devonian Controversy: The Shaping of Scientific Knowledge among Gently Specialists* (Chicago: University of Chicago Press, 1985); Charles Thorpe, *Oppenheimer: The Tragic Intellect* (Chicago: University of Chicago Press, 2006); and Paul Rabinow, *Making PCR: A Story of Biotechnology* (Chicago: University of Chicago Press, 1996).

of exact science and the social phenomena alluded to by Foucault and Daston and Galison interrelate without reducing the one to the other. Savants like Cuvier or Laplace absorb the head of state's interventions into scientific affairs to aggrandize their own status within the field, while the head of state patronizes these figures to legitimate the regime. Yet these conjunctures also push us to ask how the notion of the field obtains under conditions when the field itself is clearly still emergent. As I have argued, the "autonomy" of the field is two-fold, pertaining both to a given kind of cultural production's articulation with state or economic power and to its articulation with neighboring forms of cultural production. As long as the incentives guiding a given savant's production take shape within the conditions associated with a low degree of "horizontal" autonomy, the kind of autonomy governing its relationship with other forms of cultural production, the influences which Bourdieu describes as "refracted" by the dynamics internal to the field may plausibly be expected to diffuse in alternative ways. The history of Volta is intended to show how one scientific agent negotiated the social pressures associated with rival epistemic ideals at a time when the scientific field as such was still emerging. Hesitating between the distinct epistemic cultures of London and Paris and adapting his work to suit each alternatively, Volta ultimately skyrockets to fame and fortune thanks not to the internal dynamics of the sciences in Paris but rather to the direct intervention of the head of state.

The First Consul's action shows that in Volta's time the sciences were relatively non-autonomous in the vertical as well as the horizontal dimension. In contrast, the "objective" sciences studied by Daston and Galison had already attained the status of independent professions. As such, they are both vertically and horizontally autonomous, fully capable, that is, of absorbing political and economic power according to the special dynamics of the field and indifferent to the incentives associated with other forms of cultural production. Yet understanding how the sciences achieved that degree of autonomy entails an examination of the epistemic ideals that precede the emergence of objectivity. In this context, the notion of "exactitude" helps us understand where the professionalized nineteenth-century sciences which Daston and Galison study came from in the first place. As in Chapter One's inquiry into the discourse of "admiration," this chapter's characterization of "exactitude" expands Daston and Galison's notion of the epistemic virtue by showing that it does more than govern scientific production per se, participating to boot in the construction (and destruction) of notions of scientificity. The particular form of cultural production we associate with autonomous science itself emerges, I aim to show, from the triumph of exactitude as an epistemic ideal.

In the remainder of this chapter, I shall focus most closely on the epistemic dimensions of exactitude and on its role in the horizontal autonomization of the sciences. In the first part of the chapter, I shall more closely parse exactitude's particularity relative to experimental practices pursued in the spirit of admiration or utility, showing how it differed historically from prior epistemic ideals and how it continued to differ from epistemic ideals in force elsewhere in Europe in the early nineteenth century. In the second part of the chapter, I shall return to Volta's consecration at the *Académie des sciences* as an instance when the practices of spectacular display and an engineering-oriented middle epistemology are transformed into the high epistemology of the elite French savants. In the third, I shall explore the criteria according to which the partisans of exactitude distinguished scientific inquiry from other forms of cultural production, and how the low degree of vertical autonomy implied by Napoleon's cultural policy facilitated the differentia-

tion of cultural forms. And finally, I shall show how Volta's discoveries about the nature of electricity in animal bodies contributed to a broader trend orienting the institutional study of living things, helping to generate the terms according to which animal bodies could be studied as purely physical, rather than vital, objects. The methodological effect of Volta's polemic with Galvani over the nature of animal electricity was to abet a notion of life that could subsequently be excised from professional study in preference of the animal's physico-chemical components. This step, I argue, reflects the adaptation of exactitude to areas of inquiry beyond those, like astronomy, chemistry or investigations of light and heat, out of which it first emerged, and the institutionalization of these sciences as "satellite" or "ancillary" disciplines relative to physics or chemistry. As I hope to show, this institutional subordination takes place within a dynamic according to which the Napoleonic patronage of the exact sciences provides the cultural and economic capital to incite the autonomization of the sciences as an autonomous form of cultural production.

In his funeral elegy for Alessandro Volta, the astronomer François Arago would look back at the seminal events of November 1801 from thirty years' remove.³²⁹ By then, Volta had long since joined the pantheon of great physical scientists, memorialized as the conqueror of Galvani and the discoverer of contact electricity. Yet Arago, speaking as perpetual secretary of the institution that had awarded Volta his famous medal, strains, we sense, to justify this gesture. "*Les usages, disons plus, les règlements académiques, ne permettait guère de donner suite à cette demande,*" recounts Arago, of the First Consul's proposal to award the medal to Volta. Arago objects that the sciences would never have performed such a gesture if left to their own devices. "*Mais les règlements sont faits pour les circonstances ordinaires,*" the secretary concludes, "*et le professeur de Pavie venait de se placer hors ligne.*"³³⁰ Arago struggles here, we may feel, to reconcile his sense of academic propriety with his duties as memorialist of Volta and perpetual secretary of the Academy. Though he tells us that Volta's achievement places him "*hors ligne,*" his sensitivity to Napoleon's breach of institutional decorum leads us to suspect, perhaps, that it was the First Consul whose behavior was really, for Arago, "out-of-line." In the secretary's formulation, a celebration of Volta's extraordinary merit displaces a condemnation of Napoleon's extraordinary temerity. Given the circumstances, it would no doubt have been impossible to allude to the impropriety of Napoleon's action in more explicit terms, even though, following a succession of governments, the sciences could plausibly have vaunted a high degree of vertical autonomy. What was at stake in Arago's periphrase was not only the reputation of a great savant but, more crucially, the myth that the sciences had been autonomous from power all along. To unmask Napoleon would also, in this case, have been to expose the *arcana imperii* of the sciences, as well.

II. A Parisian Ideal

³²⁹ Volta had died in 1827 but the elegy was delivered in 1831, when Arago assumed the post of *secrétaire perpétuel*.

³³⁰ "Éloge de Volta," xcvi.

As a northern Italian, Volta stood poised between two rival scientific networks, one converging on Paris, the other on London, the great scientific centers of late eighteenth-century Europe. The Italian professor initially achieved more recognition among the savants of London; during the seventeen-eighties and -nineties the theologian, natural philosopher and experimentalist Joseph Priestley became his most energetic and powerful foreign correspondent, and the support he received among the members of the Royal Society culminated in the Copley Medal awarded him in 1794 in recognition of his triumph over Galvani. French military victories in Italy contributed to re-orienting Volta's initiatives toward Paris, however, for while the Austrian administration of Lombardy had facilitated his travels and correspondence with London, the French victory over the Austrians in 1800 increasingly eased the road to Paris.³³¹ During a time of European war, the tensions reigning among the scientific milieux of Paris and London inevitably took on a national character, though French and British savants continued to correspond with one another as members of a putatively neutral "republic of Letters."³³² As we have seen, the minutes of the *Institut* cast Napoleon's proposal to medal Volta as a signal that Paris is ready to welcome the discoveries of foreign savants. In this light, Napoleon's gesture figures as a brilliant rejoinder to the award of the Copley Medal, signaling a competition over the cultural capital enjoyed by learned men in the interest of national prestige.

This rivalry between Paris and London was also a question of competing epistemic ideals and assumptions about how to practice science, with British savants, generally speaking, prizing the invention of new instruments and a broader, more democratic experimental culture, while French savants prized theory and the centralization of experimental culture around fewer instruments of extreme precision.³³³ If this tension between a culture of "utility" and one of "precision" can be expressed in geographic terms, it is chronologically oriented, as well. The experimental traditions associated with spectacular display and useful application increasingly fell to the lot of the past, while the emphasis on a pure, exact science increasingly belonged to a vision of progress. As Giuliani Pancaldi's biography intricately shows, Volta's scientific practice stands at the crossroads not only of London and Paris but also of tradition and innovation, notably with regard to his assumptions about the means and ends of experimentation. While sense experience and rough approximation often served as experimental data for Volta, only quantities of extreme precision sufficed for the proponents of exactitude. And while the invention of new machines that could successfully elicit previously unsuspected, often spectacular physical phenomena often constituted the final product of Volta's experimentation, the invention of measuring machines constituted just a first step in the elaboration of universal laws in the practice of the proponents

³³¹ For the role of the Battle of Marengo in re-orienting Volta's plans, see Pancaldi, *Volta*, 234-35.

³³² See Ken Alder's account of the invention of the meter for details on the international dimension of scientific initiatives during France's foreign wars, "The Empire of Science," *The Measure of All Things*, 235-262. See also Jan Golinski's "'The Nicety of Experiment': Precision of Measurement and Precision of Reasoning in Late Eighteenth-Century Chemistry," *The Values of Precision*, 72-91 for details on exchanges among French and British chemists.

³³³ These differences emerge in the gamut of sciences collectively explored in Christian Licoppe's *La formation de la pratique scientifique*, and Jan Golinski's "'The Nicety of Experiment': chemistry, surveying, physical experimentation, electricity and others. For more detail on the values of "values" in the London setting, see also John Heilbron, "A Mathematician's Mutiny, with Morals," in *World Changes: Thomas Kuhn and the Nature of Science*, ed. Paul Horwich (Cambridge, MA: MIT Press, 1993).

of exactitude. Although the new pure precision science achieved resounding successes, what I hope to show here is that, far from constituting the *ne plus ultra* of scientific “method,” it ultimately favored some kinds of valuable inquiry while precluding others, maximizing some aspects of experimental objects while minimizing others. As embodied in Biot’s report on Volta, the rhetoric of exactitude occluded, as we shall see, the chemical dimension of electrical currents, for instance, an element of Volta’s machine that was only brought to light once the zeal for extreme precision had somewhat abated.

As a natural philosopher, Pancaldi suggests, Volta is generally more invested in revealing new aspects of how and where electricity functioned than in identifying the nature of electric matter or arriving at the “law” which might explain this matter’s behavior, aspects of the study of electricity favored by his Parisian counterparts. The phenomena Volta was able to reproduce through the invention of instruments like the “electrophorus” begged to be theorized, yet at critical junctures he tended to defer the articulation of a “theory” in favor of continuing experimentation.³³⁴ “Several electricians throughout Europe,” writes Pancaldi, “were convinced by the early 1780s that there *was* indeed a Voltaic “system” of electrical science, which could valuably be built on by its author, or, should he fail to pursue the task himself, by others.” Yet, as Pancaldi contends, “the Voltaic “system” of electrical science never materialized.” For this reason, he writes, “some in the 1780s could depict Volta as “the Newton of electricity,” Franklin being regarded as the Kepler, [while] others continued to regard him as merely an inventor of “*amusements électriques*.”³³⁵ If the status of a “Newton of electricity” assimilated him to the cutting edge exact natural philosophy of the Parisian academicians, that of a perpetrator of “*amusements électriques*” linked him to the increasingly obsolete tradition of spectacular experimentation.

Like many figures who experimented on electricity during the period, Volta was profoundly shaped by the spectacular tradition. As we saw in Chapter One, the rhetoric of spectacle flowed beyond the non-experimental natural philosophies of Bernardin de Saint-Pierre or Chateaubriand, and their forebears Bonnet and Buffon (to mention just a few) to shape experimental practice as well. The public displays staged by Réaumur, for instance, readily embraced the power of spectacle to bring otherwise hidden physical relationships to the senses and to produce compelling sensory impressions on a community of witnesses. Before an assembly at the *Académie des sciences*, Réaumur’s demonstration of the tiny freshwater polyp’s capacity to self-reproduce required an expert *mise en scène*; and the success of the cataract operation he performed, the meager audience of which so aroused Diderot’s ire, depended as much on what the witnesses saw as on what the blind woman did. The innovation of the electrophorus, Volta’s first signature instrument, occurs, Pancaldi contends, as Volta transformed aspects of pre-existing theory and *matériel* into a “simple, easily replicable, portable machine to be used in displaying electricity, and enabling a lecturer to give a full course on it, while at the same time conspicuously testifying to the ingenuity of its inventor.”³³⁶ As Christian Licoppe observes, spectacular experimentation relied on just such a “*mise en scène spectaculaire de phénomènes sensibles*,” and

³³⁴ See Pancaldi, 115-16 and 121.

³³⁵ *Ibid.*, 111.

³³⁶ *Ibid.*, 100.

the proliferation of statements like “I saw,” “I tasted,” or “I smelled” in experimental reports testifies to the status of sensory phenomena themselves as experimental data.³³⁷ Volta’s electrophorus participated in this economy by bringing the dynamics of static electricity to visibility in the form of impressive sparks, suitable for public display.

At the same time, Volta’s experimental practice also bears clear affinities with the practices of “utility” discussed in Chapter One, as embodied in the engineering culture embraced by Bernardin de Saint-Pierre. As in the engineer’s emphasis on functionality and *matériel*, Volta’s experimentation on electricity resulted in the electrophorus itself rather than in a particular theory, the form the machine ultimately took on embodying new knowledge about electricity’s behavior rather than participating in articulating it textually. The “middle epistemology” Ken Alder identifies in the culture of engineers has its counterpart, moreover, in the “mid-range conceptualizations” Pancaldi ascribes to Volta.³³⁸ Like the engineers depicted by Alder, Volta tended to proceed by modifying one experimental variable gradually, then another, pursuing a trial-and-error approach that might give rise to a working model of the physical relationship at stake and an optimal means of manifesting this relationship to the senses. In his experiments on the pile, for instance, Volta added charge to his conductors according to an incremental series, rather than seeking to confirm a theory matching a given charge with a given physical effect. Likewise, he varied the substances that composed the pile widely while observing their relative success as conductors, compensating for a lack of theoretical incisiveness about metals’ conductivity with a certain breadth of investigation. This variation of experimental parameters is more amenable to developing a rough model of a given physical system, as Alder points out, than to fixing a theory of the physical relationships at stake.³³⁹

Beyond these basic affinities with the cultures of spectacle and utility, Volta’s experimental practice proved mutable. Volta participated in what Licoppe calls the late eighteenth-century’s “metrocentrism,” a rush to create instruments of measurement rather than of vision, “-mètres” rather than “-scopes.” Volta’s “eudiometer,” for instance, measured the respirability of the air and his “straw electrometer” created a standard scale for measuring quantities of electricity.³⁴⁰ In his polemic with Galvani, moreover, Volta invented a new electrometer that could detect electrical currents as weak as the ones that were making Galvani’s frog legs twitch; whereas the frog legs themselves had been functioning in Galvani’s experiments as extremely sensitive detectors of electricity, Volta showed with the help of his “doubler” of electric charge that no organic material was necessary to generate currents between metals.³⁴¹ The rivalry with Galvani pushed Volta

³³⁷ *Formation de la pratique scientifique*, 260-61.

³³⁸ See Alder, *Engineering the Revolution: Arms and Enlightenment in France, 1763-1815* (Chicago: University of Chicago Press, 1997), 60; and Pancaldi, “Chapter Four: Volta’s Science of Electricity: Conception, Laboratory Work, and Public Recognition,” *Volta*, 110-145.

³³⁹ *Engineering the Revolution*, 60.

³⁴⁰ *Formation*, 276-77; on the innovation of instruments in general during this period see *Volta*, 207-10; Heilbron, *Electricity in 17th and 18th Centuries: A Study of Early Modern Physics* (Berkeley: University of California Press, 1979): 78-96; Heilbron, *Weighing Imponderables and Other Quantitative Science Around 1800*, 5-6; and Heilbron, “A Mathematician’s Mutiny, with Morals,” 106.

³⁴¹ *Volta*, 182.

to develop an electrometer more refined than any he had used before, in view of quantifying the minute forces which the contact of metals turned out to incite.

In spite of this incipient quantitative bent, the exact natural philosophers of Paris could still cast Volta's experimental practice as rudimentary in many ways. This is because Volta's experimental practice differs from that of the Parisian proponents of exactitude both in *how* he measured and what he *did* with his measurements. While for Volta, measuring the play of currents across a variety of substances itself constituted a fruitful research program, revealing aspects of electricity that had never before been suspected and generating new possibilities for experimentation, the Parisian academicians viewed this style of experimentation as un-rigorous, the measurements associated with it as inexact. For these academicians, the characterization of currents remained incomplete insofar as it did not descend to the "corpuscular" level to describe the displacements of what they imagined as electrical molecules. In their view, Volta not only failed to refine his measurements to such a degree that these events might be adequately characterized in corpuscular terms, he also declined to arrange his measurements in the form of rigorous "laws." While the notion of exactitude, as we have seen, could be used to conflate precise measurement and strict mathematical reasoning, this second step—the elaboration of rigorous mathematical formulae—is missing in Volta. Pancaldi's inspection of Volta's laboratory notebooks has revealed that calculation played a variety of roles in the professor's experimental practice, but "mathematization as such," he notes, "found little place in Volta's published work."³⁴² Though Volta appreciated the more sophisticated mathematical negotiations of such predecessors in electrical studies as Boscovich, Aepinus and Cavendish, his "quantifying strategy," Pancaldi asserts, "was deeply affected by his limited mathematical training."³⁴³ In light of the particular elements of his own technical repertoire, Volta remains content with rough characterizations of the exchanges of current at work—what Biot calls, not without malice, his "approximations" and what Pancaldi more charitably calls his "mid-range conceptualizations"—and avidly pursues the suggestive relationships these conceptualizations evoked while eschewing any attempt to fix them in "law" form. From the Parisian academicians' perspective, Volta's inexactitude arose from both the relative roughness of his measurements and his inability or disinclination to construe them as evidence for their own corpuscular assumptions.

The mutability of Volta's practice clearly emerges in the ways he presented his most famous discovery, the electrical "pile," in London and Paris, respectively. The pile emerged from his polemic with Galvani, as an attempt to show that metals could conduct electricity in the absence of frogs' nerves or muscles. A stack of metal discs, it proved capable of generating a spontaneous electrical current under controlled conditions for the first time in history. In London, Volta found that the instrument itself engendered more interest than the "mid-range conceptualizations" he had elaborated to explain its workings.³⁴⁴ In consequence, his presentation of the pile foregrounded the instrument itself, rather than the theory of its mechanism or its relationship to

³⁴² Ibid., 129.

³⁴³ Ibid., 137.

³⁴⁴ As Pancaldi writes, Volta's conceptual idiom translated imperfectly into the London setting and his presentation of his work there featured an "emphasis on instruments and a move away from theory. (224-28)"

the polemic with Galvani. As Pancaldi points out, the article with which Volta publicly introduced the pile in London, “On the Electricity Excited by the Mere Contact of Conducting Substances of Different Kinds,” is primarily devoted to an account of how to construct and operate the pile, with descriptions of various experiments it could be used to replicate.³⁴⁵ Only at the very end of the memoir does Volta allude to the “contact” theory of electricity which he had developed to explain the way electrical currents could be aroused by the simple touching of substances. In contrast, his presentation to the *Académie des sciences* of Paris one year later foregrounds the theoretical implications of the pile and presents it as conclusive evidence that electricity could be generated by the merecontact of certain substances. The memoirs he had previously published on the subject, he maintains, already articulated “*un système complet de théorie et de doctrine*,”³⁴⁶ and he corroborates his notion of contact by recounting a series of experiments whose outcomes are quantified through readings taken from an electrometer.

Perhaps the most striking difference in these writings is the total absence of the language of exactitude in the London memoir and its pervasiveness in the Paris memoir. Composed within a year of one another, this difference is explained by the context for which each was tailored rather than by any progress or change on Volta’s part. Not only does Volta use sense experience instead of quantities as experimental data in the London memoir, but the part of this memoir devoted to experimental effects takes the form of a narrative of the pile’s effects on each bodily sense, one by one. “*Le courant de fluide électrique, mu et sollicité par un tel nombre et espèces de conducteurs différents*,” he writes, “*n’excite pas seulement des contractions et spasmes dans les muscles, des convulsions plus ou moins violentes dans les membres qu’il traverse dans son cours, mais il irrite aussi les organes du goût, de la vue, de l’ouïe, et du tact, proprement dit, et y produit des sensations propres à chacun*.”³⁴⁷ The pile transmits numbness, stings and heat to the sense of touch, acid and bitter flavors to the sense of taste, flashes of light to the sense of sight, and regrettably little or nothing to the senses of hearing and of smell. “*La plus curieuse de toutes ces expériences*,” Volta continues, is one in which more than one sense is stimulated at the same time: one holds “*la lame métallique serrée entre les lèvres*,” he instructs, “*et en contact du bout de la langue; puisque, lorsqu’on vient ensuite compléter le cercle, de la manière convenable, on excite à la fois, si l’appareil est suffisamment grand, en bon ordre, et le courant électrique assez fort et en bon train, une sensation de lumière dans les yeux, une convulsion dans les lèvres, et même dans la langue, une piqûre douloureuse sur son bout, suivie enfin de la sensation de saveur*.”³⁴⁸ For Volta, bodily sensation itself constitutes experimental data, the more varied and curious the better.

³⁴⁵ Though the title of this article is in English, the article itself is written in French, a mark of the language’s status as international “scientific” idiom. The fact that both articles are written in French makes it all the easier to track the changes in Volta’s rhetoric from one to the other. *Philosophical Transactions of the Royal Society of London* 90 (1800): 403-431.

³⁴⁶ Volta, “De l’électricité dite galvanique,” *Annales de chimie* 40 (Dec. 1801): 225-56, 226. As the note accompanying this article in the *Annales de chimie* indicates, “De l’électricité dite galvanique” is the text of Volta’s address to the class of physics and mathematics at the *Institut national*.

³⁴⁷ “On the Electricity Excited by the Mere Contact of Conducting Substances of Different Kinds,” 420.

³⁴⁸ *Ibid.*, 426-27.

In this light, Volta's experimental discourse belongs to the tradition of spectacular experimentation progressively displaced in France by the exactitude advocated by Lavoisier and others, as we have seen. In the London context, Volta is less interested in fabricating laws than in arousing "curious" results and in raising areas of potential application. His use of the body as a source of experimental data parallels Bernardin's anthropometric estimates of earthly proportions. In both cases, it is the natural philosopher's own body that is asked to give an account of the physical relationships in question, even if in Bernardin's case the "experiment" is merely notional in nature. Neither subject nor object, the experimenter's body uniquely incorporates the study of Nature, locating knowledge in wonder or reflection on personal sensation. Neither the bodies of others nor independent quantities function as experimental objects or data in quite the same way as the experimenter's body does here. The rhetoric of curiosity merges here with that of utility, for Volta is most interested in parlaying this sensuous knowledge of Nature into medical therapies. Like many others, Volta immediately recognized the pile as a potentially useful instrument. At least at first, however, the applications imagined for it were medical rather than industrial. For Volta, the pile's sensational effects might one day be harnessed to produce new knowledge about the body in sickness and health. The pile's effects on the body, he writes, "*vont ouvrir un champ assez vaste de reflexions, et des vuës, non seulement curieuses, mais intéressantes particulièrement la médecine. Il y en aura pour occuper l'anatomiste, le physiologiste, et le praticien.*"³⁴⁹

In contrast, sense data is totally absent from the Paris memoir. In the place of descriptions of sensation we find numerical estimations, and in the place of a rhetoric of admiration or utility, we find the quantitative rhetoric of exactitude. Whereas Volta had limited himself in the London memoir to allusions to the sense effects of the pile and to the possibility of using a numerical electrometer, he focuses entirely on the numeric properties associated with different configurations of the pile. "*Il me semble convenable de déterminer avec précision et exactitude,*" he writes, "*les degrés que l'électricité reçoit du contact de deux métaux de nature différente.*"³⁵⁰ In his use of the rhetoric of exactitude, Volta alludes both to precise measurement and rigorous mathematical reasoning in the spirit of his Parisian counterparts. As Pancaldi tells us, Volta had determined a numeric value for the effects of his electrical condenser specially for his trip to Paris. But the adaptation of his experimental rhetoric to the Parisian context also impelled him to frame the explication of the pile as a search for the "law" of its functioning. "*La force ou l'impulsion que deux métaux donnent au fluide électrique,*" he writes, "*égale la somme des forces de ceux qui se trouvent dans la série ou l'échelle graduée entre ces deux métaux.*"³⁵¹ Electric current, that is, passed between discs of different pairs of metals with different degrees of force. If a pile were to be composed of discs of a variety of metals, the force of the current that passed between the first metal of the stack and the last would equal the sum of the forces passed between each intermediary pair, and the quantity of current passed between any two pairs within the stack would likewise be equivalent to the sum of the force between them. Volta qualifies this effect as

³⁴⁹ Ibid., 428-29.

³⁵⁰"De l'électricité galvanique," 228.

³⁵¹ Ibid., 251.

a “*rapport exact*,” a stable, experimentally reproducible relationship between varieties of metal and the electric current they conduct.³⁵²

The divergent experimental ideals according to which Volta tailors his two contemporaneous accounts of the pile evince a larger dispute among London and Parisian savants about the value of numbers. Jan Golinski, M. Norton Wise, Christian Licoppe and others have shown that the “exactitude” advanced by Lavoisier, Laplace and others maximized epistemic benefits that were indifferent to their counterparts in London while minimizing other benefits preferred by these counterparts. These perspectives highlight the rhetorical dimension of the discourse of exactitude, in showing that it functioned as a means of persuasion in a polemical context where the persuasiveness of this discourse itself was under attack. The aspects of exactitude that promised to lead to the perfection of physics in the view of its Parisian practitioners were precisely what made it so unconvincing to their London counterparts. The more democratic social configuration in which London savants found themselves embedded, the diverse publics their works coordinated and the quite distinct goals they set themselves corresponded to alternative practices of quantification, informed by different values. While the Parisians were accustomed to addressing an audience of pure savants, the London savants openly maintained links with manufacturers, artisans and merchants; while the Parisians valued precision measurements at the expense of replicability, the Londoners valued replicability at the expense of precision; and while the Parisians sought to transform the particulars of experimental results into the universals of natural “laws,” the Londoners construed experimental results as local effects whose horizon of applicability had yet to be determined in any given case.

The close rapport between British savants and artisans is evident in writings where the contributions of artisans to experimental practice are explicitly acknowledged and the value of the experiment to artisans and manufacturers in general explicitly conveyed. As Licoppe points out, English natural philosophers were much more inclined to express their debt to artisans’ opinions in their accounts of experiments, and instrument makers themselves were sometimes published in the Royal Society’s *Philosophical Transactions*.³⁵³ If skilled artisans sometimes make an appearance within the experimental narratives of natural philosophers, they also figured among the publics coordinated by these texts. Licoppe quotes from a narrative of experiments on iron in which the physician and natural philosopher Thomas Beddoes (1760-1808) represents himself as having acquired valuable expertise from a laborer at the forge: “*Un ouvrier très intelligent était . . . là,*” writes Beddoes, “*pour répondre à toutes mes questions, de sorte que je pus disposer également du bénéfice de son expérience.*”³⁵⁴ While Beddoes’ laborer aids him in his experimental set-up, the natural philosopher in turn undertakes to demonstrate the utility of his operations to artisans and particulars of means. However exact the measuring instrument used by the natural philosopher might be, it buttresses the authority of British natural philosophers only to the extent that it is easily manipulable and widely applicable, Licoppe contends. The surveyor William Roy even goes so far to make this assertion about a complex theodolite developed by

³⁵² “De l’électricité dite galvanique,” 252.

³⁵³ *Formation*, 305-06.

³⁵⁴ *Ibid.*, 305.

the famed instrument-maker Jesse Ramsden: “*Grâce aux quatre planches auxquelles réfère cette description,*” he writes, “*il est espéré que l’instrument pourra être compris par deux classes de personnes auxquelles il est principalement destiné; tout d’abord par ceux qui, possédant une telle machine souhaiteraient en acquérir pour eux-mêmes la maîtrise; et ensuite par des artistes assez ingénieux pour en entreprendre la construction.*”³⁵⁵ In contrast, artisans and instrument makers are mostly absent from the experimental accounts of French savants, displaced by the image of the savant as a prestigious unveiler of Nature’s laws. To some extent, moreover, the exclusive possession of the precision instrument underscored the French natural philosopher’s prestige. The case of Roy’s theodolite contrasts, for instance, with that of the “repeating circle” invented by the chevalier de Borda. If the congenial astronomer Delambre allows his assistant to take measurements with this rare instrument, his counterpart Méchain is perhaps more typical in maintaining an exclusive prerogative over its use.³⁵⁶ Far from feeling compelled to demonstrate the widespread availability and utility of their newest instruments, the French savants are more inclined to restrict their circulation.

The British natural philosophers’ imbrication with industry correlates with their relative distance from royal power. These natural philosophers often performed experiments on the premises of and at the behest of industry, seeking to yield results, as Josiah Wedgwood put it on the occasion of a report on the invention of a new thermometer, for both “philosophers” and the “practical artist.”³⁵⁷ On the contrary, attempts to secure royal patronage for scientific endeavors could arouse great animosity, as Roy found in courting the sponsorship of the king for a survey of the land. The relatively greater degree of vertical autonomy in the British sciences of the period corresponds to a lesser degree of horizontal autonomy, with regard to “industry” in all its acceptations (as well as to natural theological and poetic discourse). The situation is reversed in France; the sciences’ dependence on the royal sponsorship of the *Académie royale des sciences* removed a major incentive for collaborating with artisans or manufactures and the vast private fortune of Lavoisier was likewise consecrated to advancing his own experimental agenda and that of other naturalists of a similar mindset.

These differences in the material cultures of experimentation in Paris and in London corresponded to differences in the valorization of quantity. The kinds of quantities preferred by the respective parties differed to the extent that precision and replicability conflicted as ideals. The emphasis on replicability exhibited in large part by the English savants arises, it has been argued, in tandem with the impulse toward utility, the local effects of the experiment generalized to as many different experimental and functional contexts as possible, the extreme precision of measurements like those taken by the French seen as interfering with the widespread utility of the technique, the instrument, or the process. Even in experiments oriented toward discovering a “truth” about Nature, extreme precision was censured in England as a potential impediment to experimental verification by others. As Golinski shows in an examination of Lavoisier’s publica-

³⁵⁵ Ibid., 300.

³⁵⁶ On the repeating circle and on Méchain’s reservation of the right to use it see Alder, *The Measure of All Things*, 52-57 and 112-13, respectively.

³⁵⁷ *Formation*, 306.

tions on combustion, the extreme exactitude of Lavoisier's measurements impinged on the British preference for replicability. The London natural philosopher Joseph Priestley, for instance, not only cast doubt on the possibility of achieving the exactitude of measurement claimed by Lavoisier (to six, seven or eight decimal places), given his experimental apparatus, but also on the desirability of such precision in the first place. Of the experiment in which Lavoisier synthesized water, for instance, Priestley wrote that it required "so difficult and expensive an apparatus, and so many precautions in the use of it, that the frequent repetition of the experiment cannot be expected; and in these circumstances the practised experimenter cannot help suspecting the certainty of the conclusion."³⁵⁸ For Priestley, the very sensitivity of the experimental apparatus and the fineness of the quantities which it putatively realized undermined rather than clinched Lavoisier's claims, since these elements made it all the less likely that the results could be replicated.

This skepticism about the experiments' replicability resulted from more than just technical disagreement. At stake were the metaphysical assumptions underpinning the London and Paris savants' studies of physical nature. While the English authorize their discourse as *physiciens* on the basis, as Licoppe writes, "*d'un faire pratique qu'ils partagent et dont ils contrôlent la diffusion*" the French savants "*s'attacheront plutôt à se représenter dans le rôle de découvreur et de porte-parole d'un ordre naturel supposé a priori parfaitement régulier, immuable et absolu.*"³⁵⁹ The assumptions about Nature likely to be embraced by the British natural philosophers reflect the "local" world also evident in many ways in the natural philosophical discourse of Bernardin de Saint-Pierre. Prolific in repeat trials, prodigal in empirical particulars and cautious about drawing absolute conclusions, the British natural philosophers' circumspection about universalizing experimental results radically distinguishes them from their French counterparts. The nonconformist minister and natural philosopher Richard Price, for instance, emphasizes the potential irregularity of experimental results, however frequently an experiment had been replicated. For Price, writes Licoppe, "*Il peut toujours surgir quelque chose qui dérange l'ordre et la régularité attendus d'après une répétition des événements observée maintes fois.*" This solicitude for the local and discrete shapes the natural philosophical texts of Price and his colleagues. Just as Priestley objects to Lavoisier's magisterial succinctness, so Lavoisier objects to Priestley's earthbound prolixity. Of a treatise by Priestley, Lavoisier laments that "*le Traité n'étant en quelque façon, qu'un tissu d'expériences, qui n'est presque interrompu par aucun raisonnement, un assemblage de faits, la plupart nouveaux, soit par eux-mêmes, soit par les circonstances qui les accompagnent, on conçoit qu'il est peu susceptible d'extrait.*"³⁶⁰ Rather than reflecting a deficiency in scientificity per se, this highly circumstantial style of discourse reflects an order of experimentation that answers to other practical and epistemic imperatives than does that of exactitude. As Licoppe argues, the construction of authority among the English natural philosophers

³⁵⁸ Quoted in Golinski, "The Nicety of Experiment," 82.

³⁵⁹ *Formation*, 304.

³⁶⁰ *Ibid.*, 258.

is founded on “*le savoir-faire matériel nécessaire à la reproduction des faits, et un refus explicite de paraître monopoliser la vérité dans l’ordre du discours, et imposer celle-ci aux autres.*”³⁶¹

In similar fashion, the French savants’ tendency to seek simple, universal laws in complex experimental results contravenes the British preference for replication rather than proving detrimental to scientificity per se. Replication is by no means actively marginalized among the French practitioners of exact experimentation, but it occupies an implicit status in the narratives of experimentation they produce. Since the physicist’s role is to unveil a law “*dont il attend l’existence,*” Licoppe argues, “*une seule série de mesures peut à la limite suffire.*”³⁶² Within the narrative economy of the experimental reports of Coulomb, for instance, it is “tacitly” understood that “*la valeur obtenue est toujours obtenue par l’auteur avec une incertitude qu’il juge insignifiante, et que quiconque réutiliserait un tel dispositif, un autre jour, en un autre lieu, obtiendrait un résultat similaire.*”³⁶³ The care showered among the English on ensuring that readers of an experimental report would be able to replicate the experiment is absent in Coulomb, replaced by the almost iconic quality of the experimental value itself. It is the number rather than the process that circulates among the Parisians and their loyal correspondents abroad.

In the culture of exactitude, the number in question is more convincing the more closely it hews to mathematical projection. About Lavoisier’s repeated experiments on the decomposition of water, for instance, Licoppe writes that for him they are increasingly convincing “*parce qu’elles réédites ses expériences antérieures, mais parce qu’elles s’approchent plus des proportions idéales qu’il attend.*”³⁶⁴ At stake is the quantity’s capacity to be refined, its “*susceptibilité de précision.*” In fact, the British natural philosophers were right to cast suspicion on the French preoccupation with precision, as Thomas Kuhn, John Heilbron and other prominent historians of science have since affirmed. The British natural philosophers objected to the experimental results of Lavoisier and others on the basis that the quantities in question were too refined to have been measured as such, having been worked up to “crowds of irrelevant decimals,” as Heilbron puts it.³⁶⁵ Thus, the English lecturer and instrument-maker William Nicholson objects to those figures “carried to five, six, and even seven places of figures,” as impossible to replicate with any regularity, as well as to “the theoretical deductions in chemistry that depend on a supposed accuracy in weighing, which practice does not authorize.” “In general,” adds Nicholson, “where weights are given to five places of figures, the last figure is an estimate or guess figure; and where they are carried farther, it may be taken for granted that the author deceives either intentionally, or from want of skill in reducing his weights to fractional expressions or otherwise.”³⁶⁶

The numbers put forth by the proponents of exactitude, “these long rows of figures,” as Nicholson phrases it, often arose from the elaborate formulae used to correct for the effects of

³⁶¹ Ibid., 297-98.

³⁶² Ibid., 302.

³⁶³ Ibid., 246-47.

³⁶⁴ Ibid., 302.

³⁶⁵ Heilbron, *Weighing Imponderables*, 31. Kuhn, “The Function of Measurement in Modern Physical Science.”

³⁶⁶ Quoted in Golinski, 84.

temperature, pressure, humidity and other variables on the instruments being used. These formulae extruded figures whose strings of post-decimal numbers exceeded a given instrument's actual accuracy. For Nicholson and others, this discrepancy impinged on the credibility of their counterparts' results. Not only did the excessive "nicety" of these numbers constitute "a parade," as Nicholson put it, "which true science has no need of," but they also obscure the "real degree of accuracy" of which the experimental apparatus was capable. Far from impressing Nicholson with the experimenter's techno-scientific prowess, this style of quantification disposed him to "doubt," as he put it, appropriating Lavoisier's own terms, "whether the *exactitude scrupuleuse* of the experiments be indeed such as to render the proofs *de l'ordre démonstratif*."³⁶⁷ In his report on the decomposition of water, Lavoisier had asserted precisely that the "scrupulous exactitude" of the experiments had resulted in conclusions "of a demonstrative order." "*Cette double expérience*" he wrote, referring both to the decomposition and recomposition of water, "*une des plus mémorables qui ait jamais été faite par l'exactitude scrupuleuse qu'on y apporta, peut-être regardée comme une démonstration de la possibilité de décomposer l'eau, & de sa résolution en deux principes, l'oxygène et l'hydrogène, si toutefois le terme démonstration peut être employé en physique & en chimie.*"³⁶⁸ The plausibility of oxygen as a theoretical construct depended, in Lavoisier's view, on the "scrupulous exactness" of the measurements; yet this very consideration undermined its plausibility from that of Nicholson and his colleagues. "Precision of measurement and precision of reasoning," Golinski observes, "two elements of the 'quantifying spirit' that were intimately bound together in Lavoisier's practice, fell apart on the other side of the Channel."³⁶⁹

Lavoisier's parade of excessive refinement typified the quantifying practices of exactitude as a whole. The experiments Biot and Arago jointly undertook in 1806 on the refractive powers of gases similarly exhibit the way formulae for controlling for variables could modify exact measures. "The refractive powers" of the gases, writes Eugene Frankel, "are all given to six significant digits, whereas the angles, with all the correction factors taken into account, could only be measured to four."³⁷⁰ In their experiments, Arago and Biot might have obtained direct measurements of four decimal places, but were then obliged to process these numbers through standard formulae designed to correct for the vagaries of temperature, pressure and humidity on their instruments, variables that could not be experimentally controlled. The result was what Heilbron sardonically calls "one of the best cultivated numbers of their day."³⁷¹ In these and other cases, the relationship between measurement and mathematical reasoning supposed by the rhetoric of exactitude was reversed. Mathematical reasoning effectively preceded measurement

³⁶⁷ Kirwan, Richard. "Note de M. Lavoisier sur la décomposition de l'eau," *Essai sur le phlogistique et sur la constitution des acides, traduit de l'anglais de M. Kirwan, avec des notes de MM. Morveau, Lavoisier, de la Place, Monge, Berthollet & de Fourcroy*. (Paris: Rue et Hôtel Serpente, 1788), 65-66. Quoted in Golinski, 81.

³⁶⁸ Emphasis Lavoisier's. In insisting on the "demonstrative" order of the experiment, Lavoisier transports the certitude of mathematical proofs to the order of physical investigation. *Ibid.*, 65-66.

³⁶⁹ Golinski, 75.

³⁷⁰ Frankel, "J. B. Biot and the Mathematization of Experimental Physics in Napoleonic France," 61-62.

³⁷¹ Heilbron, *Weighing Imponderables*, 31.

in cases where the standard formulae shaped the final numerical value. “The last two digits in the refractive powers are meaningless,” Frankel writes of Arago and Biot’s data.³⁷² Yet though insignificant, the exact natural philosophers’ refined digits were not inconsequential: these figures’ extremities sustained the prestige of the physicists who forged them while representing the superiority of exact science in general, at least among those who were willing to be convinced.

The differences between Volta’s London and Paris reports reveal his efforts to satisfy the ideal of exactitude ahead of his sojourn to France. In the year that lapsed between these visits, Volta began re-orienting his experiments toward the production of precise quantities and the generalization of “laws” describing what was happening in the pile.³⁷³ Yet if these steps indicate Volta’s desire to transform his work into “exact” science, the *Institut* committee report made it clear how far Volta had yet to go. As we have seen, the report Biot and others produced on Volta’s work implicitly criticized the foreigner for the approximate nature of his measurements and his failure to mathematize his research, even going so far as to minimize the originality of Volta’s findings by assimilating it to the French tradition of electrical research. In particular, Biot and his colleagues on the Commission construed Volta’s findings as a coarse statement of facts that had either been anticipated by Coulomb, then deceased, or would eventually be articulated with greater precision by those working in his wake. Pressured by Napoleon’s direct intervention to celebrate Volta, these savants responded by arguing that the phenomena exhibited by the pile, remarkable as they were, could be comprehended by the search for microcosmic “laws of affinity” espoused in general terms by Laplace and realized in electrical studies in particular by Coulomb. Biot’s subsequent experimentation on the pile did show that certain of its aspects could be integrated into Coulomb’s framework. Yet in the study of the pile, the costs of exactitude included not just the imperatives of utility and sensation advanced by the London savants, but also the promising work initiated by other Parisian savants on the pile’s chemistry, not fully guided by the ideal of exactitude. Indeed, Biot’s use of Coulomb’s precise measuring instruments obscured crucial chemical events that were subsequently found to participate in the pile’s remarkable effects.³⁷⁴

In the memoir Volta presented to the *Institut*, as we have seen, he set forth what he called the “*rapport exact*” that linked the various pairs of metals he used in his experiments (zinc and silver, for example, or silver and copper, to name just two of many) and the strength of the current that passed between them.³⁷⁵ As he discovered, the electromotive force that arose between a

³⁷² Frankel, 61-62.

³⁷³ Pancaldi, 234-240.

³⁷⁴ See, for instance, Frankel, “J. B. Biot and the Mathematization of Experimental Physics in Napoleonic France” and particularly Geoffrey Sutton, “The Politics of Science in Early Napoleonic France: the Case of the Voltaic Pile,” *Historical Studies in the Physical Sciences*, 11:2 (1981).

³⁷⁵ Volta, “De l’électricité dite galvanique,” 252.

given pair of metal discs remained constant; placed in contact with one another, the same two metals always produced the same electromotive force. As Volta also discovered, the electromotive force that passed between pairs of metals discs stacked in a pile would only be cumulative if a “humid” material were present, interposed between one pair of metal discs and another. The “exact” relationships Volta had identified concerned the electromotive force passed between metals, or “first class” conductors, as he called them, and between first class conductors and humid materials, or “second class” conductors. The little discs of moistened cardboard Volta used as second class conductors proved necessary to the construction of powerful piles, but Volta admitted he was at a loss to explain just why. He was unable to explain to the *Institut* the role that moisture played in the propagation of an electric current aroused between metals any more than he was able to verify that voltaic effects could be aroused by contact between one kind of fluid and another. Yet the example of the electric eel’s shock-generating organ suggested either that such a phenomenon was possible or that a third, as yet unknown class of conductors existed in nature.³⁷⁶

Though Volta speaks the language of exactitude here, the kind of exactitude he has in mind pertains to the regularity of experimental effects, the possibility of inciting the same phenomena in repeat trials. Yet identifying regular effects most certainly did not fulfill the ideal of exactitude espoused by the Parisian natural philosophers, even when these effects were described in quantitative terms. In their eyes, Volta’s experimental protocol proved suggestive, but lacked both precision in measurement and rigor in isolating the physical dynamics in question. As Biot puts it in a passage from the *Institut*’s “Rapport” which we have previously encountered in part:

*Après avoir reconnu et évalué, pour ainsi dire, par approximation l’action mutuelle des élémens métalliques, il reste à la déterminer d’une manière rigoureuse, à chercher si elle est constante pour les mêmes métaux, ou si elle varie avec les quantités d’électricité qu’ils contiennent, et avec leur température. Il faut évaluer avec la même précision l’action propre que les liquides exercent les uns sur les autres et sur les métaux. C’est alors que l’on pourra établir le calcul sur des données exactes, s’élever ainsi à la véritable loi que suivent, dans l’appareil du citoyen Volta, la distribution et le mouvement de l’électricité, et compléter l’explication de tous les phénomènes que cet appareil présente. Mais ces recherches délicates exigent l’emploi des instrumens les plus précis qu’aient inventés les physiciens pour mesurer la force du fluide électrique.*³⁷⁷

Without denigrating Volta explicitly, Biot insinuates the partial and piecemeal character of his work. To “complete the explanation” of the pile’s phenomena, he asserts, it would be necessary to find out whether the “*rapport exact*” Volta had identified held steady under a much broader set of experimental conditions than Volta himself had investigated. If the metal discs were saturated with a higher degree of electricity, would the force of the current between them remain the same? Would temperature affect the force as well? Could liquids likewise be induced to exhibit regular electromotive effects? As Biot indicates, the electrometer invented by Volta for the purposes of

³⁷⁶ “De l’électricité dite galvanique,” 247-56.

³⁷⁷ “Rapport sur les expériences du citoyen Volta,” 208.

measuring this force would never be sufficiently precise for such a series of experiments, though the delicate “torsion balance” invented by Coulomb probably would.

These discreet criticisms blossom into full-blown contempt in the entry Biot later wrote on Volta for the *Biographie universelle*, long after the fall of Napoleon (1827). There, Biot judges that “*par un autre effet de cette tournure d’esprit qui le rendait insensible à la rigueur mathématique, [Volta] ne comprit jamais que son électroscope à pailles, qui était un instrument parfaitement propre à rendre sensibles la présence et la nature des électricités développées dans les corps, ne l’était point à mesurer leur intensité avec exactitude. . . . Ce fut vainement que l’on voulut faire comprendre à Volta la supériorité, nous dirons même la nécessité mathématique, de la méthode que Coulomb avait suivie pour obtenir ces mesures, fondement de toute la science.*”³⁷⁸ For Biot, Coulomb’s measurement techniques are the “*fondement de toute la science*”—in their particular application, of the science of electricity in particular, but also, perhaps, in their general mode, of science *per se*. Volta’s mere ability to detect the presence and relative intensity of electricity in the pile derogates from legitimate scientific inquiry in general, from this point of view, given the tight correspondence Biot presumes between the measurement, mathematization and proper scientific inquiry. In the report, Biot transformed the rudimentary expression of the “*rappports exacts*” that Volta had reported into algebraic form, offering formulae that described the “distribution and movement” of electricity in the pile under a variety of experimental conditions. As Pancaldi puts it, “in tune with his display of mathematical effectiveness and elegance, Biot—no doubt informed through Laplace and Coulomb of the story of Volta’s earlier, unsuccessful claims for recognition pressed on the Parisian natural philosophers since the 1780s—took the opportunity offered by the report on the battery to reassert what was regarded in Paris as *the* winning strategy in the science of electricity: a strategy based on a mathematical approach that, Biot argued, first introduced by Dufay, had led to Coulomb’s law via Franklin and Aepinus.”³⁷⁹

As Biot’s focus on Coulomb indicates, it was the minute description of electrical forces that counted in the study of the pile, the “electrostatics” that sought to describe the force exerted by one charged object on another and the distribution of electric force over the surface of the object.

Biot’s reports prepares the groundwork for establishing the study of the pile as an extension of Coulomb’s electrostatics. For him and the other members of the Commission, the pile was useful insofar as it presented a chance to extend Coulomb’s discoveries to a new experimental apparatus, tracing changes in the transmission of electromotive force from one end of the pile to another, and at different points within its body. As Geoffrey Sutton puts it, “Laplace and his protégé Jean-Baptiste Biot took up these problems within the general framework of Coulomb’s electrostatics. Their solutions presented great innovations in detail, . . . as well as a mathematical sophistication then uncharacteristic of experimental physics.”³⁸⁰ Ultimately, Biot produced a

³⁷⁸ “Volta (Alexandre),” *Biographie universelle ancienne et moderne*, 85 vols. (Paris: Michaud, 1811-1862), vol. 49 (1827), 460.

³⁷⁹ *Volta*, 242-43.

³⁸⁰ “The Politics of Science in Early Napoleonic France,” 345.

number of conclusions about the behavior of electricity in the pile which successfully translated Volta's observations into the much more sophisticated mathematical language of the exact natural philosophers. "The laws of motion for the galvanic fluid result from the repulsive properties of the molecules that compose it," he concluded, "and . . . from this point of view, these laws are the same as those for the electric fluid." Moreover, "the diversity of galvanic phenomena in different apparatus has for its cause the different combinations of the quantity of mass of that fluid combined with its speed."³⁸¹ The language of speed and mass was precisely that used by Newton for calculating the movement and distribution of celestial bodies. Thanks to advances in the mathematical description of the microcosm, Biot was able to put them to use in describing the movement and distribution of electrical ones.

So effectively did the *physiciens géomètres* assimilate the pile to electrostatics that it soon ceased to pose any interest to them at all. As Sutton observes, "Laplace and Berthollet did not spend long on the pile. For them, the new voltaic phenomena fitted neatly into existing programs of molecular forces."³⁸² Yet the imperatives of exactitude, extremely precise measurement and the mathematical depiction of "molecular" events led to a partial understanding of the pile. Biot's choice to adopt the electrostatic framework led him to minimize the role of chemistry in producing the pile's current. Yet as British savants soon discovered, the electromotive force aroused in the pile was caused by a chemical reaction, not by the difference in the electric charge of the two metals, as Biot presumed. This discovery explained why Volta's "second class" conductors were necessary in the construction of the pile; metal alone would not suffice to perpetuate the electric current because it lacked the water necessary to incite the chemical reaction. In an experiment in which different kinds of humid conductors produced different quantities of electricity, Biot foreclosed the possibility that chemistry was involved by presuming that these differences resulted from differences in the "conductive properties" of the substances, their ability to transmit the currents engendered by the metals alone. As Frankel writes, Biot's "choice of instrument"—Coulomb's torsion balance—"redefined the reality of the cell for him. The measured electrostatic charges became the *only true* indicators of a cell's activity, and electric current phenomena took on the secondary role of 'side effects.'"³⁸³ Ultimately, Frankel concludes, the electrostatic program blinded Biot to what soon came to be known as the pile's "electrochemical" aspects.

As Sutton shows, the chemists Fourcroy and Guyton de Morveau had begun making compelling discoveries about the chemistry of the humid conductors, but their research programs were foreclosed before they could discover just what role they played in generating the electrical current. These chemists, Sutton writes, "tried to determine which constituents of chemical compounds would attach themselves to the voltaic fluid, which were necessary for its liberation, and when the fluid caused new chemical reactions."³⁸⁴ This style of investigation remained quite distinct from the neo-Newtonian description of electrical forces, without necessarily opposing it.

³⁸¹ Biot, "Sur le mouvement du fluide galvanique, par le C. Biot, associé de l'Institut national," *Bulletin des sciences de la Société philomatique*, 48. Quoted in Sutton, 348.

³⁸² "The Politics of Science," 331.

³⁸³ "J. B. Biot and the Mathematization of Experimental Physics," 51.

³⁸⁴ "The Politics of Science," 349.

Similar experiments in electrochemistry soon led the British natural philosopher Humphrey Davy to discern the positive and negative valences of the various fluids he used in the construction of his piles and to link this phenomenon to the perpetuation of the electrical current himself. Not only did it turn out that the pile decomposed water into oxygen and hydrogen particles, but Davy even succeeded in using it to isolate the new elements sodium and potassium. In France, the research programs of Fourcroy and Guyton were quashed by promotions to administrative posts; Napoleon elevated Fourcroy to a time-consuming position as director-general of public instruction and Guyton to the directorship of the *École polytechnique*.³⁸⁵ Moreover, the savants most directly favored by Napoleon, Berthollet and Laplace, opposed the kind of chemistry undertaken by Fourcroy, Guyton and others. Though primarily a chemist, Berthollet understood chemistry as a branch of mathematized physics, wishing to understand chemical affinities themselves as physical forces,³⁸⁶ whereas the other chemists pursued their explorations of chemical affinities without reference to the question of forces and without attempting the kind of rigorous mathematization such an approach entailed.³⁸⁷

Sutton stops short of attributing the decline of Fourcroy's or Guyton de Morveau's research on the pile to the intentional intervention of Bonaparte. We do know, though, that the First Consul took a direct interest in the disputes that ranged Berthollet against the other chemists. An entry from the journal kept by Benjamin Thompson, Count Rumford during his stay in Paris shows that Napoleon was aware of these differences. "The Meeting of the Institut was over at 8," Rumford writes. "After the Meeting was over the first Consul entered into conversation with Laplace, Berthollet, Fourcroy, Chaptal, Myself and several other persons, and Volta repeated several of his principal experiments on Galvanic Electricity. A dispute respecting the galvanic process in which Berthollet on one side & Fourcroy & Vauquelin on the other took part rendered the conversation very animated and very interesting."³⁸⁸ Rumford's testimony indicates that the differences of opinion between Berthollet and the other chemists arose immediately upon the introduction of the pile into France and that Napoleon witnessed their emergence. While Napoleon's decision to consolidate power among the chemists in Berthollet and to promote Fourcroy and Guyton to taxing posts may not necessarily have been intended to sideline chemical research on the pile, he certainly had the power and knowledge to advance the programs of Fourcroy and others, should he have so desired. In this way, we can see that the quite narrow notion of exactitude promoted by Biot and others, including Berthollet, was not identical with legitimate scientific inquiry, as they themselves often affirmed, but rather that it emphasized certain

³⁸⁵ Ibid., 352-53.

³⁸⁶ Ibid., 337.

³⁸⁷ Ibid., 349. As Sutton writes, Berthollet used the battery to further his researches on chemical affinities as the effects of physical forces, in keeping with the so-called Laplace program, while Guyton and Fourcroy were more interested in using the battery as a tool to catalyze and catalogue chemical reactions. While Berthollet's chemical science was oriented toward mathematical physics, that of Guyton and Fourcroy, according to Sutton, was oriented toward natural historical and earth sciences.

³⁸⁸ Benjamin Thompson, Count Rumford. "Count Rumford's Journal," 34. A transcription of the Rumford journal was supplied by the Dartmouth College Library, Hanover, NH and kindly procured by UC-Berkeley French specialist librarian Claude Potts.

aspects of the experimental object over other, equally legitimate aspects. The Parisian savants' insistence on assimilating the pile to Coulomb's electrostatics ultimately diverted them from exploring its chemical activity, leaving the field open to Humphrey Davy and others to discover these effects.

The biographical entry Biot published on Volta in the year of the Italian's death assumes the voice of posterity, rendering a final judgment on the savant's life and works. "*Il est à remarquer,*" Biot judges, "*qu'en général Volta n'a jamais montré dans ses écrits ce caractère philosophique de l'esprit qui rend apte à établir des théories rigoureuses, quoique sa perspicacité le conduisit très-loin et très-sûrement dans les déductions des faits qu'il pouvait suivre expérimentalement.*"³⁸⁹ For Biot, Volta was a one-hit wonder, distinguished only by his fortuitous invention of the pile and his adeptness at experimentation. In a reversal of positions, though, posterity has been much kinder to Volta than to Biot. Biot's twentieth-century biographer renders a judgment of his subject in similarly summary tones, arguing that Biot sinned not by doing too little but by doing too much: "Between 1800 and 1807 [Biot] produced major memoirs on electricity, magnetism, sound, optics, heat, astronomy, chemistry, and mathematics; in addition he wrote two textbooks and translated a third, and he wrote a score of reports for the First Class. The sheer quantity of this work is scarcely imaginable in an environment where personal and institutional resources were less accessible and concentrated than in Napoleonic Paris. . . ." Yet, Frankel continues, "much of his work was hasty, superficial, or incomplete. . . . His theoretical work consisted of little more than quick aperçus or clever extensions of accepted theories that were never followed up." As we shall see in the next section, this facility was shaped by the assumption that imponderable matters like electricity or light could all be mathematized in the same neo-Newtonian way, allowing a mathematician like Biot to transition from one area of inquiry to another without varying his approach. As his biographer concludes, "Biot seemed unable or unwilling to stick to a subject until he had fully mastered it and could present it in a finished work. Indeed, why should he, when there were so many "quick killings" to be made in so many subjects?"³⁹⁰ Deriding Volta's lack of exactitude, Biot enjoyed the full support of the *Institut* establishment; yet it was the prestige of the establishment itself that would dim in the coming years, vexed by new scientific challenges. Even as the ideal of exact measurement and rigorous mathematization began to spread from France to points beyond, the program that brought it to the fore of physics research in France soon faltered in view of the microcosm's unexpected complexity.

III. *The Empire of Exactitude*

"To those who bow to the authority of great names, one remark may have its weight. The *Mécanique Coeleste*, and the *Théorie Analytique des Probabilités*, were both dedicated, by Laplace, to Napoleon. During the reign of that extraordinary man, the triumphs of France were as eminent in Science as they were splendid in arms. May the

³⁸⁹ "Volta (Alexandre)," 459.

³⁹⁰ "J. B. Biot and the Mathematization of Experimental Physics," 66-67.

institutions which trained and rewarded her philosophers be permanent as the benefits they have conferred upon mankind!”³⁹¹

—Charles Babbage, *Reflections on the Decline of Science in England; and on Some of its Causes* (1830)

“Attirez fortement l’empereur de la lune,
Le système triomphe, et vous faites fortune.”³⁹²

—Louis-Sébastien Mercier, *Satires contre les astronomes* (1803)

Of Napoleonic-era natural philosophers, perhaps only Volta or Lamarck still enjoy the pop celebrity accorded figures like Newton, Darwin or Einstein. Yet to these figures’ contemporaries, the canon of living scientific celebrities looked quite different than it does today. When Germaine de Staël declares, for instance, that “*Nous possédons dans les sciences, et particulièrement dans les mathématiques, les plus grands hommes de l’Europe,*” she is vaunting a certain kind of French-born, mathematically astute natural philosopher, whose style of working departed strikingly from the loosely quantitative Volta or the resolutely speculative Lamarck.³⁹³ Her tribute gives voice to widespread excitement about the changes transforming the sciences in France, incited by the conviction that the new mathematical physics and its ancillary sciences were opening Nature up to investigation in epoch-making ways, that this abrupt departure from the scientific past heralded an era of steady and cumulative “progress” in the natural sciences, and that the new mode of scientific inquiry was distinctly French in origin. For historians of science, this characteristic new way of mathematizing Nature marks the inception of modern physics. After 1800, writes Thomas Kuhn, “the work of Laplace, Fourier and Sadi Carnot had made higher mathematics essential to the study of heat; Poisson and Ampère had done the same for electricity and magnetism; and Jean Fresnel, with his immediate followers, had had a similar effect on the field of optics. Only as their new mathematical theories were accepted as models did a profession with an identity like that of modern physics become one of the sciences.”³⁹⁴ While the neo-Newtonian notions underpinning many of these figures’ assumptions about the nature of the microcosm were ultimately proven wrong, their application of exact means to its study and their success in marginalizing contemporaries who studied Nature in alternative ways realized mathematical physics as the dominant discourse of the nineteenth-century physical sciences.

The prestige of mathematics reached well beyond the new physics in France, moreover, to become “*the paradigm of sound knowledge*” in other sciences as well, Kuhn asserts, while

³⁹¹ London: B. Fellowes, 25-26.

³⁹² Paris: Terrelonge, 15.

³⁹³ *De la littérature* (Paris: Flammarion, 1991), 364.

³⁹⁴ “Mathematical versus Experimental Traditions in the Development of Physical Science,” *The Essential Tension: Selected Studies in Scientific Tradition and Change* (Chicago, UCP, 1977), 61.

spreading to points in Europe and beyond.³⁹⁵ Trickle down from mathematical physics' heights, the rhetoric of exactitude inspired both resistance and open-armed embrace from figures subject to its hegemony. While the anatomist and physiologist Xavier Bichat (1771-1802), for instance, lamented that the notions of "*pesanteur*," "*affinités*," or "*compositions chimiques*," along with "*un langage tout basé sur ces données fondamentales*" had come to dominate physiology, "*une science où elles n'ont plus la plus obscure influence*," the physiologist François Magendie echoed Cuvier's praise of "*l'esprit mathématique*" in affirming that "*les sciences physiologiques*" would never acquire "*la perfection et la certitude imposantes des sciences physiques*" without imitating the physical sciences' "*marche*."³⁹⁶ Shaping the languages, objects and institutions of sciences construed as behind or below, exactitude eventually traveled laterally to points across the globe, as well. As Kuhn further affirms, "nothing comparable" to the mathematization of French physics occurred elsewhere in Europe, "before the 1840s, when the British and Germans began belatedly to adopt and adapt the example set by the French a generation before."³⁹⁷ With the rhetoric of exactitude, Laplace, Berthollet and other leaders of French physical science provided discursive grounds for conceiving the sciences as a federated bloc, a dual epistemic and institutional scenario that gradually redefined the nature of scientific inquiry in the West. Beyond any particular "discovery," the importance of the Parisian exact natural philosophers in the time of Volta lies in their success in practicing science in ways that remain substantially familiar today. Though the persistent view of "science" as a transhistorical thing obscures the magnitude of these figures' achievement, they can be credited with establishing the prestige of quantification as a characteristic of modernity in general, as well as with setting in motion the autonomization of the sciences as a form of cultural production. If cultural histories of the Napoleonic period no longer echo de Staël in foregrounding mathematical physicists like Laplace or Berthollet, that may be because these figures' greatest achievement lay in transforming the meaning of "science" itself in ways we cannot help but take for granted.

In the transformation effected by the mathematical physicists, the prestige of quantification and the sciences' achievement of cultural autonomy were inextricably bound. The style of quantification espoused by the French exact natural philosophers was singularly suited to advancing a state of affairs in which, as Bourdieu defines scientific autonomy, scientific producers

³⁹⁵"The Function of Measurement in Modern Physical Science," *The Essential Tension*, 178. Emphasis Kuhn's. What Kuhn argues in terms of the "paradigm" also features in French historical epistemology, as in Canguilhem's examination of the way the developing life sciences came to adopt the physico-chemical assumptions of the physical sciences in "The Living and its Milieu" or "Experimentation in Animal Biology" in *The Knowledge of Life*. See also Vincent Debaene's account of how the prestige of physics shaped the discourse and disciplinization of French ethnology and anthropology in the twentieth century in *L'Adieu au voyage. L'ethnologie française entre science et littérature* (Paris: Gallimard, 2010). As we shall see, the discourse of physics likewise leaves its mark in fundamental ways on Bourdieu's sociology of cultural production itself.

³⁹⁶ *Recherches physiologiques sur la vie et la mort* (Paris: Gabon, 1822), 104. Counter to the rhetoric of exactitude, Bichat insists that "*La physiologie eût fait plus de progrès, si chacun n'y eût pas porté des idées empruntées des sciences que l'on appelle accessoires, mais qui en sont essentiellement différentes*." (Emphasis his.) Cuvier, *Rapport*, 389-90; Magendie, "Quelques idées générales sur les phénomènes particuliers aux corps vivans," *Bulletin des sciences médicales* (1809), 145-47.

³⁹⁷ "Mathematical versus Experimental Traditions," 62.

“*tendent à n’avoir d’autres clients que leurs concurrents.*”³⁹⁸ Manipulating rare instruments, questing for measurements of extreme precision, and practicing forms of mathematization that surpassed the capabilities of all but a select few scientific producers, the proponents of exactitude defined a form of cultural production that could only be evaluated as such by others of their ilk. As we have seen, this arrangement broke radically with scenarios in which scientific inquiry was subordinated to industry or enmeshed in the culture of letters. Unlike the proponents of utility in British or French experimental culture, the French exact natural philosophers preferred instruments too delicate to be useful in most practical situations, while addressing their writings exclusively to other seekers of pure knowledge rather than to artisans or manufacturers. Unlike experimentalist showmen, moreover, they spurned spectacular demonstrations for *mondain* and common publics as a mode of legitimate physical experimentation; and unlike the proponents of a non-experimental, hermeneutic natural philosophy or *géomètres philosophes* like d’Alembert or Condorcet, they omitted to appeal to general reading publics. In the eyes of many contemporaries, the exact natural philosophers’ exclusiveness failed to translate into distinction, their desire to differentiate themselves as such from artisans, industrialists and the public at large constituting a sign of pride rather than of real superiority, their precision numbers nothing more than a vain “parade” of knowledge. But for those willing to subscribe to the intellectual economy of exactitude, the precise quantification and rigorous mathematization of Nature increasingly became the measure of distinction against which other scientific producers were judged. In the spirit of Bourdieu’s observation that fetish effects often arise through operations which guarantee the “rarity” of the producer (rather than that of the product), the long rows of figures generated by the mathematical physicists not only worked to approximate Nature but also to register the physicists’ own scarcity as cultural producers, the slight numbers they produced implying, as it were, the slight numbers of those who produced them.³⁹⁹

While the exclusive tendencies of the exact natural philosophers sometimes incited charges of “arrogance” or “aristocracy,” these scientific producers were also able to argue that their neglect of heterogeneous audiences guaranteed the disinterested nature of their research. In censuring the “interest” inherent in collaborating with industry, performing demonstrations or writing for the public, the discourse of rectitude intervened to sustain the purity of the exact sciences as a form of cultural production, in spite of many savants’ ardent pursuit of official positions and honors. In an 1807 article for the *Moniteur universel* Cuvier identifies the new sciences’ restricted audience as one of its virtues, in terms which anticipate Bourdieu’s formulation of a scenario in which the clients of scientific producers were limited to their competitors. While the general public acts, writes Cuvier, as “*le tyran des autres écrivains, obligés de sacrifier sans cesse aux caprices de ce maître aussi changeant qu’absolu,*” the savants brook no such compromise. The integrity of their efforts to discover the “secrets of nature” are guaranteed by the regularity of Nature itself, Cuvier insists, as well as by the elite community of other savants. “*Ils sentent qu’ils n’ont de juges que leurs pairs,*” he affirms, “*répandus dans tout le monde civilisé, et*

³⁹⁸ “La spécificité du champ scientifique et les conditions sociales du progrès de la raison,” *Science et structure sociale* 7.1 (1975), 91-118.

³⁹⁹ See for example “Haute Couture et Haute Culture,” *Questions de sociologie* (Paris: Éditions de minuit, 1980), 204.

qu'aucun prestige ne pourrait ni éblouir ni gagner."⁴⁰⁰ Published in the official newspaper of the regime, these lines muddle the definition of autonomy through a specious play on the locus of "tyranny" in Napoleonic France. The so-called tyranny exercised by the reading public on those "other" *écrivains* deflects the actual subordination of the sciences to Napoléon's desires, the allegation of one changeable and absolute master obscuring the reality of another. Cuvier's rhetoric alludes to the liberation of the sciences from power even as it expertly cultivates it, and in performing the exclusion of those who write for general audiences from the canon of legitimate producers of scientific knowledge, it concomitantly advances the differentiation of the sciences from other cultural practices.

As in Bourdieu's definition of scientific autonomy, Cuvier's formulation implies autonomy's dual "vertical" and "horizontal" dimensions. If the field's freedom from intervention by political or economic powers can be cast as the vertical dimension of its autonomy, its differentiation from other forms of cultural production can correspondingly be cast as horizontal in extent. While Bourdieu's definition of autonomy implies both dimensions, most discussions of autonomy in his work turn on the field's freedom from economic or political determination. Yet as the simultaneous denial and performance of subordination to Napoleon in Cuvier's article suggests, a comprehensive examination of both dimensions may be fundamental to explaining how the vision of scientific production espoused by Cuvier and others like him triumphed over that of the kind of producers against whom his article is clearly aimed.

In this performance, Cuvier writes to define the values of the field and the criteria for determining who can and cannot be considered to act within it, advancing the interests of the disinterested and proscribing those "other" *écrivains*. As Bourdieu observes and as Cuvier's article illustrates, the identity of the field is itself a product of the struggles for distinction which take place within it. "*Lorsque les défenseurs de la définition la plus "pure", la plus rigoriste et la plus étroite de l'appartenance disent d'un certain nombre d'artistes (etc.) que ce ne sont pas réellement des artistes,*" Bourdieu observes, "*ou que ce ne sont pas des artistes véritables, ils leur refusent l'existence en tant qu'artistes, c'est-à-dire du point de vue qu'en tant qu'artistes "vrais," ils veulent imposer dans le champ comme le point de vue légitime sur le champ, la loi fondamentale du champ, le principe de vision et de division (nomos) qui définit le champ artistique (etc.) en tant que tel, c'est-à-dire comme lieu de l'art en tant qu'art.*"⁴⁰¹ A cultural producer's success in achieving the title to which he or she aspires depends on the values and dispositions in force in the field. For his part, Cuvier affirms the reality of a more exclusive definition of scientific activity than that acknowledged by the figures he proscribes, thereby enacting these figures' disenfranchisement from the field of legitimate scientific activity, defined as such precisely by such gestures of exclusion. As Cuvier's rhetoric and his position in the field of scientific production suggest, he does so in the name of a "nomos" which can readily be identified with what I have termed exactitude. If Cuvier works to impose his "point of view" on the field, a point of view which the very existence of his article attests has not yet achieved irreversible dominance, this point of view originates not with Cuvier himself, however, but with certain practi-

⁴⁰⁰ *Moniteur universel*, 3 November, 1807.

⁴⁰¹ *Les Règles de l'art: génèse et structure du champ littéraire* (Paris: Éditions du Seuil, 1998), 366. Emphasis Bourdieu's.

tioners of the physical sciences in the decades preceding Cuvier's article. The point of view adopted by Cuvier in his dismissal of scientific *écrivains* is the very same as that imposed by Biot and others on the all-too approximate Volta.

But if Cuvier arbitrates who should and should not be recognized as a scientific producer, the titles to which scientific producers might aspire are themselves still a matter of uncertainty in this period. The ambiguity of the titles at stake in Cuvier's article is implicit in his reference to those "*autres écrivains*," a designation which implies, with whatever degree of conviction, that legitimate scientific producers themselves might be considered writers of a sort, or at least that they can as yet be designated as a group only in negative terms. If Cuvier himself does not positively imagine the absolute differentiation of scientific and literary production expressed much later in the title "*scientifique*," a new title did exist to convey the mathematizing tendencies which initiated this differentiation. Where the title *physicien* designated anyone who studied physical Nature, "*physicien géomètre*" more particularly designated those who applied rigorous mathematical criteria to its study. The minting of a new scientific identity was necessary to accommodate the conjoining of mathematics and experimentation, even though few individuals were as yet equipped to embody both aspects of the *physicien géomètre* at once. In the seven-teen-seventies and -eighties, the chemist Lavoisier and the mathematician Laplace collaborated on a series of experiments that demonstrated the promise of such a persona; their famous experiments on the synthesis of water, for instance, succeeded in showing that the "element" was in fact a compound of two gases, at least for those who were willing to accredit their "point of view." With the execution of Lavoisier during the Revolution, Laplace became the most powerful advocate of this new identity and the epistemic ideals it entailed, continuing to collaborate with experimentalists and spell out new ways of conceiving physical Nature in mathematizable terms, while sponsoring the careers of younger, mathematically trained experimentalists who might one day do such work independently.

By the time of Volta's visit to Paris, no one in France rivaled Laplace's scientific prestige and institutional authority. At the Revolution's inception, he was the pre-eminent mathematician and astronomer in Paris; at its close, he was something much, much more. Thanks to the publication of such celebrated works of astronomy as the *Exposition du système du monde* (1796) and the *Traité de mécanique céleste* (1799), his accumulation of scientific posts, his careful cultivation of consular and, later, imperial patronage, his brief service as Minister of the Interior during the Consulate and later nomination as officer in Napoleon's *Sénat conservateur*, and his protection of younger savants like Biot and Arago, Laplace became what Michelet later called "*un chef, un pape*" of France's scientific scene.⁴⁰² In addition to these institutional advantages, Laplace's dominance was bolstered by his success in articulating an overarching vision for the new century's sciences, a vision in which the application of mathematics to physical Nature would entail the realization of a number of new physical objects and scientific disciplines. Ultimately, Laplace's ambition to extend "*le domaine de la géométrie*" into the physical sciences turned most crucially on the supposition that all kinds of matter, including light, magnetism, electricity

⁴⁰² Jules Michelet, *L'Histoire du XIXe siècle*, vol. 26 of *Oeuvres complètes* (Paris: Flammarion, 1878), 86, quoted in Vida Azimi, *Les premiers sénateurs français: Consulat et Premier Empire 1800-1814* (Paris: Picard, 2000), 73.

and heat, were composed of tiny “*corpuscules*.”⁴⁰³ The assumption underpinning this notion was that the means by which Newton had managed to predict the action-at-a-distance among celestial bodies might eventually be adapted to predict the action-at-a-distance among such microcosmic bodies. This proposition required experimentalists to manifest nature in such a way as to make it available to mathematical analysis, and experimentalists who did not work in corpuscular terms found themselves increasingly marginalized from the highest levels of scientific recognition in Paris, as the misadventures of Volta, Guyton de Morveau, and Fourcroy have suggested. Though the analogy between the macrocosm and microcosm constituted a discursive option independent of any one historical actor, Laplace’s success in articulating it and in enforcing conditions which made neglecting it risky to the pursuit of a successful scientific career have led it to be identified with his name. In the guise of the so-called “Laplace program,” the ambition to do for the microcosm what Newton had done for the macrocosm dominated French science through the Restoration.⁴⁰⁴

Laplace’s institutional preeminence and the simplicity of the analogy between macrocosm and microcosm lent the period’s physical sciences “a most uncommon unity of style and purpose,” as the historian Robert Fox has put it, and fomented extravagant optimism about the era of scientific discovery to come.⁴⁰⁵ Yet if in principle the parallel between macro- and microcosms instituted an elegant paradigm for the physical sciences, in practice the oddities of the microcosm threatened to warp Newtonian discourse. “*La force attractive disparaît entre les corps d’une grandeur peu considérable:*” cautions Laplace in the *Exposition*, “*elle reparoît dans leurs élémens, sous une infinité de formes différentes.*” The varieties of matter complicated the utter elegance of Newton’s universal gravitation, the “*force attractive*” to which Laplace alludes; transitioning from the macrocosm to the microcosm was like passing through a looking glass into a world of entities whose formal peculiarities likely only obscured, in Laplace’s view, the universality of Newtonian attraction. “*La solidité des corps, leur cristallisation, la réfraction de la lumière, l’élévation et l’abaissement des fluides dans les tubes capillaires, et généralement toutes les combinaisons chimiques,*” Laplace affirms, “*sont les résultats de forces attractives dont la connoissance est un des principaux objets de la physique. Ces forces sont-elle la gravitation même observée dans les espaces célestes, et modifiée sur la terre par la figure des molécules intégrantes?*” Laplace believed so, and the entire Laplacian venture depended on the possibility of

⁴⁰³ John Heilbron, *Weighing Imponderables*, 5-6.

⁴⁰⁴ Robert Fox, “The Rise and Fall of Laplacian Physics,” *Historical Studies in the Physical Sciences* 4 (1974), 89-136. In “A Mathematicians’ Mutiny, with Morals” J.L. Heilbron shows that the Newtonian heritage was repurposed in fascinatingly different ways in Newton’s home country. While Laplace was advancing neo-Newtonian physical science in France, the president of the Royal Society, Sir Joseph Banks, was engaged in a polemic with mathematicians who felt that he was fostering an un-rigorous culture of gentleman amateur natural philosophers. Of a group led by the mathematician and bishop Samuel Horsley, Banks declares: “Those gentlemen [Horsley and company] might easily be informed that howsoever respectable mathematics as a science might be it by no means can pretend to monopolize the praise due to learning it [sic] is indeed little more than a tool with which other sciences are hewed into form. Sir Isaac Newton demonstrated it is true that the discoveries which made him immortal by the help of mathematics but he owes his immortality to his discoveries in Natural Philosophy not mathematics.” Quoted in “A Mathematicians’ Mutiny, with Morals,” *World Changes. Thomas Kuhn and the Nature of Science* (Cambridge: MIT Press, 1993), 87.

⁴⁰⁵ “The Rise and Fall of Laplacian Physics,” 91.

identifying these forces, whatever they might be. If the shapes of the molecules themselves accounted for the different kinds of affinity exhibited by different kinds of matter, Newtonian attraction, it might ultimately be found, reigned among molecules as well as planets. In such a case, it would be possible to explain “*toutes les variétés des forces attractives*” by the variety of molecular shapes, and “*ramener ainsi à une seule loi générale, tous les phénomènes de la physique et de l’astronomie.*”⁴⁰⁶

Should the molecule’s shapes turn out to be irregular, however, it would be difficult, perhaps impossible, to describe them mathematically. “*L’impossibilité de connaître les figures des molécules, rend ces recherches inutiles à l’avancement des sciences,*” posits Laplace about the attempt to determine molecule’s shape. But there was a way around this seemingly crippling impediment. “*Au milieu de ces incertitudes,*” he continues, “*le parti le plus sage est de s’attacher à déterminer par de nombreuses expériences, les lois des affinités; et pour parvenir, le moyen qui paroît le plus simple, est de comparer ces forces, à la force répulsive de la chaleur, que l’on peut comparer elle-même à la pesanteur.*”⁴⁰⁷ In order to describe the movements of imponderable substances, that is, one did not have to mathematize individual molecules, as Newton had mathematized the individual planets of the cosmos; instead, it would suffice to infer their movements from the behavior of the substance itself. In this work of drawing inferences, analogies were to play an important role, as Laplace’s comparison of heat and gravity here attests. Just as gravity offered a universal model for understanding how the force exerted by one body attracts or repels other bodies, heat’s ability to expand gases or decompose such seemingly unique substances as water likewise results, Laplace ventures, from forces that can similarly be distilled to a single, mathematically expressible law.

Assuming this framework of analogies, the *physicien* Coulomb had succeeded in doing for electricity precisely what Laplace had recommended, characterizing “*les lois des affinités*” of electrical fluid by means of “*nombreuses expériences.*” Not only had he reduced the attractive power of electricity to a single formula, but this formula had turned out to be none other than the “law of inverse squares” that Newton himself had used to describe universal gravitation. The force that pushed away or attracted electrically charged particles, that is, was precisely the same as that which pushed away or attracted heavenly bodies. Even if Volta and other prominent natural philosophers contested its viability, Coulomb’s law was taken as a major triumph of the culture of exactitude in France, and seemed at the time like a harbinger of more triumphs to come.⁴⁰⁸ If the action of the molecules themselves would be impossible to describe for the fore-

⁴⁰⁶ *Exposition du système du monde*, vol. 2 (Paris: De l’Imprimerie du Cercle-Social, 1795), 196-98.

⁴⁰⁷ *Ibid.*, 198.

⁴⁰⁸ John Heilbron, *Electricity in the 17th and 18th Centuries: A Study of Early Modern Physics* (Berkeley: University of Berkeley Press, 1979), 461-62. One of the main reasons for Volta’s initial marginal status on the Parisian scientific scene was his dissatisfaction with Coulomb’s results. As Heilbron argues, Volta felt that Coulomb’s results were too precise to be reproduced at all times and places, and the dispute between Volta and Coulomb perfectly encapsulates the conflict between advocates of exactitude and those of other experimental styles. In replicating Coulomb’s experiments, writes Heilbron, Volta’s “best results, obtained with five-inch disks at a potential difference of about 5000 volts, gave the inverse-square dependence exactly. But he quite properly did not regard the relation as universal, or even as fundamental. He knew that changes in geometry or in technique influenced the results, and he had found that repulsion and induction obeyed different relations. Indeed, he denied the general applicability of the law of Coulomb.”

seeable future, the laws of attraction that governed their behavior en masse might yet be discovered through careful observation.

Laplace's "point of view" on the physical sciences thus not only transformed them into mathematical pursuits but also framed them in terms of a particular theory of matter. As a field coalesced around the epistemic virtue of exactitude, the range of legitimate utterances available to entrants in the field was further constrained by the aims, means and objects of this experimental Newtonianism. For Laplace and the *physiciens* close to him, this Newtonianism sufficed to demarcate the bounds of viable science, unfurling what Bourdieu calls an "*espace des possibles*" that seemed likely to orient the distribution of material and symbolic profits for the foreseeable future. With the consolidation of the Laplacian point of view, a disciplined dialectic of positions took shape in conformance with the strategies of conservation, succession and subversion pursued by recognized and would-be scientific actors. Laplace himself pursues the strategies of conservation predicted by his position, delimiting legitimate science to those forms of inquiry best suited, as Bourdieu puts it, to sustaining "*la position dominante en assurant la position la plus haute dans la hiérarchie des valeurs scientifiques aux capacités scientifiques dont il est le détenteur à titre personnel ou institutionnel (par exemple en tant que directeur d'une forte culture mathématique,*" etc.).⁴⁰⁹

Having helped articulate the persona of the *physicien géomètre*, Laplace sustains the value of mathematical pursuits by giving encouragement to those who undertake them and censuring or omitting to reward those who do not. The semi-formal Société d'Arcueil that Laplace and his colleague Berthollet established at their adjoining country estates outside Paris became a powerful means of sponsoring a young generation of developing *physiciens géomètre*. The Arcueil circle soon became a de facto center of power in French science, a site of sociability that surpassed the *Institut* in prestige even as many of its younger members had yet to be elected. "During the decade of high Laplacian physics," writes Geoffrey Sutton, "connections with the Arcueil circle became a practically necessary and nearly sufficient step to a successful scientific career."⁴¹⁰ At Arcueil, Laplace and Berthollet not only orchestrated discussions of scientific work but also opened up their laboratories to their protégés. Younger figures like Biot, Arago and Gay-Lussac pursued critical research on microcosmic attraction at the suggestion of Laplace and Berthollet, a scenario acknowledged by Biot in the *mémoire* he and Arago wrote on the refractive indices of gases: "*Le sujet de toutes nos recherches étoit indiqués dans leurs ouvrages,*" affirms Biot of Laplace and Berthollet; "*leur conversation et leurs conseils nous ont*

⁴⁰⁹ "Spécificité du champ scientifique," 96.

⁴¹⁰ Sutton, 364. "Dominant les autres cercles intellectuels," as a recent historian of the *Sénat conservateur* puts it, "[la société d'Arcueil] paraît à elle seule une classe "privée" de l'Institut, vivier de penseurs mais aussi d'acteurs et de coopérateurs du nouveau régime." Vida Azimi, *Les premiers sénateurs français: Consulat et Premier Empire, 1800-1814* (Paris: Picard, 2000), 73.

fourni les moyens de les suivre et de les terminer."⁴¹¹ Laplace's surest ally in the younger generation, Biot wholeheartedly espoused the existence of Newtonian attraction in the microcosm: "Newton a prouvé," he writes in the same *mémoire*, "qu'il résulte d'une attraction que les corps exercent sur les molécules de la lumière, attraction seulement sensible à de très-petites distances, et, en cela, tout-à-fait analogue aux affinités chimiques."⁴¹²

If Laplace's and Berthollet's robust protection of bright young savants helped sustain their scientific dominance, the alacrity with which Biot and others embraced their protection attests to the profitability of succession strategies during this period. Applying the same means and the same explanatory framework to investigations of phenomena as various as light, heat, magnetism and electricity, these protégés reaped the many "quick killings" available to those who stayed within the bounds of Laplacian science. Yet the risks turned out to be as great as the rewards, as the botanist and frequent Arcueil visitor Augustin Pyramus de Candolle recalled in his memoirs. In Paris, reflected de Candolle, a young savant "*est trop entouré de gens qui sollicitent des récompenses pour ne pas se laisser aller à la fièvre des places, or cette fièvre détourne des travaux de longue haleine, comme elle ne peut s'apaiser que par la faveur des hommes puissants, on se laisse entraîner à faire des ouvrages qui ne blessent pas leurs opinions plutôt que ceux qui tendraient à modifier profondément l'état de la science.*"⁴¹³ Though framed in general terms, Candolle's sardonic commentary on the value of patronage in Paris applies directly to orthodox figures like Biot and Poisson. Biot in particular enjoyed a brilliant reputation as Laplace's foremost protégé, but failed to tackle the kinds of "*travaux de longue haleine*" that might have guaranteed a more lasting reputation at the cost of delayed scientific profits or even the contravention of Laplacian assumptions. In retrospect, Candolle is happy, as he writes, to have ended up making a career first in Montpellier, then in Geneva, removed from the high pressure politics of the sciences in Paris.

In imposing his "point of view" on scientific activity, did Laplace effect a revolution in the order of the field or realize a field where none had existed before? As scientific producers' "clients," in other words, became restricted to their "competitors," did a pre-existing scientific field move toward autonomy, or did the scission that transformed the sciences into a new form of cultural production signal the emergence of previously absent field dynamics? Though Bourdieu's notion of the field has sometimes been construed as ill-adapted to describing historical

⁴¹¹ "Mémoire sur les affinités des corps pour la lumière et particulièrement sur les forces réfringentes des différents gaz," (Paris: Bachelier, 1806), 304, quoted in Crosland, *Arcueil*, 259. This is the very same memoir whose excessively refined result John Heilbron calls "one of the best cultivated numbers of [the] day." *Weighing Imponderables*, 31. Fox conveys the importance of this paper to the Laplacian program as a whole in remarking that Biot and Arago believed that "their observations on the bending of light rays had yielded an accurate measure, indeed the first accurate measure of forces on the molecular scale which had hitherto almost defied quantification." "The Rise and Fall of Laplacian Physics," 102.

⁴¹²"Mémoire sur l'affinité des corps," 302. In spite of Biot's certainty, these assumptions were soon thrown into doubt.

⁴¹³ Augustin Pyramus de Candolle, *Mémoires et souvenirs*, (Geneva: Ramboz et Schuchardt, 1862), 205. Quoted in Crosland, *Arcueil*, 426-27.

change, this misconception has been put to rest in recent work by Philip Gorski and others.⁴¹⁴ Bourdieu's description of processes which result in revolutions in the order of the field and his frequent references to the "emergence" of certain fields clearly show that the field functions in his oeuvre as a tool of historical analysis. Yet Bourdieu's vocabulary for describing the historical dimension of fields makes it difficult to determine when changes in the *degree* of the field's autonomy might be better described as changes in *kind* pertaining to the inception or disappearance of fields. Even as Bourdieu attributes changes in the identity of a given field to struggles undertaken within the field itself, his terms for talking about the identities of fields often seem to lend them transhistorical continuity. "Arbitrariness is . . . the basis of all fields," he writes, for instance, "even the 'purest' ones, like the worlds of art and science. Each of them has its 'fundamental law', its *nomos* (a word that is normally translated as 'law' and would be better rendered as 'constitution', a term which better recalls the arbitrary act of institution, or as 'principle of vision and division', which is closer to the etymology)."⁴¹⁵ Though a given field appears on the earth arbitrarily, we might imagine (in accord, as it were, with the faculties of the species), it nevertheless maintains "its" fundamental law, in Bourdieu's formulation, a self-consistent principle which remains partially unavailable to conscious reflection. The acts and dispositions made in keeping with this law may be modified by economic or political determinations, but in Bourdieu's terms these modifications typically represent a spurious departure from the real spirit of the law. In cases like the autonomization of the sciences, though, the alteration of the law itself is at stake in the re-disposition of forms of cultural authority. Defined by their scission from a general culture of letters, the appearance of the exact sciences raises the question of "horizontal autonomy" usually so implicit in Bourdieusian analyses of autonomy in general. The cultural positions embraced by contemporaries like Bernardin de Saint-Pierre and Laplace are so very different that they can best be characterized not as competing manifestations of the same *nomos* but as manifestations of two different *nomoi*, the fundamental laws of hermeneutics and representation respectively. Moreover, a comparison of the social dynamics regulating the production of "scientific" works in the eighteenth century with the dynamics regulating the production of scientific works during the latter half of the nineteenth century makes it implausible, I believe, that the appearance of the exact sciences should mark only a modification in a single transhistorical field. Fully imbricated in the production of letters in general during the earlier period, and fully differentiated as "science" from the world of "literature" by the later, legitimate scientific activity instead comes to occupy an altogether new place within the full span of cultural activity. Though the sciences of exactitude clearly drew on elements of the scientific past and accumulated cultural authority in ways that mark transformations in the order of a pre-existing scientific field, they ultimately represent a wholly new cultural formation and source of personal dispositions.

Bourdieu's notion of "heteronomy" reinforces this sense that the notion of the field takes on a somewhat a priori character in his analysis. For Bourdieu, the notion of "heteronomy" designates the field's permeability to influence by dominant groups in the social world at large. The roots of the term (*hetero-*, *-nomos*) suggest that while the field is henceforth ordered by two

⁴¹⁴ See the essays in the volume *Bourdieu and Historical Analysis*, ed. Philip Gorski (Durham, NC: Duke University Press, 2013).

⁴¹⁵ *Pascalian Meditations*, trans. Richard Nice (Stanford: Stanford University Press, 2000), 96.

“laws,” the law proper to the field itself persists in spite of its dilution or temporary disappearance. The term thus takes on a tautological quality, given that the field is assumed to endure as such even when the law that underwrites its identity is diluted or warped or suspended altogether. This assumption also colors the work of many of Bourdieu’s successors. Gisèle Sapiro’s adoption of the notion of “phase harmonization,” for instance, extends this tautological definition of the field to an analysis of the field’s place within culture at large, embracing a lunar metaphor in which the action of forces proper to the field are synchronized with forces external to it in such a way as to render them imperceptible, even as they continue to exist as such.⁴¹⁶ In response, one might assert on a metaphysical level that cultural production of any kind might better be imagined as an exception on the background of a radical silence, and on an empirical level that autonomous fields have been more an exception than a norm in histories of cultural production. Most importantly, this problem strikes to the heart of the analysis of fields in modernity, because while vertical effects may often stifle or interrupt the operations of the field according to a law which resurfaces once such effects disappear (as in Sapiro’s analysis of the literary field during the Second World War), horizontal effects may call into question the very identity of the field in ways which transform it forever.⁴¹⁷

(In fact, the notion of heteronomy may be better adapted to conveying the horizontal differentiation of forms of cultural production, the scission of such production into fields with alternative laws, than to conveying the subordination of fields to power. Though Bourdieu quite explicitly roots the notion of the field in the physical sciences notion of “milieu” documented by Canguilhem in “*Le milieu et son vivant*,” it is interesting to speculate how the notion of the field might differ were it modeled on specifically biological, rather than physical, categories. In biology, after all, “heteronomy” refers to species’ increasing distinction from other, similar forms, an association that would convey the progressive specialization and autonomization of cultural forms in modernity. Given the pre-existing use of “heteronomy” in Bourdieusian sociology, I have avoided using it in this acceptance, however, in favor of the less couth “horizontal autonomy.”)

The distinct *nomoi* of the exact sciences and the sciences of admiration are evident in both the epistemological criteria and the social dynamics they entail. If for Bourdieu *doxa* is the “law” of a field in the guise of actors’ presuppositions about its means and ends, the rise of the exact sciences compels figures like Bernardin de Saint-Pierre and Chateaubriand to articulate a hermeneutic *doxa* as well as to denounce the alternative *doxa* of the exact sciences insofar as they are able. (Bourdieu seems to use the notions of *nomos* and *doxa* interchangeably, but a more sustained look at how these terms appear in his work might be revealing.) Far from accepting the premise of the exact sciences, the *Études de la nature* or the *Génie du christianisme* contest the rise of “representation” itself as a law of scientific activity. In declaring, for instance, that “*la science entre les mains de l’homme dessèche le coeur, désenchanté la nature, mène les esprits foibles à l’athéisme, et de l’athéisme à tous les crimes*,” Chateaubriand is not just asserting reli-

⁴¹⁶ “Structural History and Crisis Analysis: The Literary Field in France during the Second World War,” trans. Susan Emanuel, *Bourdieu and Historical Analysis*, ed. by Philip Gorski (Durham, NC: Duke University Press, 2013), 266-67.

⁴¹⁷ See also *La guerre des écrivains: 1940-1953* (Paris: Fayard, 1999).

gious orthodoxy; rather, he is positioning the exact and the hermeneutic sciences as outgrowths of rival ways of life, in effect stating the rule of exactitude as best as he can from the point of view of a partisan of admiration.⁴¹⁸ Chateaubriand symptomatically combats the sciences not on the basis of their findings but on the way the assumptions that underpin these findings eclipse the dispositions corresponding to a hermeneutic world. The fact that the proponents of hermeneutic science experience the rise of the exact sciences as an attack on “sentiment” is one measure of the gap between them. The centrality of sentiment in Chateaubriand’s polemic is not solely a consequence of its importance in hermeneutic science per se, but also an effect of the diminishing value of the law which underpins it. In this reaction, the role of sentiment in the hermeneutic sciences is doubled by the melancholy that affects any class of actors whose dispositions are being comprehensively eclipsed by the ascent of some other rival class.⁴¹⁹

That the gap between the hermeneutic and exact sciences is a gap in kind and not just in degree is also implied by the scenario’s social dynamics. If the proponents of hermeneutic science are vociferous in combatting the rising sciences of representation, the latter most often meet their opponents with silence. This strategy expresses the logic according to which relatively dominant actors risk admitting their opponents into the field through mere acknowledgment of them, even if they do so only to argue for their exclusion. As Bourdieu writes, “*c’est déjà exister dans un champ que d’y produire des effets, fût-ce de simples réactions de résistance ou d’exclusion. Il s’ensuit que les dominants ont peine à se défendre contre la menace qu’enferme toute redéfinition du droit d’entrée explicite ou implicite sans accorder l’existence, par le fait de les combattre, à ceux qu’ils veulent exclure.*”⁴²⁰ The explicit acknowledgment of Bernardin and Chateaubriand in Biot’s article on “exact ideas” is rare in the writings of the scientific elite precisely for this reason, and even here Biot’s rivals are acknowledged from a position of authority which licenses him to imagine the entire subsumption of literary under scientific culture. More common is Cuvier’s veiled reference to “*des autres écrivains*” as a means of combatting such figures without explicitly naming them, as well as the silence that met Bernardin’s frequent demands for the acknowledgment of his theory of the tides. Calling on journals, academies, and

⁴¹⁸ *Génie du christianisme*, vol. 2, 1803, 34.

⁴¹⁹ This hermeneutics likewise shapes the expectations of figures as ambiguous or ambivalent as Alessandro Volta and Germaine de Staël; for the Volta of the Paris presentation, the battery is documented through rough quantification, while for the Volta of the London presentation, it is best studied by interpreting the signs it incites in the body. Likewise, in de Staël, a keen enthusiasm about the rise of the exact science coexists with an anxiety about the sentiments they may trammel. These tensions are condensed in a passage in which de Staël writes, “*J’ai tâché de développer dans ce chapitre combien il importait de soumettre à la démonstration mathématique toutes les idées humaines; mais quoiqu’on puisse appliquer aussi ce genre de preuve à la morale, c’est à la source de la vie qu’elle se rattache; son impulsion précède toute espèce de raisonnement.*” De Staël goes on to assimilate “*démonstration mathématique*” and “*raisonnement*” with “*intérêt personnel*” in affirming that “*la même puissance créatrice qui fait couler le sang vers le coeur, inspire le courage et la sensibilité, deux jouissances, deux sensations morales dont vous détruisez l’empire en les analysant par l’intérêt personnel, comme vous flétririez le charme de la beauté, en la décrivant comme un anatomiste.*” De Staël’s sense of the irreducibility of the moral and its divine source, as well as the motif of the “anatomist,” links this passage to a providential hermeneutics, even though she limits the province of this hermeneutics to the self. *De la littérature*, 378.

⁴²⁰ *Règles de l’art*, 369-70.

finally “*tout lecteur à qui il reste une conscience*”⁴²¹ to admit the viability of his theory, Bernardin complains that if the journals, as he puts it, “*donne mes parties pour juges*” in recommending that the scientific academies in France themselves adjudge his theory, “*aucune [académie] jusqu’à présent n’a voulu la juger.*”⁴²² This reticence on the part of the *Académie des sciences* in particular persisted even when its official verdict on Bernardin’s work was actively solicited. Having pestered the Ministry of the Marine for years for a pension based on his theory’s potential value for navigation, Bernardin finally succeeded in compelling it to consult the *Académie* on the merits of this theory. Yet the *Académie* never evaluated Bernardin’s work. As a note on the margin of Bernardin’s Marine dossier tellingly remarks: “*Monseigneur [Castris] a demandé à M Le Chev. de Borda ce qu’il en pensoit et le Jugemen que l’academie en porte; mais il paroît que cet officier a comme membre de l’academie des Sciences, des motifs pour ne pas s’expliquer.*”⁴²³

While the exact sciences marked their difference from hermeneutic natural philosophy through silence and other means, they also marked their difference from “letters” in general as a mode of cultural production. Though a disciple and sometime colleague of d’Alembert and Condorcet, Laplace conceived the authority of the mathematician in entirely different terms. As Roger Hahn points out, the persona of the *géomètre philosophe* embodied by d’Alembert and Condorcet gave way with Laplace to the persona of the *physicien géomètre*. While Laplace’s early career depended on the patronage of these figures, he never wrote the equivalent of a “Préambule” to the *Encyclopédie* like d’Alembert, or an *Esquisse d’un tableau historique des progrès de l’esprit humain* like Condorcet, never sought institutional power over the culture of letters in general, never positioned himself as the “*chef des philosophes.*” The scientific identities of these elder mathematicians were bound up in the encyclopedic tradition and the spreading of *lumières*, but that of Laplace was primarily invested first in pure theoretical physics, then in the application of mathematics to the physical sciences.⁴²⁴

The scission of the exact sciences from the eighteenth-century culture of letters contravenes Bourdieu’s account of the inheritance of cultural authority on a few notable counts. Of revolutions in cultural production, Bourdieu writes that “*les fondateurs d’un ordre scientifique hérétique rompent le contrat d’échange qu’acceptent au moins tacitement les candidats à la succession: ne reconnaissant d’autre principe de légitimation que celui qu’ils entendent imposer, ils n’acceptent pas d’entrer dans le cycle de l’échange de reconnaissance qui assure une transmission réglée de l’autorité scientifique entre les tenants et les prétendants.*”⁴²⁵ In this rupture, one group captures the symbolic capital previously monopolized by another group, but the symbolic

⁴²¹ *Études de la nature*, 40.

⁴²² *Paul et Virginie* (Paris: L’Imprimerie de Monsieur, 1789), xiii-xiv.

⁴²³ “Observation,” 21 mars 1787. Archives national d’outre mer, Secrétariat d’État à la Marine, Lettre B. FR ANOM COL E 363. Reference URL: http://anom.archivesnationales.culture.gouv.fr/ark:/61561/up424icfbff.num=20.referer=nominatifpersname_authfilenumber=4310. Accessed 30 January, 2015.

⁴²⁴ Roger Hahn, *Pierre-Simon Laplace, 1747-1827: A Determined Scientist* (Cambridge, MA: Harvard University Press, 2005), 47. As Hahn further points out, “Laplace, for his part, was never willing to engage in the extended and elegant discussions of metaphysical and philosophical issues that became second nature for Condorcet.” 64

⁴²⁵ “Spécificité du champ scientifique,” 104.

capital in question already exists in such a state that it can be converted from one form to another. In the case of the exact sciences, however, the accumulation of authority occurs in quite different ways. On the one hand, Laplace was far from a “heretical” young mathematician in that he succeeded in capturing the cultural capital enjoyed by figures like d’Alembert and Condorcet in the mode of “an orderly transmission of scientific authority” (in this case a “scientific” authority pertaining to pure mathematics). On the other hand, the kind of authority he came to embody is thoroughly incommensurable with that enjoyed by prior actors in the general culture of letters. It is no longer sustained by the recognition of cultural producers like writers and publicists, nor by the recognition of the aristocracy or other consumers of intellectual goods; instead, it is realized by the recognition of a new class of cultural producers who define themselves according to the narrowness of their specialization and the rarity of their peers. Though Laplace successfully presented himself as a candidate of succession, he nonetheless realized a kind of scientific authority that had not previously existed as such.

Only with the advent of a second generation of *physiciens géomètres* did the logics of succession and subversion concomitant with field dynamics emerge in unmistakable form.⁴²⁶ This emergence marked the consolidation of the Laplacian “point of view” on science, the entrenchment of representation (and mathematical representation in particular) in scientific inquiry. But ironically, it also marked the moment when Laplace himself and his closest allies began straying farther and farther from the physical sciences’ dominant pole, as the corpuscular assumptions of the Laplacian program came increasingly under attack. Though important young strategists of subversion accepted the basic premise of mathematical physics, they nevertheless rejected the notion that matter could be described in terms of discrete particles. Augustin Fresnel’s study of light figures as the classic moment of subversion in histories of Laplacian physics, the moment after which it was impossible to ignore the vulnerabilities of the Laplacian program as a whole. Reviving the dispute over the nature of light that had pitted Huygens against Newton, waves versus particles, Fresnel (1788-1827) submitted a controversial paper on “diffraction” to the *Institut* in 1815. Fresnel’s success in showing that corpuscular assumptions fell short of accounting for the behavior of light compelled the First Class of the *Institut* to announce a prize competition on the matter in January 1817. Since previous work had shown that “double refraction” and other light phenomena could successfully be described in terms of corpuscular affinities, the prize competition marked a strategic occasion to reconcile diffraction with the dominant position, as well.⁴²⁷ Though the committee consisted of Laplace and other figures more or less sympathetic to the corpuscular position (including Berthollet, Biot, Poisson, Arago and Gay-Lussac), it recognized the superiority of Fresnel’s work by awarding him the grand prize.⁴²⁸ Yet the *Institut* neglected to publish Fresnel’s paper for another seven years, a delay that may have repre-

⁴²⁶ As Bourdieu points out, what counts more in the definition of “generations” than biographical age is the moment of entry in the field.

⁴²⁷ See Fox, “Rise and Fall,” for an account of the way work on double refraction had initially bolstered the Laplacian position (103-07).

⁴²⁸ Fox, “Rise and Fall,” Crosland, *Arcueil*, 407-09. For fuller treatments see Eugene Frankel, “Corpuscular Optics and the Wave Theory of Light: The Science and Politics of a Revolution in Physics,” *Social Studies of Science* 6 (1976): 141-84, and Theresa Levitt, “Chapter Two, *Le Rouge et le vert*: the Colors of Opposition in Restoration France,” in *The Shadow of Enlightenment: Optical and Political Transparency in France, 1789-1848*.

sented a bid to buy time on the part of the Laplacians, or that may simply be ascribed to the institutional dynamics of scientific publication during the period, dynamics that were in any case favorable to conservative interests.

Though Fresnel's victory cast doubt on the corpuscularist's assumptions, it did not result in an immediate reversal of positions. Given the complexity of the issues at stake, the relative value of corpuscular and wave-oriented assumptions about the nature of light remained uncertain for a few more years. Yet Fresnel's findings contributed to reshaping the space of possibilities that constituted (and were ordered by) the field of scientific production. In similar fashion, Alexis Thérèse Petit (1791-1820) and Pierre-Louis Dulong (1785-1838) reversed several aspects of Laplacian work on "caloric" during this period; André-Marie Ampère (1775-1836) refuted many of Coulomb's assumptions about electricity; and Sophie Germain (1776-1831) successfully countered the loyal Laplacian Poisson on the subject of elastic surfaces.⁴²⁹ Together, these circumstances impelled many important Laplacians to modify their positions, and newly accredited varieties of scientific speech that were incommensurable with or contrary to the Laplacian code. Throughout these conflicts, the integrity of the field persisted in the antagonists' common espousal of mathematical physics. Whether tending to entrench Laplacian physics or subvert it, all parties reaffirmed the *doxa* associated with mathematical physics. This scenario confirms Bourdieu's observation that "*le champ de discussion que dessinent, par leurs luttes, l'orthodoxie et l'hétérodoxie se découpe sur le fond du champ de la doxa, ensemble des présupposés que les antagonistes admettent comme allant de soi, en deçà de toute discussion, parce qu'ils constituent la condition tacite de la discussion. . . .*"⁴³⁰ In the conflict pitting proponents of exactitude against those of admiration, the "dispute" often remained tacit thanks to the absence of presuppositions in common and of shared mechanisms for distributing credit among actors; here, on the other hand, the existence of presuppositions in common and of mutual recognition as scientific actors conduced to the articulation of the dispute.

With the success of these subversion strategies, the Laplacians' scientific reversals were doubled by institutional ones. The election of the permanent secretary of the *Académie's* mathematical section served as a bellwether for Laplacian fortunes. Laplace's loyal collaborator Delambre died in office in 1822, setting off a campaign pitting the Laplacian Biot against Arago and Joseph Fourier. When Arago withdrew from the running, Fourier won an easy victory, and, smarting, Biot felt compelled to retire from active scientific life for much of the decade. With Fourier's death in 1830, moreover, the way was paved for Biot's arch-nemesis Arago to accede to the post in turn. Biot's astonishing fall from grace conveys the sharp reversal of positions that occurred in the sciences during the eighteen-twenties.⁴³¹ "By the mid-1820s," writes Robert Fox,

⁴²⁹ Fox, "Rise and Fall," 112-22.

⁴³⁰ "*Spécificité du champ scientifique*," 109.

⁴³¹ For details on Biot's life during his self-imposed exile, see Theresa Levitt, "Chapter Three: Astronomy, the Light of the Heavens," *The Shadow of Enlightenment: Optical and Political Transparency in France, 1789-1848* (Oxford: Oxford University Press, 2009), 70-75. Levitt cannily situates Biot's decision to retire to the life of a large landowner as part of a broader social current encompassing the restitution of *émigré* property and the enrichment of conservative élites. Though not himself of an *émigré* family, Biot's move suggests that for him a scientific career became the stepping stone to the *noblesse campagnarde* under the Restoration just as for Laplace or Berthollet it became the stepping stone to notability under the Empire.

“the intricate structure of Laplacian science had collapsed, leaving just a few increasingly isolated diehards to pursue the chimera that the program and its attendant beliefs were then generally recognized to be.”⁴³² In spite of the ruin of this program, however, Laplacian science would set the tone for the positive sciences in modernity. Laplace's sometime antagonist Fourier captured the basis of this innovation in the elegy he pronounced as perpetual secretary. “*Les ouvrages de Newton,*” pronounces Fourier, “*font assez connaître tout le prix que ce grand géomètre attachait à l'étude spéciale des sciences physiques. Laplace est de tous ses successeurs celui qui a fait le plus d'usage de sa méthode expérimentale; il fut presque aussi grand physicien que grand géomètre. Ses recherches sur les réfractions, sur les effets capillaires, les mesures barométriques, les propriétés statiques de l'électricité, la vitesse du son, les actions moléculaires, les propriétés des gaz, attestent que rien, dans l'investigation de la nature, ne pouvait lui être étranger.*”⁴³³

If the Laplacian point of view realized a new field, how did it gain the authority to do so? How did this first generation of *physicien géomètres* succeed in entrenching their own brand of authority, while definitively de-legitimizing that of the scientific *écrivains* and the non-exact *physiciens*? The Laplacian program was not innately superior to rival ways of doing science; Laplacian assumptions about the corpuscular nature of matter turned out to be false, and they foreclosed lines of research that turned out to be fruitful. Like Napoleon crowning himself emperor, the Laplacian point of view on science imposed itself unilaterally, as it were, as an act of self-law-giving or auto-nomy that inevitably implicated many more cultural actors than those who consented to it or participated in realizing it. Unilateral as it was, though, the imposition of the Laplacian point of view was not *sui generis*. As Bourdieu shows in the case of later nineteenth-century artistic production, the struggles internal to the field “*sont en quelque sorte arbitrées par les sanctions externes,*” the relative value of the positions constitutive of the field shaped by conditions prevailing beyond it.⁴³⁴ Tending toward a state of affairs in which legitimate scientific actors were to have no other “*clients que leurs concurrents,*” the point of view of the dominant scientific actors of the Napoleonic period is as “pure” in scientific terms as that of the dominant artistic and literary actors later in the century would become in artistic terms, and the close relationships that united many leading proponents of exactitude with the First Consul, then Emperor, suggest that the relative power of scientific actors in this period was mediated just as thoroughly by external sanctions as that enjoyed by other kinds of cultural actors. But the history of the sciences under Napoleon asks us to extend Bourdieu’s insight about the role of external sanctions in fields of cultural production. For if external sanctions mediate the positions of scientific fields that are already constituted as such, the dynamics of Napoleonic science show that they can additionally precipitate a new field from a previously unified space of cultural produc-

⁴³² “Rise and Fall,” 109.

⁴³³ Joseph Fourier, “Éloge historique de M. le marquis de Laplace [1829],” *Mémoires de l'Académie des sciences de l'Institut de France*, vol. 10 (Paris: Gauthier-Villars, 1831), cliv. http://www.academie-sciences.fr/activite/archive/dossiers/Fourier/Fourier_pdf/Mem1829_p81_102.pdf.

⁴³⁴ *Règles de l'art*, 416.

tion. In the scission of the sciences from the general culture of letters, the self-crowning of Napoleon is more than just a mirror image of the Laplacian program's unilateral realization; it is also its most powerful efficient cause.

The link between political and scientific forms of authority was forged through Napoleon's avid patronage of the exact sciences, and the *physiciens'* avid pursuit of that patronage. Though Napoleon's enthusiasm for the exact sciences became part of his "legend" in his own lifetime, surprisingly little scholarly attention has been devoted to how, precisely, it shaped the sciences as a form of cultural production. Napoleon's agency, I am arguing, can be credited with establishing the autonomy of the sciences in irreversible form, along with the modes of scientific production that entailed. This agency acted not only through the avid patronage of the sciences but also through the sparse patronage of other forms of cultural production, comporting a *differential* deployment of symbolic and material capital across forms of cultural production. This differential patronage is conveyed in an anecdote about none other than Bernardin de Saint-Pierre, recounted by Napoleon's personal secretary, Bourrienne: "*Je me rappelle qu'ayant un jour essayé de lire les Études de la Nature,*" writes Bourrienne, "*au bout d'un quart-d'heure il jeta le livre avec dépit en me disant: 'Comment peut-on lire de pareilles sornettes; c'est plat, c'est vide; il n'y a rien là dedans; ce sont les rêveries d'un songe creux! . . . Ces gens-là ne sont bons à rien sous aucun gouvernement! Je leur donnerai pourtant des pensions parce que je le dois comme chef de l'État; ils occupent, ils amusent les oisifs; mais je ferai Lagrange sénateur; c'est une tête cela.'*"⁴³⁵ Largely contemptuous of literary culture in general, as contemporaries amply attest, Napoleon showers practitioners of the exact sciences with material and symbolic rewards while depriving literary writers of similar rewards or distributing them less liberally; to the meager pensions for writers in Bourrienne's anecdote corresponds the mathematician Lagrange's nomination to a windfall senatorship. The dominance of Napoleon's cultural policy and the relatively small fund of cultural capital distributed by the regime among literary producers mediates the exact sciences' scission from the republic of letters; for Napoleon's censorship of the press and powerful grip on public opinion ultimately limited the power of readers to consecrate certain writers as scientific producers, even as many contemporary readers remained receptive to the virtuous sciences of admiration *as* sciences. The reading public's role in conferring scientific authority was increasingly eclipsed by Napoleon's power to consecrate some figures and not others, a power which enabled the favorites in question to determine whom among the broad swath of competitors for scientific authority they themselves would acknowledge as *their* competitors, whom among potential clients they would ultimately acknowledge as *their* clients.

If the practitioners of the exact sciences were able to ensure that these two populations would ultimately be the same, they benefited from the coincidence of their own dispositions with those bearing authoritatively on scientific production from the outside. As Bourdieu shows in the case of artistic production in the time of Manet, revolutions in the field's internal values often correspond to revolutions in the world beyond the field. "*Les plus décisifs de ces changements,*" writes Bourdieu of such revolutions, "*sont les ruptures politiques qui, comme les crises révolutionnaires, changent les rapports de force au sein du champ (ainsi, la révolution de 1848 renforce le pôle dominé, déterminant une translation, provisoire, des écrivains vers l'art social),*"

⁴³⁵ *Mémoires de Bourrienne*, vol. 5 (Paris: Chez l'Advocat, 1830), 247-48.

ou l'apparition de nouvelles catégories de consommateurs qui, étant en affinité avec les nouveaux producteurs, assurent la réussite de leurs produits."⁴³⁶ For Bourdieu, the conjunction which produces the revolution in the order of the field changes the relative authority of one position to another but does not conduce to the articulation of totally new positions. "*Bien qu'elles en soient grandement indépendantes dans leur principe,*" writes Bourdieu, "*(c'est-à-dire dans les causes et les raisons qui les déterminent), les luttes qui se déroulent à l'intérieur du champ littéraire (etc.) dépendent toujours, dans leur issue, heureuse ou malheureuse, de la correspondance qu'elles peuvent entretenir avec les luttes externes (celles qui se déroulent au sein du champ du pouvoir ou du champ social dans son ensemble) et des soutiens que les uns ou les autres peuvent y trouver.*"⁴³⁷ Just as the congruence of a principle determining a form of cultural production and a principle determining a kind of social demand can influence the positions of an autonomous field, they are also capable of initiating a process of autonomization where none had been previously under way. In the case of the sciences in Napoleonic France, Napoleon was both the one exception to this scenario of clients as competitors and an external authority with whose dispositions those of the *physiciens géomètres* beautifully aligned. Given this scenario, the preferences of the man himself determined the "outcome" of the sciences' progressive autonomization through a variety of means, achieving a scenario of structural subordination through institutional reforms, personnel choices and personal interventions in scientific debates, among other tactics. In keeping with Bourdieu's insight, Napoleon does not himself invent new scientific positions in this process, only selects for those most congruent with his own dispositions.

Even under the autocratic conditions of Napoleon's regime, it may seem incredible that one actor could play such a determinant role in the inception of scientific modernity. Yet the extreme centralization of political authority in Napoleonic France was mirrored by an extreme centralization of scientific authority, a characteristic that had distinguished French culture throughout the eighteenth century and before. While London's Royal Society, for instance, was supported by private subscriptions and boasted a large and heterogeneous membership, the *Académie des Sciences*, like the First Class of the *Institut* that succeeded it, was supported by the State and monopolized the distribution of scientific authority in France and beyond. The extreme centralization of the political and scientific fields conduced to the initiation of scientific autonomization, the consolidation of power in the hands of Bonaparte and the accumulation of prestige and scientific posts in the hands of Laplace, Cuvier or Berthollet, concentrating what might otherwise have been diffuse systemic processes into exchanges at just a few key interpersonal nodes.

Given this historical scenario, the value of distinguishing between the horizontal and vertical dimensions of cultural autonomy emerges in full. Contrary to the state of affairs outlined by Bourdieu in his study of literature, the sciences' ability to achieve the status of a distinct emerging field occur not thanks to the lifting of political or social control but rather to its opposite. If in the case of late nineteenth-century literature, the advocates of a "pure" art, an art for art's sake, were those who most thoroughly distanced themselves from the tastes of their moment's social and political elites, the advocates of a "pure" science, a science for science's sake, were, on the contrary, those who most avidly courted the patronage of Napoleon. The literary field achieves

⁴³⁶ *Règles de l'art*, 417.

⁴³⁷ *Ibid.*, 416.

autonomy in Bourdieu's estimation to the extent that its dominant figures eschew the "*principe hétéronome*," the tendency to minimize the vertical autonomy of the field through a rapprochement with political and economic elites; but the scientific field achieves its own autonomy precisely through the opposite tendency, the embrace of heteronomy in the form of a rapprochement with Napoleon. The material and symbolic rewards which Napoleon distributes among the scientific actors willing to submit to this subordination, often in the form of direct personal intervention in his capacity as head of state, enable them to impose their vision of the field on the breadth of affected cultural producers. Cuvier's eulogy for Lamarck tells us as much, since Cuvier quite explicitly blames Lamarck's poverty on his own unwillingness to perform the kind of science favored by the "dispensers of favors," a phrase which I have argued refers both to Cuvier as occupant of multiple powerful posts and to Napoleon himself.

What Bourdieu calls the "*économie à l'envers*" of autonomous literature is correspondingly absent from the autonomizing sciences. With the advent of literary autonomy, a kind of literature emerged in which the symbolic recognition of writers' peers outweighed the material recognition of consumers, and in which, moreover, material success tended to undermine their status in the field. In the point of view on the field espoused by proponents of literary autonomy, an inverse relationship thus governed the accumulation of symbolic versus material capital.⁴³⁸ In the sciences of the early nineteenth-century, the discourse of "rectitude" presumed a similarly inverse relationship between scientific integrity and material wealth, yet the historical evidence suggests that something quite different was afoot. Many proponents of an autonomous scientific field enjoyed both a great deal of symbolic capital as scientific actors and a great deal of material capital as recipients of Napoleonic patronage. The honors, posts and gratuities which significant actors in the exact sciences accumulated under Napoleon endowed them with the means to advance the careers of younger scientific actors in turn, shaping the identity of legitimate scientific inquiry in their favor. While cultural capital and economic capital stood in inverse relationship in the autonomization of the literary field, cultural capital and economic capital ultimately stood in a direct relationship in the autonomization of the scientific field, and the reduced vertical autonomy which the sciences accepted as the price of this scenario facilitated their horizontal autonomization. Though this scenario clearly shaped scientific speech, my argument is not that this speech took on explicit ideological content or suffered in quality or credibility as such. Rather, I am arguing that authoritative scientific speech came to reflect the congruence between Napoleonic and mathematical-physical dispositions, as well as the modes of specialization that corresponded to this new state of horizontal autonomy.

While Napoleon affirmed a close connection between "*l'avancement et la perfection des mathématiques*" and "*la prospérité de l'État*," his patronage of mathematical sciences seems to have been driven as much by his own personal predispositions and educational history as it was by a concern for good governance.⁴³⁹ As chief of state, his habitus reflected the fusion of mathematics education and military disciplinization that characterized the engineering schools of the late Enlightenment in France. By the end of the eighteenth century, mathematics had become one of the principle criteria for distinguishing merit among students of the royal military schools,

⁴³⁸ *Règles de l'art*, 139.

⁴³⁹ Dhombres and Dhombres, *Naissance d'un nouveau pouvoir*; 669.

with scores on mathematics exams determining which military institutions students would be eligible to join. As Dhombres and Dhombres write, “*les élèves les plus doués en mathématiques passaient au Génie, puis à l’Artillerie ou à la Marine, tandis que les autres se retrouvaient dans l’Infanterie ou dans la Cavalerie. Ainsi, Napoléon avait-il bénéficié de la méritocratie par la science qui devait devenir le mode régulier de sélection des élites techniques en France.*”⁴⁴⁰ Ken Alder further argues that this choice of mathematics as a gauge of merit was arbitrary in many ways. It displaced patronage ties or family history as explicit criteria of merit for advancement in military service in part, he writes, because it was “a publicly verifiable standard that did not depend on the judgment of the examiners.” Moreover, adeptness in mathematics bore an ambiguous relationship to adeptness at military or engineering tasks in the field: “this meritocratic scheme implied that an individual’s ability in mathematics measured (or predicted) something like real performance in tasks deemed important to the state Yet . . . this assumption was by no means self-evident, even to contemporaries. Leaders in all the engineering schools realized that practical training continued to be essential to producing effective engineers.”⁴⁴¹

For Alder, mathematics’ rise as a criteria of merit had as much to do with the associations attached to the curricula they in large part displaced as with the advantages of mathematics themselves. “The traditional subjects that had provided a rigorous education since the Renaissance,” he writes, “—Latin and rhetoric—had been denounced since the seventeenth century for inculcating skill in equivocation and sophistry, the very values that the new commanders abhorred.”⁴⁴² In replacing rhetoric and belles-lettres in the royal military schools, mathematics “was intended as a form of discipline,” Alder adds, “not as useful knowledge.” The artillery command similarly enforced an education in mathematics for the values it was imagined to impart, as well as for what was perceived as the superior rigor of the material. In the choice of an “impersonal” standard, the social value of uniformity was such that faculty and students were discouraged from looking for heterodox solutions to mathematical problems. “The intention,” according to Alder, “was to impose a uniformity of habit and thought, instilling a solidarity that was the technicians’ equivalent of esprit de corps. Mathematics was particularly well suited for this role because it impressed on students the virtues of uniformity and precision.”⁴⁴³

The increasing overlap between the military and mathematics during this period resulted in an increasing overlap between the military and the sciences, as well. This “commutative” state of affairs resulted in a closer relationship between the military and the sciences than had previously existed. The anecdotes François Arago recounts about his own choice of vocation confirm the degree to which a military habitus and a scientific habitus had come to co-exist, or even to which military dispositions had come to precondition an élite career in the sciences. Growing up amid the comings and goings of troops on the border of France and Spain, Arago recalls that as

⁴⁴⁰ Ibid., 648.

⁴⁴¹ “French Engineers Become Professions; or, How Meritocracy Made Knowledge Objective,” *The Sciences in Enlightened Europe*, ed. by William Clark, Jan Golinski and Simon Schaffer (Chicago: University of Chicago Press, 1999), 98-99.

⁴⁴² Ibid., 108.

⁴⁴³ Ibid.

early as seven he evinced “*des goûts militaires si décidés, que ma famille était obligée de me faire surveiller de près pour empêcher que je ne me mêlasse furtivement aux soldats qui partaient d’Estagel.*”⁴⁴⁴ A subsequent encounter with a graduate of the *École polytechnique* proved decisive; discovering that the prestigious young man had graduated from an institution whose entrance exam tested candidates on mathematics, the young Arago throws himself into the subject: “*À partir de ce moment, j’abandonnai les classes de l’école centrale, où l’on m’enseignait à admirer Corneille, Racine, la Fontaine, Molière, pour ne plus fréquenter que le cours de mathématiques.*”⁴⁴⁵ As a student of the *École polytechnique*, Arago becomes so invested in preparing for a military career in the Artillery corps that he initially refuses Laplace’s offer of a post at the *Observatoire de Paris*. It is only with Laplace’s guarantee that he may resume a career in the artillery if he wishes that Arago finally agrees to embark on a career in the sciences. If Arago’s military and scientific vocations ultimately conflict, the mutually reinforcing character of mathematics and military formation pave the way to a career in the sciences in the first place. In this respect, Arago’s biography reflects broader structural changes in the culture of the sciences in France.

A similar conflict between the military and the sciences characterized Napoleon’s early career, at least by his own testimony. Mathematics’ increasing importance as a criteria of merit in the military seems to have favored the young Napoleon’s personal predispositions. As schoolboys, Napoleon and his childhood friend and personal secretary Bourrienne exchanged, as Bourrienne attests, “*la solution des problèmes que l’on nous donnait à résoudre et qu’il trouvait sur-le-champ avec une facilité qui m’étonnait toujours, contre des thèmes et des versions dont il ne voulait pas entendre parler;*”⁴⁴⁶ and accounts of his exile to Saint Helena convey his predilection for whiling away the hours by solving mathematical or physical problems.⁴⁴⁷ During his time in power, Napoleon likewise proclaimed his regrets at having sacrificed a scientific vocation for the pursuit of military glory, as the anecdote told by Geoffroy Saint-Hilaire about Bonaparte’s conception of the “*monde des détails*” attests. If Napoleon praises Newton’s mathematization of the cosmos, he himself, according to Geoffroy, would have devoted himself to determining “*comment s’opère le mouvement qui se communique et se détermine par l’intervention des plus petits corps.*”⁴⁴⁸ As Geoffroy remembers, Bonaparte declares before the group of savants who had accompanied him to Egypt that, “*si je n’étais pas devenu général en chef. . . je me serais jeté dans l’étude des sciences exactes. . . Aucune autre gloire n’aurait pu tenter mon ambition.*”⁴⁴⁹ Upon his return to Paris from Egypt, Bonaparte’s election to the *Institut* in the mechanical arts section of the First Class and assiduous attendance at its meetings bore out this predilection for the exact sciences. Displacing several prestigious candidates for the seat vacated by Lazare Carnot, victim

⁴⁴⁴ François Arago, *Histoire de ma jeunesse* (Bruxelles: Kiessling, Schnée et Co, 1854), 37.

⁴⁴⁵ *Ibid.*, 39.

⁴⁴⁶ *Mémoires*, vol. 1, 31.

⁴⁴⁷ Dhombres and Dhombres, 672-74.

⁴⁴⁸ Geoffroy Saint-Hilaire, *Notions synthétiques*, xxviii.

⁴⁴⁹ Cited in Dhombres and Dhombres, 646.

of the Fructidor purge, Bonaparte achieved full membership in the *Institut* thanks largely to the zeal of Laplace.⁴⁵⁰ Typically seating himself next to Laplace, the general, then chief of State, attended meetings of the *Institut* frequently through 1802, reading reports on scientific works and even serving on a scientific commission.⁴⁵¹

This affinity for the sciences was matched with a thoroughgoing antipathy to literary culture, and while Napoleon avowed the utility of mathematics and the sciences to the state, he often presumed the uselessness or harmfulness of letters. As Bourrienne attests, Napoleon's contempt for literary art was often driven by works' political or potentially political content. Going so far as to censor older works whose revival might give them new political punch, Napoleon despised new political works all the more strongly. "*Le dédain, ou pour mieux dire le dégoût de Bonaparte pour les lettres,*" writes Bourrienne, "*s'appliquait particulièrement à quelques hommes qui les cultivaient avec succès; il détestait Chénier et encore plus Ducis. Il ne pouvait pardonner à Chénier les principes républicains dont ses tragédies étaient imprégnées; et Ducis éveillait en lui comme un instinct de haine involontaire. . . .*"⁴⁵² But if Bonaparte's contempt for letters was driven in part by political content, it was also driven by his own antipathy for literary culture in general and his apparently minimal instruction in letters. Napoleon's scant literary culture is documented by Chaptal, the chemist and sometime minister of the Interior: "*Les auteurs grecs et latins lui étaient presque inconnus,*" declares Chaptal:

Il avait rapidement parcouru quelques historiens dont il avait retenu quelques faits; il s'était formé une opinion à la hâte; et les autorités les plus respectables, l'approbation unanime des siècles ne pouvaient opérer aucun changement dans ses idées. Tacite était, selon lui, le plus mauvais historien de l'antiquité; peut-être s'en était-il formé cette opinion d'après le tableau que cet auteur fait de Tibère. Horace n'était bon que pour des sybarites. Homère seul avait son hommage. Parmi les modernes, il admirait peu Voltaire, Racine et Rousseau. Corneille était celui de nos poètes qu'il estimait le plus.

⁴⁵⁰ For details on Napoleon's election see Alder, *Measure of All Things*, 237. "[Bonaparte's] main claim to scientific fame," writes Alder, "was the fact that he had been Laplace's examination pupil at artillery school. He had no pretensions to original invention or research. Rather, Laplace had advanced his candidacy (over the marvelous Lenoir, among others) in the hopes of allying the Academy to France's rising political star." See also Crosland, *Arcueil*, 9-12. About Bonaparte's rivals in the election, Nicole Dhombres adds, "*Les candidats battus avaient pourtant des titres très sérieux: l'ingénieur en chef des Ponts et Chaussées Dillon était l'auteur d'importants mémoires sur les constructions hydrauliques et devait construire le premier pont en fer existant en France, le fameux pont des Arts à Paris. Quant à l'auteur de l'ouvrage controversé de la Fortification perpendiculaire, Montalembert, déjà membre correspondant de l'Académie des Sciences, il avait atteint l'âge canonique de quatre-vingt-quatre ans en 1797 et méritait bien la consécration de l'Institut pour cet ouvrage imposant. . . .*" "Napoléon et les scientifiques. 1: 1779-1798; 1797-L'entrée à l'Institut," http://www.napoleon.org/fr/salle_lecture/articles/files/@Napoleon_scientifiques_1_1779-1798.asp#ancre6.

⁴⁵¹ Dhombres and Dhombres, 665-67. Count Rumford adds that in gatherings with scientific men, Napoleon "converses more with Laplace than with anybody else." *Journal*, 34.

⁴⁵² *Mémoires*, vol. 5, 246. For an account of the régime's paranoid obsession with "application," see Pierre Frantz, "Le théâtre sous l'Empire: entre deux révolutions," *L'Empire des Muses*, 173-97.

*Il lisait rapidement presque tous les ouvrages qui paraissaient; il en approuvait peu et faisait supprimer tous ceux dont la morale ou les principes lui avaient déplu.*⁴⁵³

Bourienne similarly attests to Bonaparte's interest in a mere handful authors, including the Bernardin de Saint-Pierre of *Paul et Virginie*. "Comme il y avait du vague dans son esprit, une constante énergie dans son caractère, et qu'il rapportait tout à lui," adds Bourienne, "son esprit se plaisait dans les nuages d'Ossian, et son caractère positif se trouvait comme exprimé dans les hautes pensées de Corneille; de-là sa prédilection presque exclusive pour ces deux auteurs. Du reste les plus beaux ouvrages de notre littérature n'étaient pour lui qu'un arrangement de mots sonores et vides de sens et qui, selon lui, ne frappaient que l'oreille."⁴⁵⁴ However interested both Chaptal and Bourienne may have been in distancing himself from Napoleon at the time of writing their memoirs, they each convey what was widely accepted as Napoleon's indifference to letters in general.

Bonaparte's contemporaries attribute this antipathy to literary culture to various personal dispositions. For Chaptal, his contempt corresponded to a lack of sympathy for artistic production in general: "Napoléon n'aimait pas les arts," Chaptal asserts, "ce qui provenait peut-être de ce que la nature lui avait refusé ce tact particulier qui nous sert à en apprécier le mérite. Il était même si borné à cet égard, qu'il ne concevait pas qu'on pût s'enthousiasmer d'un tableau ou d'une statue, attendu, disait-il, que "tous étaient des copies de la nature, et qu'il n'y avait pas grand mérite à copier ou à imiter." . . . C'était par politique ou par ostentation qu'il encourageait les arts, jamais par ce sentiment qui nous fait juger une nation et son état de civilisation par les monuments et les productions du génie."⁴⁵⁵ For Chaptal, this disposition arises from a more general impatience with use-less things. "Je me suis expliqué l'inimitié générale dans laquelle Bonaparte enveloppait tous les gens de lettres," he writes. "C'était moins chez lui l'effet d'une prévention qu'une nécessité de son caractère. Il faut du temps pour apprécier, pour lire seulement les ouvrages littéraires, et le temps était si précieux pour lui, qu'il aurait voulu, pour ainsi dire, abrégé la ligne droite; aussi n'aimait-il que les hommes qui s'occupaient de choses positives, exactes, renfermées dans un cercle où ne pouvait s'introduire aucune censure d'administration, aucune pensée de gouvernement." For Bourienne, moreover, Napoleon's antipathy to letters arises from envy deriving from his own minimal literary talents. Of Napoleon's opinion of "gens de lettres," Bourienne writes, "Quand il m'en parlait, lorsque j'étais auprès de lui, il les appelait des phraseurs, il ne leur pardonnait pas d'être supérieurs dans un genre où il n'avait aucune supériorité, et, à quelques éclairs près, je n'ai jamais connu un homme plus insensible que Bonaparte à la belle poésie ou à la belle prose."⁴⁵⁶

These personal dispositions had concrete consequences for the symbolic status and material support of literary careers. Under the Convention, the *Institut national* had been organized in three classes (1795), whose denomination was intended to evoke a hierarchy of cultural produc-

⁴⁵³ Jean-Antoine Chaptal, *Mes souvenirs sur Napoléon* (Paris: Plon, Nourrit et Cie, 1893), 348-49.

⁴⁵⁴ *Mémoires*, vol. 5, 246.

⁴⁵⁵ Chaptal, *Mes souvenirs sur Napoléon*, 270-71.

⁴⁵⁶ *Mémoires*, vol. 5, 245.

tion. In this iteration of the *Institut*, a First Class of *Sciences Mathématiques* preceded a Second Class devoted to *Sciences Morales et Politiques* and a Third Class devoted to *Littérature et Beaux-Arts*, an institutional scenario that reflected the ascendancy of the *Idéologues* in its consecration of intellectual endeavor at the expense of artistic creation. The reform of the *Institut* undertaken by the First Consul in 1803 abolished the Second Class and confirmed the primacy of the sciences: in the new *Institut* a First Class of *Sciences Mathématiques* preceded a Second Class of *Langue et Littérature Françaises* and Third and Fourth Classes devoted to *Histoire et Littérature Ancienne* and *Beaux-Arts*. The relative prestige of the First Class is also suggested in the sums awarded to winners of the Classes' respective annual prizes. As Crosland remarks, "the prize awarded by the First Class was to be 3000 francs, whereas a prize for literature, for example, was worth only 500 francs."⁴⁵⁷ Together, these details suggest the extent to which the subordination of letters as a form of cultural production was codified in the *Institut*.

Literary writers were not only subordinated within the field of cultural production, however, but were also passed over for nomination to lucrative civil posts, as Bourrienne's anecdote about Bernardin and Lagrange suggests. If Napoleon sought to instill a new hierarchy of cultural values through the creation of an elite of "notables," literary writers were almost entirely excluded from this promotion. Napoleon's conception of "notability" confirms "*le passage d'une élite fondée sur la naissance à une aristo-ploutocratie de fonction, consolidant en partie l'oeuvre de la Révolution,*" as a historian of Napoleon's *Sénat conservateur* puts it.⁴⁵⁸ As an instrument of Napoleonic cultural policy, the *Sénat* played a major role both in consecrating the sciences and disfavoring belles-lettres and other literary practices. In addition to Lagrange, Laplace, Berthollet, Monge, Lacépède, Chaptal and others were all named to the *Sénat* on the basis of their scientific work. In contrast, the literary men admitted to the *Sénat* were all distinguished more by their loyalty to Napoleon or by legal or political careers than by their literary reputations. Though previously a member of the Ancien Régime *Académie française*, Henri-Cardin-Jean-Baptiste d'Aguesseau was primarily reputed as a counselor and legal scholar; and though elected to the restored *Académie française* in 1803, Louis Philippe, comte de Ségur was likewise best known as a diplomat and statesman. Constantin de Volney (1757-1820), François de Neufchâteau (1750-1828), and Louis de Fontanes (1757-1821) all similarly belonged either to the *Ancien Régime Académie française* or to its successors under Napoleon's rule and were to some degree recog-

⁴⁵⁷ Crosland, *Sciences Under Control*, 42.

⁴⁵⁸ Vida Azimi, *Les premiers sénateurs français: Consulat et Premier Empire 1800-1814* (Paris: Picard, 2000), 76.

nized as “authors;” yet for Neufchâteau and Fonatanes in particular, membership in the *Sénat* was a reward for political pliancy as much as for literary eminence.⁴⁵⁹

Though writers like these were elevated to the status of notables, many of the most celebrated writers of the period were excluded from civil service. The all-male makeup of the *Sénat* and other civil institutions categorically discriminated against the many celebrated female authors of the period, Germaine de Staël chief among them; Chateaubriand’s career in diplomacy was derailed by the assassination of the Duc d’Enghien; and Napoleon simply despised the Bernardins de Saint-Pierre and Louis-Sébastien Merciers of the world, to say nothing of the Morellets and the Suards. Most importantly, the conditions for literary production under Napoleon were unfavorable enough to discourage the pursuit of a literary career in the first place, re-orienting the ambitions of those who might have gone on to write literary works under different political circumstances. In her *Mémoires*, Mme de Rémusat puts a fine point on the constraints faced by literary artists: “*Si le bon génie de la France eût permis que Bonaparte, en même temps qu’il nous rendait au repos, nous eût accordé quelque ombre d’une saine liberté,*” the long-time lady-in-waiting to the Empress Joséphine opines,

il est vraisemblable que l’alliance des souvenirs d’un temps orageux, où la pensée avait subi une fermentation passionnée, unie à celle d’un état de choses plus ordonnée, eût enfanté des productions plus importantes. Mais l’empereur, voulant que tout tournât à son seul profit, faisant des efforts immenses pour rattacher à son règne toutes les célébrités, contraignit l’esprit, et le marqua du sceau de son despotisme, en interdisant

⁴⁵⁹ In addition to these figures, the playwright Ducis refused a post on political principle. Other literary figures like Joseph Fiévée and Stéphanie-Félicité, comtesse de Genlis served Napoleon in other official (and unofficial) capacities. Of de Genlis, Bourrienne recounts that Napoléon developed an affinity for her writings and used her as a sort of spy on aristocratic society. In spite of the criticism of the Consulate that the public’s enthusiasm for the engravings in de Genlis’ novel *Madame de la Vallière* implied, “[Bonaparte] *ne s’en prit point à cette femme célèbre,*” writes Bourrienne, “*qui lui fut recommandée, notamment par M. de Fontanes et par M. Fiévée, et qui lui adressa plusieurs lettres. Ce genre de correspondance n’étant point dans le cercle de mes occupations, je ne vis pas les lettres de madame de Genlis, mais je sus seulement par madame Bonaparte qu’elles contenaient un nombre considérable de noms propres, et j’ai lieu de penser qu’elles ne contribuèrent pas peu à grandir aux yeux du premier consul le faubourg Saint-Germain* (*Mémoires*, vol. 5, 142).”

Mme de Rémusat likewise casts Mme de Genlis’ correspondence with Napoleon as a kind of soft espionage: “*Tandis que madame de Staël pouvait se plaindre si justement des poursuites dont elle fut l’objet, il est une autre femme assurément très inférieure, et moins célèbre, qui n’eut qu’à se louer de la protection que l’empereur lui accorda. Ce fut madame de Genlis. A la vérité, il ne trouva chez elle ni talent ni opinions qui lui fussent contraires. Elle avait aimé et exalté la Révolution; elle sut profiter de toutes ses libertés. Devenue vieille, un peu prude et dévote, elle s’attacha à l’ordre, et manifesta par cette raison, ou sous ce prétexte, une profonde admiration pour Bonaparte. Il en fut flatté; il lui donna une pension, et l’autorisa à une sorte de correspondance avec lui, dans laquelle elle l’avertissait de ce qu’elle lui croyait utile, et lui apprenait de l’ancien régime ce qu’il voulait savoir. . . .* *Mémoires de Madame de Rémusat, 1802-1808*, vol. 2 (Paris: Calmann Lévy, 1880), 401-02.

Of the Idéologue senators—Volney, Cabanis, Garat and Destutt de Tracy—Isser Woloch writes: “these disillusioned Brumairians turned away from public life to private scholarship, and confided their anguished comments only to their intimate friends.” *Napoleon and his Collaborators: the Making of a Dictatorship* (New York: W. W. Norton, 2001), 83.

Woloch also writes of François de Neufchâteau’s “impressive credentials as a liberal and revolutionary public servant: poet, playwright, and man of letters during the old regime; departmental administrator elected to the Legislative Assembly of 1791; a deputy to the Convention who declined to take his seat and was arrested during the Terror; a member of the Directory after Fructidor. . . . François welcomed Brumaire, entered the Senate in its first cohort, steered clear of any dissident actions, and when the time came advanced the transition to Empire (116-17).”

tout généreux essor. On vit la plus grande partie des écrivains épuiser leur invention pour varier la louange prescrite et récompensée; on ne se permit aucun livre politique; on évita, dans les créations imaginaires, les applications douteuses; la comédie n'osa point peindre les mœurs; la tragédie ne représenta que certains héros. Il s'offrait assez de matière à l'éloge pour que la conscience fût à peu près tranquille, mais la véritable invention repoussée s'éteignit bientôt. . . . On mit donc toute sa conscience à faire le mieux possible ce qui était permis; de là cette teinte uniforme qui me semble répandue sur la plupart des ouvrages du commencement de ce siècle.

At once inhibiting writers' genuine inspirations and encouraging them in the output of the routine, Napoleon gives cause, in Rémusat's estimation, for counterfactual fantasies about the literature that might have been.⁴⁶⁰

On the other hand, Rémusat concludes, "*les progrès des sciences ne furent nullement interrompus,*" and if she recalls that Bonaparte enriched a select few savants in inducting them into his Senate, she also muses—not perhaps without malice—that "*c'était faire honneur à ce corps.*"⁴⁶¹ As Vida Azimi, historian of the *Sénat* puts it, "*Les sénateurs du Consulat et de l'Empire, situés au sommet de la hiérarchie sociale, partagent avec le reste du personnel politique, les faveurs souvent démesurées du Premier Consul, puis de l'Empereur.*" Even in the *Sénat*, the senator-savants were distinguished by the enormity of their Senate incomes. "*La noblesse impériale étant une aristocratie de fonction, le principal des revenus provient du traitement,*" adds Azimi. "*Les conquêtes impériales seront une manne inespérée et variée d'enrichissement pour certains sénateurs: dotations accordées par l'Empereur; gratifications pour les services rendus, enfin exactions pour les moins scrupuleux d'entre eux.*"⁴⁶² If the base *traitement* of a senator was 25000 francs, Berthollet, Monge, Lacépède and other scientific personalities received additional *dotations* (tribute money extracted from conquered foreign territories) of 30000 francs or more; and each of these figures was further named to a *senatorerie*, an administrative unit encompassing several departments that came with an annual revenue of 20000 to 25000 francs and entailed the temporary possession of a host of nationalized domains within the territory.⁴⁶³ For his part, Laplace received 72000 francs per year as Chancellor of the *Sénat*, "*un des traitements les plus*

⁴⁶⁰*Mémoires de Madame de Rémusat, 1802-1808*, vol. 2, 406-07. Chaptal similarly remarks on the silencing effects Napoleon exerted on literature: "*Napoléon,*" he writes, "*marquait souvent son étonnement de ce que nos littérateurs ne produisaient plus aucune pièce d'un grand mérite, et il ne voyait pas qu'il avait tellement rétréci le cercle, qu'il n'y avait plus moyen de donner carrière au talent. Il jugeait tout avec ses passions, et ce n'était point le mérite d'une belle conception, ni le talent d'une saine littérature qui le séduisaient. C'étaient toujours des sentiments analogues aux siens qu'il eût voulu qu'on exprimât. Heureusement, peu de de poètes pouvaient se plier à ses goûts (Souvenirs, 390).*"

For the literary effects of Napoleon's hands-on approach to censorship on theater production see Pierre Frantz, "Le théâtre sous l'Empire: entre deux révolutions," *L'Empire des Muses*, 173-97.

⁴⁶¹ *Mémoires de Mme de Rémusat*, vol. 2, 412-13. "*L'Institut de France compte des hommes fort distingués. Bonaparte les caressa tous; il en enrichit quelques-uns; il les décora même de ses nouvelles dignités. Il en fit entrer dans son Sénat. Il me semble que c'était faire honneur à ce corps, et que cette idée avait de la grandeur.*"

⁴⁶² Azimi, 76.

⁴⁶³ Woloch highlights the role the creation of the *senatoreries* played in Napoleon's strategizing to be named Emperor (*Napoleon and his Collaborators*, 114).

élevés de la hiérarchie civile,” notes Azimi.⁴⁶⁴ These regular *traitements, dotations,* and *senatorerie* annuities did not exclude additional *gratifications*. Thus, Laplace and Monge successfully interceded with the Emperor on behalf of Berthollet, when their colleague’s financial difficulties came to light; Napoleon readily offered to lend the senator one hundred to one hundred fifty thousand francs and expressed his satisfaction at having the “opportunity of giving you,” as he wrote, “a proof of my esteem and to be of service to you.”⁴⁶⁵

For the members of the *Institut*, Napoleon’s favor came with a cost, however. His intention to reign as both “president of the French republic and president of the republic of letters,” as a *Moniteur* article put it after the *brumaire* coup and Napoleon’s subsequent election to the presidency of the *Institut*, generally advanced the position of exactitude but sometimes put him at odds with it.⁴⁶⁶ As I have been arguing, the single most important effect of Napoleon’s domination of scientific production was to have favored the position of exactitude at the expense of other eligible sciences, thereby clearing the way for the emergence of an autonomous scientific field. Yet Napoleon’s shaping of scientific speech was not so simple, as the medaling of Volta attests. In the protection of Volta, Napoleon demonstrates a willingness to counter the very proponents of exactitude whom he otherwise patronized so lavishly, for reasons which are not immediately obvious. It may be that Napoleon’s scientific dispositions overlapped but did not fully coincide with that of the proponents of exactitude, that his notion of what the sciences should be and do strayed in some ways from theirs. Napoleon’s fascination with Volta and the battery may have corresponded to what Geoffroy Saint-Hilaire remembered as his preoccupation with the “life” of the universe, though this positions accords all too neatly with Geoffroy’s own scientific agenda at the time of his writing.⁴⁶⁷ In spite of the battery’s provenance in the debunking of vital materialist assumptions, Geoffroy asserts that for Napoleon its capacity to arouse motion in matter promised insight into the nature of microcosmic movement and perhaps of will itself. The pile also must have spoken to Napoleon’s preference for practical applications in the sciences, a preference which sometimes left him at odds with the “pure” savants he otherwise favored; and given the alacrity with which the English adopted Volta’s invention, sponsoring researches into the

⁴⁶⁴ Azimi, 77. Named chancellor of the Senate in 1803, Laplace remained in this post until the end of the Empire. *Quand Napoléon inventait la France: Dictionnaire des institutions politiques, administratives et de cour du consulat et de l’Empire*, ed. Thierry Lentz (Paris: Tallandier, 2008), 113.

As Azimi writes, the *senatoreries* entail not only “une dotation qui double le traitement sénatorial” but also “une mission de confiance” in which the senators surveyed their territory on behalf of the Emperor *Tant par leur mode de recrutement que par leur destination, les sénatoreries visent à transformer les sénateurs en agents du pouvoir exécutif, auxiliaires dévoués du gouvernement. D’où le secret qui entoure les mission, suivant une tradition étatique bien française* (98-99).

⁴⁶⁵ Quoted in Crosland, *Arcueil*, 278.

⁴⁶⁶ Quoted in Crosland, *Arcueil*, 18.

⁴⁶⁷ Geoffroy’s vital materialism is developed in the *Études progressives d’un naturaliste pendant les années 1834 et 1835* and the *Notions synthétiques, historiques et physiologiques de philosophie naturelle* (1838), as we shall see in greater depth in the next chapter.

battery in particular may have additionally occurred to Napoleon as a means of outdistancing France's rival at a time of international ill-will.⁴⁶⁸

Beyond the medal, Napoleon's protection of Volta extended to forcing his election to the *Institut* as foreign associate. While the *Institut* initially resisted Volta's candidacy, the institutional reforms of 1803 left it no grounds to demure. Under the rules of the pre-1803 *Institut*, the First Class voted for the three candidates it wished to submit to the vote of the *Institut* as a whole. In a series of votes in 1802, Volta failed to make the First Class' list of three once and placed third twice, falling short in his bid for election to the *Institut* all three times in spite of the First Consul's express wish. In part as a result of this intransigence, the rules of the post-1803 *Institut* stipulated that the First Consul himself would approve each Class' list of candidates, and Volta was subsequently elected to the *Institut* with an absolute majority. Though his rivals on the list were the same as in previous elections, Volta was finally elected thanks to this erosion of the *Institut*'s independence. "Needless to say," as Geoffrey Sutton concludes, "the consul approved the choice and the unprecedented solidarity of the Institute."⁴⁶⁹

Beyond the question of Napoleon's own scientific preferences, actions like the protection of Volta also evoke a desire to dominate scientific speech for the mere sake of demonstrating dominance. In his journal of scientific life around the time of Volta's Paris sojourn, Count Rumford recounts an anecdote which confirms this notion. "From [Mme Laplace], writes Rumford, "I learnt several interesting anecdotes of the Revolution which were new to me and also several anecdotes of the first Consul which appeared to me to be characteristic.

One of them relates to an event--of no great importance in itself--which took place last Evening at the Meeting of the National Institut when I was present. There was an election, by a sort of ballot, of an assistant Astronomer at the Observatory. The Members of the Section of Astronomy proposed five candidates, each of the Members of the Class present wrote down the Names of the five Candidates on a slip of Paper one under the other, in the order in which they estimated the pretensions of the candidates. The first Consul who sat [next] to M. Laplace asked him to let him see his list before he wrote his own. He showed it to him. The first Consul laid it down before him on the

⁴⁶⁸ See Patrice Bret, *L'État, l'armée et la science: l'Invention de la recherche publique en France (1763-1830)* (Rennes: Presses universitaires de Rennes, 2002), 18-21. Bret positions the enormous battery that Napoleon had built at the behest of Berthollet as *the* symbol of state intervention in scientific research. As anecdote has it, it was the Englishman Humphrey Davy's successes in experimenting with the battery that motivated Napoleon to allocate the funds.

The prospect that Napoleon was a man of engineering before he was a man of science is raised in an anecdote relayed by Biot to Sainte-Beuve, in which the poet and Grand-Maître of the Université Fontanes permits himself to mock Napoleon before Biot. In this exchange, Biot remarks to Fontanes that he would be willing to give the speech marking the distribution of prizes in the University's annual *Concours général* in French rather than in the traditional Latin, as long as it were possible to confine the praise of the emperor within reasonable boundaries. But of the emperor Fontanes retorts, "*Cet homme-là n'aime des sciences que ce qui rime à canon, et des lettres ce qui rime à Napoléon.*" In "sciences that rhyme with cannon," the poet seems to affirm a preference on Napoleon's part not just for applied sciences but for military engineering in particular. Charles Augustin Sainte-Beuve, *Chateaubriand et son groupe littéraire sous l'Empire*, vol. 2 (Paris: Garnier Frères, 1861), 123.

⁴⁶⁹ Sutton attributes at least some of the resistance of the *Institut* to the largesse Napoleon had showered on Volta since his trip to Paris.

table and took up his pen to make out his own. M. Laplace seeing this preparation thought no doubt that he was going to copy his list--instead of doing so he inverted the order in which the names stood in it--Putting that name at the head of his list which stood at the bottom of that made out by Laplace. He is determined to show that he will be led by nobody--not even by the Man with whom he is on the most intimate footing.⁴⁷⁰

With this willful reversal of his scientific patron's ballot, Napoleon dramatizes a refusal to behave as a neophyte in the scientific domain, adopting instead an absolute and arbitrary conception of the role of political authority in the administration of the sciences, and indeed in the administration of cultural production in general. While Napoleon's role in the autonomization of the sciences was decisive, the story of the ballot indicates that he saw himself as exempt from observing this autonomy, free to impose his preferences both as the head of state and as an actor in the scientific field. The cost of the sciences' autonomization was its acquiescence in the principle of such arbitrary domination.

If Napoleon refuses to behave in accord with his objective position, as it were, as a member of the scientific field, he similarly refuses to defer to the field's independent dynamics in his capacity as head of State. Beyond the liquidation of the Second Class and the changes in election rules, the *Institut* reforms of 1803 abolished the Class's rotating secretaryships in favor of perpetual secretaryships like those which had characterized the *Ancien Régime* academies. The *Institut*'s reforms were debated and recommended by a commission named by the First Consul, and the names of those who were to fill the perpetual secretaryships were imposed by the First Consul rather than being opened up to the vote of the respective Classes. These steps further concentrated institutional power into the hands of a few privileged scientific actors, consolidating Napoleon's mastery of the *Institut*. The tenor of these dealings is captured in a letter from the anatomist André-Marie Constant Duméril (1774-1860) to Cuvier, then absent from Paris. "*On s'occupe de réorganiser l'Institut,*" writes Duméril, of the commission consisting of Laplace, Fourcroy, Roederer, Dacier and Vien.⁴⁷¹ "*Toi et Delambre, vous êtes nommés secrétaires perpétuels, chacun dans votre partie avec des appointemens de 6000 francs. C'est Bonaparte qui nomme aux places vacantes. L'Académie lui présente deux sujets entre lesquels il choisit . . . On fait entre d'emblée Biot, Corvisart et Pinel. Voici comment: vous et Delambre êtes hors de rang. Deux places libres: Pinel a la tienne, Biot celle de Delambre et pour faire entrer Corvisart,*

⁴⁷⁰ *Journal*, 35-36. For Bourdieu in *Méditations pascaliennes*, tyranny is none other than the arbitrary imposition of a form of authority proper to one field on another. There, he defines it as "*une intrusion des pouvoirs associés à un champ dans le fonctionnement d'un autre champ . . . Il y a tyrannie, par exemple, lorsque le pouvoir politique ou le pouvoir économique interviennent dans le champ scientifique ou dans le champ littéraire, soit directement, soit à travers un pouvoir plus spécifique, comme celui des académies, des éditeurs, des commissions ou du journalisme . . . , pour y imposer leurs hiérarchies et pour y réprimer l'affirmation des principes de hiérarchisation spécifiques* (124-25)."

⁴⁷¹ The commission consisted of Fourcroy as director of Public Instruction, and "*un représentant de chacune des quatre futures classes: le mathématicien Laplace, le littérateur Roederer, l'humaniste Dacier, le peintre Vien.*" Henri Deherain, "Lettres à Georges Cuvier sur l'organisation de l'Institut en l'an XI," *Journal des savants* (1916), 370-73.

Broussonet passe dans celle [dans la section] d'agriculture."⁴⁷² Duméril's account of the reforms presents a series of backroom dealings designed to favor Napoleonic loyalists, engineered by the First Consul himself and the commission he named to advise him. Ultimately, their plans aroused the opposition of the members of the *Institut* themselves and even of Napoleon's *Conseil d'État*, which approved the plan by an unusually close vote of 15 to 11.⁴⁷³ Though the most dramatic effect of these reforms was to eliminate the political and moral sciences from the institutional landscape of France, they also served to advance the position of exactitude by bolstering Napoleon's control over the sciences and by promoting Cuvier and the Laplace loyalist Delambre to perpetual secretaryships.

In their nominations to the Senate or in these scientific dealings, the savants in question were much more than passive beneficiaries of Napoleonic largesse. Though a great deal of work has been devoted to Napoleon's patronage of the sciences, little has been written about how these savants went about pursuing it. Figures like Laplace, Berthollet and Lacépède molded themselves into courtiers, skilled in deploying the kind of flattery that moved the increasingly authoritarian Emperor to advance their interests and disfavor those of their opponents. In the case of Laplace, this pursuit of Napoleonic patronage began relatively early in Bonaparte's ascent, when the young general returned triumphantly from Egypt and was elected to the *Institut* with Laplace's suffrage. Under the Consulate, Laplace's pursuit of favor was so avid that it provoked the indignation of Bourrienne, who complains that along with Lacépède Laplace seemed intent on flattering the First Consul fulsomely enough to displace the Second and Third.⁴⁷⁴ In this Laplace was ably abetted by his wife, *dame d'honneur* to Napoleon's sister Elisa Baciocchi, sometime Duchess of Tuscany. Mme Laplace's requests for the Duchess's intercessions with the Emperor supplemented the direct pressures exerted by her husband, as a letter written by Mme Laplace on the occasion of her daughter's marriage attests: "*Nous osons M de la Place et Moi vous demander une grace qui serais d'une grande importance,*" writes Mme Laplace, "*c'est une lettre de la main de votre altesse impériale pour Sa Majesté l'empereur pour lui recommander Ms. Desportes, lorsque le contrat de Mariage sera signé. Nous aurons l'honneur de mettre sous la protection de Sa Majesté notre jeune ménage, et nous joindrions a votre lettre celle de votre main, Madame qui serait si precieuse. Votre Altesse imperiale sait combien nous lui sommes entierement dévotés et combien nous nous plaisons a vouloir tout tenir de ses bontés, pour notre bonheur.*"⁴⁷⁵ For the Laplaces, this proximity to Napoleon and the political influence that came with it continued unabated until the end of the Empire. If during the Consulate Rumford notices that "Monr. and Madame Laplace are on an intimate footing with Buonaparte and with his wife and frequently visit them in a familiar and friendly way," they continued to be invited to relatively intimate gatherings at Saint-Cloud up until the fall of the Empire."⁴⁷⁶

⁴⁷² "Duméril à Cuvier," Paris, le 5 nivôse an XI [26 décembre 1802], quoted in Deherain, "Lettres à Georges Cuvier," 369-70. Corvisart was Napoleon's personal doctor and Broussonet was an agronomist.

⁴⁷³ Deherain, 373.

⁴⁷⁴ Bourrienne, *Mémoires*, vol. 5, 94.

⁴⁷⁵ Mme Laplace à Élisa Baciocchi, 5 July 1812.

⁴⁷⁶ Rumford, *Journal*, 36; Crosland, *Arcueil*, 61.

The courting of Napoleon's favor advanced the domestic and scientific interests of a few elite actors while exposing scientific production in general to the direct action of the head of State. In this process, exactitude became entrenched as the ideal of scientific production, presiding over the emergence of a field in which the sciences became largely autonomous from all external authorities but that of the head of State himself. Napoleon's patronage enabled the proponents of exactitude to impose what became the law of a field in a unilateral manner, immune to counter-efforts by lay publics or other scientific actors. Yet if Napoleon's material and symbolic capital reinforced the scientific authority of these actors, their adhesion to the regime in turn fortified Napoleon's political authority. The loyalty displayed by famous men like Laplace and Cuvier legitimized the regime, even as these figures also took an active part in the civil administration of the Republic and the Empire. No more striking signal of this two-way exchange exists than Laplace's proclamation of the Empire: as chancellor of the Senate, he was charged with authenticating its acts, including the *sénatus-consulte* of 28 floréal an XVII (18 mai 1804) which declared that "*Le gouvernement de la République est confié à un Empereur, qui prend le titre d'Empereur des Français*" and named the "*Premier Consul actuel de la République*" to the post.⁴⁷⁷ Legitimizing the liquidation of the Republic in this way, Laplace additionally led a corps of horseback-mounted notables through Paris two days later, proclaiming the Empire at the *palais du Luxembourg*, the *Hôtel de Ville*, the *palais de Justice* and other symbolic sites.⁴⁷⁸ Laplace knew how to press home his advantage, writing to the new Emperor to evoke the moment when, as artillery examiner, he had helped launch his military career. "*Sire,*" he writes, "*Je viens de proclamer empereur de France le héros à qui j'eus l'avantage il y a vingt ans d'ouvrir la carrière qu'il a parcourue avec tant de gloire et de bonheur pour la France. Puisse la Patrie que vous gouvernez avec tant de sagesse, après l'avoir retirée de l'abysse, jouir longtemps des fruits de votre génie!*"⁴⁷⁹ The self-crowning of Napoleon figures the kind of political authority that enabled the proponents of exactitude to give their own law to the scientific domain. Yet Napoleon's self-crowning itself is not only a "cause" of exactitude's rise; it is also made possible in part by those who, like Laplace, leant the cultural authority of the sciences to the Emperor's ascent. In a tangible, even legal way, Napoleon's path to the *sacre* passed through his patronage of the sciences. Through such relays of cultural and political capital, the Empire was launched, and the modern sciences too.

If the distinction between the vertical and horizontal dimensions of autonomy is so essential to understanding processes of autonomization, why does this distinction remain latent in

⁴⁷⁷ The Senate chancellor "*participe enfin à l'authentification des actes sénatoriaux, apposant le sceau dont il a la garde (art. 13, sénatus-consulte du 14 nivôse an XI)*." *Quand Napoléon inventait la France*, 113; Thierry Lentz, *Nouvelle histoire du premier Empire*, vol. 1 (Paris: Fayard, 2002), 26, 34.

⁴⁷⁸ Thierry Lentz, *Nouvelle histoire du premier Empire*, vol. 1, 34.

⁴⁷⁹ "Laplace à [Napoléon Bonaparte], floréal an XII [avril/mai 1804], *Correspondance de Pierre Simon Laplace*, vol. 2, ed. by Roger Hahn (Turnhout, Belgium: Brepols, 2013), 743.

Bourdieu's own work on the field? One answer may lie in the historical material Bourdieu primarily dealt with in his elaboration of the field. In writing on Flaubert, Bourdieu shows us that the autonomization of literature in the late nineteenth century entailed a move toward vertical autonomy and a concomitant redefinition of "literature" itself, but this redefinition of literary production was nowhere near as radical as the precipitation of the scientific field from the culture of letters in the earlier part of the century. If the vertical shift had horizontal consequences, these consequences did not trigger the redefinition of forms of cultural production other than the literary—like science, or visual art. In the autonomization of literature the vertical and horizontal shifts in question are each negative in character, entailing the rejection of influence by external powers as well as the articulation of a pure literary art distinct from other forms of cultural production.

A more fundamental reason for the ambiguous status of horizontal autonomy in Bourdieu's work may lie in the relationship between his conception of sociology and the very sciences whose emergence we have been tracing. Adopting the Newtonian notion of "milieu" as the guiding trope for the concept of the field, Bourdieu's *science des oeuvres* embraces a mathematical-physical framework as avidly as did its exact forebears in the early nineteenth century. A certain dissonance enters into the relationship between the mathematical-physical framework that conditions Bourdieu's notion of scientific "autonomy," and the historical circumstances which made this framework so central to modernity. For if the mathematical-physical sciences serve as one of the primary paradigms for autonomy in Bourdieu's work, we have seen that their emergence as a form of cultural production actually depended on a certain exposure to the power of the State. In Bourdieu's sociology of the sciences, however, the physical sciences generally figure in an autonomous state, already freed from external determination. Where for Bourdieu the physical sciences model the "specificity" of scientific fields in general, in which the field's liberation from undue social influence sets the "*conditions sociales du progrès de la raison*," sociology becomes the example par excellence of a compromised or heteronomous scientific field. "*La question fondamentale de la sociologie de la science prend, dans le cas des sciences sociales,*" he writes, "*une forme particulièrement paradoxale: quelles sont les conditions sociales de possibilité du développement d'une science affranchie des contraintes et des demandes sociales, sachant que, dans ce cas, les progrès dans le sens de la rationalité scientifique ne sont pas des progrès dans le sens de la neutralité politique?*"⁴⁸⁰ Unlike the utterances of the physical sciences, that is, those of the social sciences will always be characteristically "political" in nature, destined to intervene in the social order in an inherently contentious manner. For this reason, as Bourdieu affirms, it follows that in the case of the social sciences, "*les positions dans la lutte interne ne peuvent jamais atteindre le degré d'indépendance à l'égard des positions dans la lutte externe qui s'observe dans le champ des sciences de la nature.*"⁴⁸¹ The physical sciences thus model scientific autonomy in a descriptive as well as a prescriptive sense, providing a synchronic picture of a scientific field freed of external determination even as they epitomize a condition for sociology and other sciences to emulate. In all, Bourdieu's sociology of the sciences constitutes a self-

⁴⁸⁰ 111-12

⁴⁸¹ "Spécificité du champ scientifique," 111.

reflexive examination of the very grounds on which an “objective” *science des oeuvres* could be undertaken.

Given this self-reflexive character, Bourdieu’s comparative sociology of scientific fields affirms the status of the physical sciences as a “paradigm of sound knowledge” in precisely the same way that the proponents of exactitude themselves had advocated the distribution of this ideal from the physical sciences to other developing fields of scientific inquiry. More than historical coincidence or simple parallel, this echo reveals motives inhering in the concept of the field itself. Bourdieu cites the genealogy of “milieu” elaborated by Canguilhem in the essay “*Le vivant et son milieu*” as a way of defining the kind of space in which he imagines the transactions of the field to take place. As he specifies in a passage from the *Règles de l’art*, the concept of the field derives from a characteristically Newtonian notion of *milieu*, quite distinct from the alternative notions of space which Canguilhem distinguishes in other sciences of physical and living things. The movements of actors in a field are governed by “forces” immanent to the field itself, Bourdieu explains, “*véritable milieu au sens newtonien, où s’exercent des forces sociales, attractions ou répulsions,*” where individuals figure as “*des particules dans un champ de forces, et leurs trajectoires seront déterminées par la relation entre les forces du champ et leur inertie propre.*”⁴⁸² These conceptual origins enact a historical *translatio* of the notion of milieu among disciplines, entirely in keeping with the claims of exactitude itself. The possibility of elaborating an “objective” interpretation of cultural texts, divorced from the mystifications of “art” or of social or political prejudices, depends on the apparent objectivity of this conception of space. Liberating itself from these peripheral determinations, the sociology of cultural works takes on a greater degree of vertical autonomy, and the scenes of scientific production from which the central metaphor of this relatively autonomous sociology derives themselves contract an air of autonomy, as if, one imagines, by association.

At moments when Bourdieu does allude to the vertical heteronomy of the physical sciences, this heteronomy is characteristically located in a pre-Newtonian past, in “*l’astronomie mathématique au temps de Copernic,*”⁴⁸³ for instance, whose conception of space corresponds with a scene of cultural production tending toward “*l’imposition légitime (c’est-à-dire arbitraire comme telle) d’un arbitraire culturel exprimant l’intérêt spécifique des dominants—dans le champ et hors du champ—*” and tending away from the scenario of “*un champ scientifique d’où tout élément d’arbitraire (ou d’impensé) social serait banni et dont les mécanismes sociaux réaliseraient l’imposition nécessaire des normes universelles de la raison.*”⁴⁸⁴ For our purposes, it matters little whether Newton’s concept of space was actually elaborated under conditions of vertical autonomy. What matters instead is that in another historical context, the relevant one, Newton’s concept was repurposed in such a way as to give birth to the modern sciences and that this action occurred under conditions of minimized vertical autonomy. In obscuring the historical foundations of scientific autonomy in the modern age, the neo-Newtonian heritage of the *science des oeuvres* acts here as an “obstacle” to its self-reflexivity.

⁴⁸² *Les règles de l’art*, 30-31.

⁴⁸³ “Spécificité du champ scientifique,” 107.

⁴⁸⁴ *Ibid.*, 110.

The general equivalence of the progress of reason with the sciences' liberation from external determination obscures, then, the particular historical processes through which the sciences achieved their identity in modernity. Claiming the mantle of the modern sciences, Bourdieu's sociology takes part in this process as well, though with the *science des oeuvres* it has now looped back to contest rather than conceal its vertical domination. This sociology's antecedence in sciences of compromised autonomy in no way impairs the *science des oeuvres* itself, however, except insofar as it occludes the interplay between the vertical and horizontal dimensions of the field or causes us to downplay the sometime vertical heteronomy of the physical sciences. The irony is that a form of cultural production born under domination could provide the conceptual grounds for another, striving to articulate the grounds of its liberation.

IV. Volta, Galvani and the Invention of Life Itself

When Volta introduced his newly invented pile to the Royal Society, he made a point of highlighting its animal origins. "*Cet appareil,*" he wrote to in a formal letter to Joseph Banks, "*semblable dans le fond, comme je ferai voir, et même tel que je viens de le construire, pour la forme, à l'organe électrique naturel de la torpille, de l'anguille tremblante, &c bien plus qu'à la bouteille de Leyde, et aux batteries électriques connues, je voudrais l'appeller Organe électrique artificiel.*"⁴⁸⁵ In emphasizing the machine's differences from traditional laboratory equipment and its similarities with the shock-producing organ of the torpedo, Volta evokes its origins in his conflict with the famous Bolognese doctor Luigi Galvani over the nature of animal electricity. As Giuliano Pancaldi has pointed out, Volta's "imitation" of the electric fish arose in part from the desire to show that the very same principle which governed the production of electricity in an animal organ also governed the production of electricity in a purely physical machine.⁴⁸⁶ In so doing, he hoped, he might successfully counter Galvani's notion that electricity was produced in animal bodies by distinctly physiological means.

In the polemic that pitted Volta against Galvani, both were right in their own ways: the mere contact of different substances *can* excite an electric current, as Volta discovered, and animal bodies *do* produce electricity in physiologically specific fashion, as Galvani believed. And both were wrong as well—Volta in disputing the role of physiologically produced electricity in nerve functioning, and Galvani in denying the existence of contact electricity. In spite of this parity of sorts, Volta's invention of the pile powerfully contributed to settling the controversy in his favor. For while the artificial organ did little to show how electricity functioned in real animate bodies, it acted to displace that problem altogether, substituting the demonstration of a new and marvelous physical mechanism for the explanation of a physiological one. Among contemporaries, the sheer wonderment induced by the discovery of contact electricity seems to have en-

⁴⁸⁵ Emphasis Volta's. "On the Electricity Excited by the Mere Contact of Conducting Substances of Different Kinds," 405. As pointed out in Part II of this chapter, the text of this document is written in French, though the title is in English and it is addressed to Sir Joseph Banks, President of the Royal Society.

⁴⁸⁶ Pancaldi, 178-79, 190-202.

couraged the impression that Volta had “won” the polemic, and Volta’s success in building a machine that manifested this new power only heightened that impression. The charisma exerted by the pile resulted in part from its exceptional recognition by the *Istituto* and the head of State, as we have seen, and French patronage dynamics additionally worked to diminish the value of Galvani’s animal electricity. For while Napoleon’s fascination with the pile and Volta’s amenability to French rule conduced to the Pavian’s achievement of notability under the Empire, the devoutly Catholic Galvani’s refusal to pledge allegiance to the French-imposed and therefore secular Cisalpine Republic in 1797 resulted, contrastingly, in the loss of his professorship at the University of Bologna.⁴⁸⁷ This purge reduced Galvani to poverty, deprived him of recognition and matériel and compromised his already declining health. By the time Volta achieved a working model of the pile in late 1799, Galvani had been dead for nearly a year.⁴⁸⁸

One of the premises of this chapter has been that the empire of exactitude extended beyond both the French Republic and the physical sciences to shape the study of living and non-living Nature in Europe at large. In the chapter’s initial section, I proposed that the hegemony exercised by the physical sciences on physiology and other sciences of living things could be understood as an effect of the discourse of exactitude. In assimilating Cuvier’s work to the ideal of exactitude, Biot, for instance, highlighted a characteristic attention to “detail” in the measuring and representation of fossil remains, and Cuvier himself made allusion to the “mathematical spirit” which ought to govern the natural sciences, he thought, despite their inherent resistance to “[les] applications du calcul.”⁴⁸⁹ But if organized bodies were not directly amenable to calculation, how precisely did the exact ideal realize such bodies as scientific objects? How did these objects differ from those of other sciences of living things, and what means did exactitude prescribe for their study? Returning in this final section to the story of Volta’s pile, we shall examine the conflict over animal electricity as a moment in the process that forged the subtle empire of exactitude over living things. If nineteenth-century biology “[reduced] itself to the role of a satellite” of the physico-chemical sciences, as Canguilhem writes in the essay “Aspects of Vitalism,” the polemic between Volta and Galvani marks a decisive moment in this process of subordination.⁴⁹⁰ Just as the reception of Volta’s pile in Paris encapsulated the transition from one epistemic culture to another, so here the polemic over animal electricity will offer a snapshot of the process according to which exact science achieved authority over the study of living things.

⁴⁸⁷ Though Napoleon was not yet Consul, his position as commander of the Army of Italy and administrator of the Cisalpine Republic gave him jurisdiction over Galvani’s destitution. Galvani was Professor of Obstetric Arts at the *Istituto delle Scienze* in Bologna, Curator and Demonstrator of the anatomical museum of the *Istituto*, and adjunct professor of anatomy at the University of Bologna. The *Istituto* and the University were two separate institutions. “The University was located in the *Archiginnasio* in Peace Square” while “the *Istituto* was a sort of graduate school of sciences and represented the active core of scientific life in Bologna, well known even abroad.” ix Galvani was reinstated as professor emeritus of the *Istituto* just prior to his death. Giulio Pupilli, “Introduction,” *Commentary on the Effect of Electricity on Muscular Motion*. Trans. Robert Montraville Green. (Cambridge, MA: Elizabeth Licht, 1953), ix, xviii-xix.

⁴⁸⁸ Galvani died on December 4, 1798. Pancaldi dates Volta’s construction of a workable pile to sometime in late November or early December 1799 (202).

⁴⁸⁹ Cuvier, *Rapport*, 389-90.

⁴⁹⁰ *Knowledge of Life*, 59.

The polemic between Volta and Galvani coincides with what Foucault describes as the emergence of “life” in modern consciousness, an event in which the difference in sameness perpetuated by “*histoire naturelle*” cedes to an “*histoire de la nature*” where living individuals appear, flourish and decline on the background of a radical absence. Where Canguilhem claims that the biology of the nineteenth century was dominated by the physico-chemical sciences, Foucault answers that the idea of biology as such becomes possible only with the emergence of a notion of life itself. With the realization of this scenario, Foucault argues, “life” becomes positive biology’s constituent other, the principle which determines the objects of biological knowledge and the modalities according to which these objects will be known. Though the central figure in Foucault’s account of this transformation is Cuvier, we learn little about how Cuvier may have facilitated the rupture between natural history and biology or what other contingencies may have provoked it. In the Volta-Galvani polemic, however, it is possible, I think, to glimpse the emergence of a notion of life “itself” as an element in the knowledge of organized bodies, projected in and through the animal body in the experiments of Galvani, yet progressively confined to the “*obscur de l’organisme*” with the triumph of Volta’s physicalist point of view. Though Volta’s physiology did not itself comport a notion of life per se, his success in displacing the focus of the polemic to the experimental set-up’s purely physical properties facilitated the “effacement of the biological object as such,” as Canguilhem has it, in the study of living things in Paris.⁴⁹¹ Volta’s roughly mathematized, trial-and-error style of experimentation jarred with the ideals of the Parisian partisans of exactitude, but his success in discrediting the physiological specificity of Galvani’s electricity aligned him with their socio-epistemic interests. Where Galvani’s experiments provoked manifestations of life in animal bodies, and the medical vitalisms of Barthez, Bichat and others saw vitality diffused throughout the animal body, the exact physico-chemical point of view on the animal realized the variety of “life” itself Foucault distinguishes in Cuvier, a notion of life that articulated the animal’s difference from brute matter while guaranteeing that the animal’s matter could be studied as if it were merely brute.

Without clearly belonging to the culture of exactitude, Volta nevertheless offered grounds both for depreciating Galvani’s medico-physiological point of view on the animal body and for legitimating a characteristically physical one. Neither Volta nor Galvani espoused what Canguilhem calls a biologically “original” point of view on the animal, in which the animal is understood to form the center of a universe of its own creation; in spite of galvanism’s spiritualist or vitalist associations, Galvani no less than Volta saw the animal in primarily physical terms. But where Volta’s treatment of the animal remained incidental to his primary engagement with purely physical phenomena, Galvani brought a conventionally medico-physiological point of view to bear on the organism, centered on how nerves and muscles functioned together to produce sensation and motion in the animal. Though incommensurable rather than directly contrary, these points of view nevertheless proved incompatible as modes of realizing scientific objects. As Bourdieu points out, a field implies a certain point of view, as well as a forgetting of the specificity of this point of view and the tendency to devalue alternative points of view on the same phenomena. “*En se différenciant, le monde social produit la différenciation des modes de connaissance du monde,*” he writes; “*à chacun des champs correspond un point de vue fondamental*

⁴⁹¹ Ibid.

sur le monde qui crée son objet propre et qui trouve en lui-même le principe de compréhension et d'explication convenant à cet objet."⁴⁹² If from a physicalist point of view, the physiological questions Galvani was posing turned out to be fundamentally indifferent, Volta's astonishing pile promoted the authority of the physical sciences in a way that tended to relegate physiological questions to the margins of scientific discourse in general. Flush with prestige, the exact physical sciences in Paris subsequently sponsored the rise of a new point of view on the animal, no longer medico-physiological but quasi-exact in conception, primed to precipitate a notion of life "itself."

With the publication of *De viribus electricitatis in motu musculari* ("Commentary on the effects of electrical force on muscular motion," 1791), Galvani launched a controversy that would profoundly alter relations between physical and physiological science in his home town of Bologna and beyond. The "Commentary" is a sober, even laconic summary of ten years' worth of experiments devoted to the nerve and muscle physiology of frogs, yet the conclusions Galvani drew from these experiments could hardly have been more ambitious. Ultimately, he believed, his experiments showed that the animal body produced its own electricity and that this electricity acted as the agent of sensation and motion in the animal body.

In one series of experiments, Galvani laid a frog's legs and spine next to an "electrical machine" (a so-called Franklin square), and observed that the legs fell into "violent tonic convulsions" when and only when the machine was made to produce a spark at the same time as the nerves were prodded with the scalpel. While such contractions had often been induced before by means of direct electrical contact, the excitement of these "contractions at a distance" suggested something new about how electricity might function in the animal body. In a second surprising incident, Galvani discovered that when the spine of a frog preparation had been pierced by a metal hook and hung from a balcony, the legs began to display, as he put it "spontaneous, irregular, and frequent movements," moving in such a way that "the frog seemed to 'hop.'"⁴⁹³ The experiments Galvani designed to explore this phenomenon suggested, he concluded, that the metals involved were discharging electricity stored in the frog. Together these experiments offered important hints, Galvani believed, about how the frogs' nerves and muscles generated, stored and discharged electricity. Absent a direct source of electricity, Galvani speculated, the frog leg was discharging electricity that had been produced and stored in it when the animal was still living.

Though Volta was initially impressed by Galvani's experiments, he soon realized that the frog played a purely incidental role in generating the electric currents, that the contractions were actually produced by the contact of metals used in the experimental apparatus. No longer engaged in refining or refuting Galvani's conclusions, Volta instead found himself compelled to identify the limits and characteristics of an extraordinary new physical phenomenon. In response to Volta's discovery that the metals were producing the frog-limbs' apparently vital effects, Gal-

⁴⁹² *Méditations pascaliennes* (Paris: Seuil, 1997), 119.

⁴⁹³ *Commentary*, 82.

vani produced contractions in the frogs' muscles using non-metallic equipment; Volta countered again by showing that even non-metallic substances could produce electricity through simple contact. In a bid to disprove Volta's contention that non-metallic heterogeneous substances could produce faint electric currents, Galvani succeeded in producing contractions using different samples of nerve tissue alone. Though he could not yet explain why contact between different nerves would generate an electric charge, this charge, he believed, could only be attributed to nerve electricity. "It appears thus to me," Galvani concluded, "that there is another series of contractions which can be obtained without stimulus, without metal, and without any minimal suspicion of heterogeneity; these are then produced by a circulation of an electricity intrinsic to the animal, and naturally unbalanced within the animal."⁴⁹⁴ As we know in light of subsequent neurophysiology, neurons *do* fire when "naturally unbalanced" electric charges form across a nerve membrane, and a new reconstruction of the Volta-Galvani polemic has suggested that Galvani's nerve-on-nerve experiment incited just such an imbalance.⁴⁹⁵ The dynamics of the polemic, then, pushed Galvani to realize "animal electricity" as an object that is still recognized in scientific discourse today, even as the discursive conditions in which he realized this object inevitably led him to misrecognize it as such.

Galvani's nerve-on-nerve experiment was announced in the *Memorie sulla elettricità animale* (1797), a text published almost at the same time as his expulsion from the University and a little more than a year before his death.⁴⁹⁶ In combination with the fact that Volta was publicizing his miraculous discovery of contact electricity around the same time, Galvani's destitution at the hands of French authorities and subsequent death contributed to burying the *Memorie* in obscurity. But if French imperialism hastened Galvani's death, the doctor's own handling of the controversy contributed to his eclipse, as well. "A cautious, strict-minded physiologist, anatomist and doctor," as the historian Marcello Pera has noted, "a shy personality, slow to communicate his findings, a poor correspondent, averse to travel and worldly fame," Galvani enjoyed little recognition beyond the prestigious medical community of Bologna.⁴⁹⁷ Composed in Italian or medical Latin, Galvani's published writings found a more circumscribed audience than did those of Volta, published in French and English. Demonstrating little appetite for battle, moreover, Galvani delegated the task of marshaling supporters and countering adversaries to his nephew, Giovanni Aldini, a figure whose writings and public demonstrations evince a commitment to an increasingly archaic natural philosophy of marvels. The "Dissertation concerning the origin and development of the theory of animal electricity" with which Aldini prefaced his uncle's seminal "Commen-

⁴⁹⁴ Marco Piccolino and Marco Bresadola, *Shocking Frogs: Galvani, Volta, and the Electric Origins of Neuroscience*. Trans. Nicholas Wade. (NY: Oxford University Press, 2013), 190-92.

⁴⁹⁵ *Ibid.*, 192. See also Chapter 9, "From Galvani to Hodgkin and Beyond: The Central Problem of Electrophysiology in the Last Two Centuries."

⁴⁹⁶ On the *Memorie*, see Piccolino and Bresadola, 186-201.

⁴⁹⁷ *The Ambiguous Frog: The Galvani-Volta Controversy on Animal Electricity*. Trans. Jonathan Mandelbaum (Princeton: Princeton University Press, 1992, xxiii.

tary” abounds in wonderful anecdotes culled from ancient and modern sources.⁴⁹⁸ Aldini situates his uncle’s work in a long line of speculations on the reality of animal electricity, a tradition which stretches back, he suggests, to the accounts “Cicero, Livy and Valerius Maximus have handed down . . . concerning the flames observed about the head of Servius Tullius,” or to the Swedish natural philosopher Bartholinus’ (1585-1630) account of “a man whom anyone could easily recognize because more light shone from his eyebrows.”⁴⁹⁹ Together, these contingencies tended to undermine animal electricity’s status as a credible scientific object.

Along with his archaic natural philosophy, Aldini’s public demonstrations imbued animal electricity with wonderful, even supernatural associations. The Italian soon rejected the use of frogs in favor of larger and therefore more spectacular bodies, submitting a cow head and even, in one instance, the body of a freshly executed criminal to the so-called “galvanic process.” The account of the execution and subsequent galvanization of the murderer Robert Foster published in London’s *Newgate Calendar* in 1803 conveys contemporaries’ often ambivalent reactions to galvanism, evoking animal electricity’s capacity to engender semi-supernatural effects while simultaneously recuperating it for medicine or science. “On the first application of the process to the face,” reports the *Newgate Calendar*, “the jaws of the deceased criminal began to quiver, and the adjoining muscles were horribly contorted, and one eye was actually opened. In the subsequent part of the process, the right hand was raised and the legs and thighs were set in motion.” Though some of the “uninformed bystanders,” we read, “thought that the wretched man was on the eve of being restored to life,” the *Calendar* insists that the real value of the experiment lay in demonstrating “the excitability of the human frame when this animal electricity was duly applied,” a phenomenon which might be useful in “rekindling the expiring spark of vitality” in cases of drowning or suffocation or stimulating the head in cases of “apoplexy.”⁵⁰⁰ In projecting belief in re-animation on the merely “uninformed,” the account manages to affirm animal electricity’s scientific credibility without clearly repudiating its spiritualist or vitalist associations.

Aldini’s demonstrations publicized animal electricity at the cost of its scientific reputation; yet even as Galvani imagined animal electricity as a strictly physical substance, his own experimental practice bore an ambivalent relationship to the remarkable effects it incited. Though Galvani’s experimental practice developed a conceptually rigorous understanding of animal electricity, the spectacle of spontaneous action seems to have been what impelled Galvani to experiment in the first place. It was as if the astonishing “hopping” of the once-living frogs he witnessed demanded to be both appreciated and explained away. The contractions induced “admiration and pleasure on the part of the beholder,” as he allowed, precisely because they repli-

⁴⁹⁸ Galvani’s “Commentary” was initially published in a volume of the proceedings of the Bologna Academy and Institute of Sciences and Arts, in an issue dated March 27, 1791 (*De Bononiensi Scientiarum Et Artium Instituto atque Academia Commentarii* VII, 363-418). It was republished at the behest of Aldini. “Introduction,” *Commentary*, x.

⁴⁹⁹ “Dissertation,” *Commentary*, 1, 4.

⁵⁰⁰ Andrew Knapp and William Baldwin, “George Foster, Executed at Newgate, 18th of January, 1803, for the Murder of his Wife and Child, by drowning them in the Paddington Canal; with a Curious Account of Galvanic Experiments on his Body,” *The Complete Newgate Calendar*, vol. 4 (London: Navarre Society, 1926), 257-59.

cated the actions of an intact, living frog.⁵⁰¹ In what might be called the primal scene of galvanism, where the experimental set-up frames the spectacle of spontaneous contractions, vital effects enacted a kind of supplement to the animal's inanimate body. Crucially, in Galvani's case, the fascination exerted by the un-dead animal primed a vast and extraordinarily rigorous experimental program, quite different in means and ends from Aldini's demonstrations. The doctor himself viewed animal electricity as a physical substance, distinguishable from common electricity only in being produced in the animal body and participating in nerve function. While in the living animal galvanic electricity was set in motion by the will, in prepared animals his experiments suggested that it could also be discharged by purely physical, external means.

Though galvanism was publicized in charlatanical terms, the ambivalent figure cut by Galvani made it difficult to cast galvanism as a purely pseudo-scientific phenomenon. This ambivalence emerges in the important *Éloge* delivered by François Arago to commemorate Volta's death (1831), a speech in which the perpetual secretary seems to dismiss animal electricity both as a popular fascination and as an illusion of Galvani's characteristically physiological point of view. Purely scientific on the one hand, animal electricity fails on the other, in Arago's estimation, because of Galvani's scientific preoccupations. In one of the prevalent motifs in Arago's speech, galvanism appears as a fundamentally popular phenomenon which penetrates science from the public inward, rather than emanating from existing scientific problematics. Though Galvani began by experimenting with frogs, Arago declares, soon the galvanists "*ne se restreignirent plus aux très-petits animaux. Ils engendrèrent dans les naseaux, dans la langue, dans les yeux d'un boeuf tué depuis longtemps, d'étranges mouvements nerveux, fortifiant ainsi les espérances de ceux auxquels le galvanisme était apparu comme un moyen de ressusciter les morts.*" If these irresistible effects first "*séduisirent le public,*" he intones, "*les physiologistes s'en emparèrent*" soon after. "*L'électricité détrôna le fluide nerveux, qui alors occupait tant de place dans l'explication des phénomènes de la vie, quoique, par une étrange distraction, personne n'eût cherché à prouver son existence,*" Arago continues. "*On se flatta, en un mot, d'avoir saisi l'agent physique qui porte au sensorium les impressions extérieurs; qui place chez les animaux la plupart des organes aux ordres de leur intelligence; qui engendre les mouvements des bras, des jambes, de la tête, dès que la volonté a prononcé. Hélas! ces illusions ne furent pas de longue durée; tout ce beau roman a disparu devant les expériences sévères de Volta.*"⁵⁰² In Arago's account, Volta's "severe experiments" dispelled illusions shared by the public and the physiologists alike, each party enthralled by galvanism's supernatural associations. Volta's superior rigor, Arago implies, reaffirms the autonomy of scientific production from popular influence.

The gullibility of "the physiologists" in this account anticipates a second motif in Arago's history of animal electricity. For Arago, the kinds of questions physiology was posing about animal organization were themselves illusory, a general error exacerbated in the particular case of galvanism by Galvani's insistence on interpreting a physical phenomenon as a physiological one. The secretary ridicules the physiologists' ambition to identify "*l'agent physique*" of sensation and voluntary motion as "*illusions,*" or as a mere "*beau roman,*" speculations incongruous with real scientific discourse. For Arago, identifying the physical agent of "will" or "intelligence"

⁵⁰¹ *Commentary*, 43-44.

⁵⁰² "*Éloge historique d'Alexandre Volta,*" lxxxii, lxxxv.

could only be tantamount to exposing the “*phénomènes de la vie*.”⁵⁰³ But while the secretary scoffs at the notion of identifying any such agent as such, the study of electricity’s role in sensation and motion could not be dismissed as merely scientific. Neither Galvani nor anyone else had identified just how electricity participated in nerve physiology, but in light of later developments they cannot be faulted for suspecting it did.

From the point of view of the physiologists in question, nerve electricity could be studied by means of experiments every bit as “severe” as those of Volta, but for Arago, Galvani’s experimentation itself led him astray. The physiologist’s persistence in seeing the prepared frog legs as physiological objects blinded him, Arago argues, to the fact they were acting as mere instruments for registering common electricity. If the phenomenon of galvanic contractions “*se fût offert à quelque physicien habile,*” he affirms, “*familiarisé avec les propriétés du fluide électrique, il eût à peine excité son attention. L’extrême sensibilité de la grenouille, considérée comme électroscope, aurait été l’objet de remarques plus ou moins étendues; mais, sans aucun doute, on se serait arrêté là. . . . Galvani, très-savant anatomiste, était peu au fait de l’électricité. Les mouvements musculaires qu’il avait observés, lui paraissant inexplicables, il se crut transporté dans un nouveau monde.*”⁵⁰⁴ For Arago, it is precisely Galvani’s savvy as an anatomist that deludes him as to the real nature of the phenomena before him, compelling him to see a complex physiological problem in place of a simple physical one. Effacing the physiological specificity of the frog, Arago insists that the effects Galvani discovered were remarkable only insofar as the frogs’ legs turned out to be more sensitive than other, previously known “electrometers.” In recasting Galvani’s frog as a mere electrometer, Arago effectively co-opts an organized body as an object best suited to purely physical inquiry, annexing the frog as an object of physicalist discourse and devaluing the medico-physiological point of view on it per se.

Volta could emerge as the polemic’s undisputed “winner” for Arago only in light of the secretary’s basic indifference to physiological questions like the means of sensation and motion. In Arago’s account, after all, Volta trumps Galvani not by proposing a superior interpretation of sensation and motion, but by supplanting these phenomena with an altogether different set of problems and interpretations. A contest between incommensurables, the polemic became considerably more complex than the dialectic of positions described in Arago’s speech. In Marcello Pera’s view, this complexity can be ascribed to the “ambiguity” of the frog body itself, an object capable of yielding answers that vary with the questions put to it. “More than a conflict of

⁵⁰³ As Piccolino and Bresadola point out, Arago’s *éloge* set the tone for much positivist historiography on the Volta-Galvani polemic. They cite the much-reprinted *Cours de physique* (7th ed., 1859) of Adolphe Ganot, which reproduces Arago’s judgments textually in some cases. “Under the phrase *animal* electricity or *vital fluid*,” Ganot writes for instance, “this theory was adopted especially by physicians and physiologists, who supposed that the secret of life had been discovered. However, this brilliant idea faded away soon with the rigorous experiments of Volta.” Piccolino and Bresadola remark that this “caricature” of Galvani reiterates Arago’s dim view of his physical knowledge. But it also reiterates his dim view of physiologists in general, while recasting Arago’s notion that they sought to explain “*les phénomènes de la vie*” as a mistaken belief that they had discovered the “secret of life.” Even as Ganot attributes this quasi-supernatural notion to the physiologists of Galvani’s era, the rhetoric of the “secrets of life” emerges as an effect of none other than the positivist discourse of life itself. Life could only be exposed as a secret once it had been radicalized as a synthetic entity in the animal body, and this radicalization is accomplished by positivist biology (*Shocking Frogs*, 1-4).

⁵⁰⁴ “*Éloge*,” lxxxix.

strategies or experiments,” Pera writes, “[the polemic] was a clash of assumptions or interpretative theories . . . a conflict between an electrobiological gestalt and an electrophysical gestalt in the same domain of observation.”⁵⁰⁵ More recent historiographies have emphasized the anachronistic character of categories like the “biological” or the “physical” and stressed the heterogeneity of natural philosophy in Volta’s period. For historians like Giuliani Pancaldi, John Heilbron, or Piccolino and Bresadola, the complexity of the polemic results from the mutual imbrication of physical and physiological problems. As they each observe, the protagonists’ penchant for incorporating both physiological and physical phenomena in their work expresses the fluidity of natural philosophy at this historical juncture: Galvani interprets animal electricity in light of his knowledge of physics and Volta arrives at the notion of contact electricity only after undertaking a great many animal experiments. Yet the mutual imbrication of physical and physiological motifs does not simply express, I would argue, a scenario of unconditioned possibility, as these historians each seem to suggest in different ways. Instead, the enmeshment of ancillary motifs in Volta’s and Galvani’s respective sciences punctuates the development of discrete and mutually exclusive points of view, such that Galvani’s notion of the physiological specificity of animal electricity becomes ever more entrenched as the conflict with Volta progresses, and Volta’s conviction about the electromotive character of the electricity in Galvani’s experiments ultimately expands to cover all electricity in any animal body.

As Piccolino and Bresadola emphasize, the *gestalten* or interpretive schema Volta and Galvani brought to bear on the frog in Pera’s account inhere neither in the object itself nor in the psychology of perception, but figure rather as cultural artifacts generated through the protagonists’ respective formations.⁵⁰⁶ Over the course of the polemic, however, the polarization of Volta’s and Galvani’s positions transforms them from the representatives of a common eighteenth-century experimental culture into the agents of distinct and mutually exclusive points of view. As Bourdieu writes, a given field confines its agents to the recognition of “*ses enjeux propres qui, à partir d’un autre point de vue, c’est-à-dire du point de vue d’un autre jeu, deviennent invisible ou du moins insignifiants ou même illusoire*.”⁵⁰⁷ While Volta initially interested himself in Galvani’s animal electricity and Galvani draws on his knowledge of common electricity to develop his physiological notions, we eventually see the positions from which each protagonist envisions the electrical phenomena in question polarize to the point of separation, hardening into those field-bound perspectives which regard the questions entailed by alternative aims as “insignificant” or “illusory.”

Amid recent historians’ effort to uncover the exchanges among diverse scientific domains which characterized late eighteenth-century natural philosophy, John Heilbron has highlighted the role that analogical thinking in particular played in the work of Volta, Galvani and others. Though the “interlocked set of analogies employed by Lavoisier, Volta, and Galvani during the 1770s and 1780s” has been obscured by current disciplinary boundaries, Heilbron observes, a more historically nuanced view would distinguish “important, even essential, links among the

⁵⁰⁵ *The Ambiguous Frog*, xxv-xxvi.

⁵⁰⁶ *Shocking Frogs*, 9-10.

⁵⁰⁷ *Méditations pascaliennes*, 117.

new chemistry, the artificial electricity of the laboratory and lecture hall, the natural electricity of the atmosphere and animal bodies, the discoveries of Galvani, and the invention of the pile. The natural knowledge of the late 18th century was more of a piece than our histories suggest.”⁵⁰⁸ These varied domains of symbolic production did not exist in a state of irenic parity, however, and the boundaries among them could not be crossed without cost or profit. Instead, the employment of “analogies” in scientific discourse and experimentation registered specific power relations among agents and fields, playing a role in a process in which the relative authority of persons and fields and the emerging horizontal autonomy of fields were at stake.⁵⁰⁹ In the case of the analogies Galvani made with physical concepts or objects, or Volta from physiological ones, the vehicle may be subordinated to the tenor, subsumed by it and often “overcome” as an obstacle to the self-articulation of the field, as in the case of Volta’s “artificial electric organ.” The act of drafting the objects of one field into another, shaped by its own, incommensurable *illusio*, expresses the impulse in these cases to overcome the original field’s distinctive point of view. “Dire . . . que “le point de vue crée l’objet”, writes Bourdieu, “c’est dire qu’une même “réalité” fait l’objet d’une pluralité de représentations socialement reconnues, mais partiellement irréductibles les unes aux autres—comme les points de vue socialement institués dans les champs dont elles sont le produit—, bien qu’elles aient en commun de prétendre à l’universalité.”⁵¹⁰ In the case of the polemic between Volta and Galvani, the frog is recognized as the target of both a physiological and physical point of view, each at least “partially irreducible” to the other yet claiming a universality that tends to displace the other.

Rather than implying scenarios of free collaboration or cooperation, analogy mediates the differentiation of fields with their distinct points of view. Just as Volta “imitated” the torpedo’s electric eel in constructing the pile, Galvani likened muscle fibers to Leyden jars, a standard piece of equipment in research on “common” electricity. Commenting on this chiasm, Piccolino and Bresadola note that, “it is certainly a kind of historical paradox that a “physicist” like Volta was directed in his endeavor by a mental image derived from the animal world, whereas a “physiologist” like Galvani drew his inspiration from one of the most famous physical tools of eighteenth-century science.”⁵¹¹ Yet this paradox is predicted by the process of differentiating social worlds in which Volta and Galvani were implicitly engaged. Given the role of the polemic itself in this process of differentiation, the conflict can be recast as a kind of negative dialectic, in which each protagonist strove to overcome the objects and tropes associated with the point of view of the other, on his way to subsuming a new object into his own point of view. Rather than a straightforward overcoming of physics by physiology, then, as the narrative told by Arago and others might suggest, the polemic evinces a dynamic in which the conflict between positions pushes each protagonist closer and closer to a statement of contrary yet equally viable perspec-

⁵⁰⁸ “Analogy in Volta’s Exact Natural Philosophy,” *Nuova Voltiana: Studies on Volta and his Times* I, edited by Fabio Bevilacqua and Lucio Fregonese (Milan: Ulrico Hoepli Editore, 2000), 2.

⁵⁰⁹ Of physics and the “life sciences” Pancaldi, for instance, writes that “contrary to some current views, during the late eighteenth century their interaction was intense and creative, and not confined to the rhetorical, sometime [sic] inconclusive, arguments adopted in the controversy over galvanism.” *Volta*, 178.

⁵¹⁰ *Méditations pascaliennes*, 119.

⁵¹¹ *Shocking Frogs*, 256.

tives on the same object. Ultimately, as Piccolino and Bresadola point out, this conflict entails a process of purification, in which physical objects and analogies tend to disappear from Galvani's work and physiological ones from Volta's. "In a somewhat mirror-like way to that in which Galvani had excluded metals from his working bench," they write elsewhere in their book, "Volta had succeeded in demonstrating his metallic electricity without recourse to frogs or other animal preparations."⁵¹² Though organic motifs subsist in Volta's work, physical ones in Galvani's, they do so in increasingly attenuated form. This process of purification registers the coalescence of discrete points of view and the potential for increased horizontal autonomy in the corresponding fields.

Galvani drew analogies between animal structures and physical objects as he struggled to imagine how the animal might generate and store electric potentials. Having detected animal electricity, as he believed, Galvani additionally sought to describe the physiological mechanisms that excited it. As Piccolino and Bresadola point out, tourmaline and the Leyden jar suggested models for animal physiology in spite of their merely "physical" character. Tourmaline offered a point of reference because it was known to develop a positive charge at one end and a negative charge at the other when heated, a property attributed by the *électricien*. Aepinus to "the internal structure and the essential constitution of the stone."⁵¹³ The fact that such an object existed in physical Nature hinted that its existence might at least be possible in animal Nature as well, and the tourmaline's structure further suggested how animal tissue might actually produce these electric potentials. Galvani likened the alternation of transparent and pinkish streaks in the tourmaline stone to the interleaving of muscle and nerve fibers in the animal. "No one ignores that the nerves run in between the strata of the muscular fibres;" he writes, "and that these latter, devoid of blood, are transparent, while the nerves are opaque. In the tourmaline the poles of the double electricity appears [sic] along the same opaque line; similarly, in the muscles they [are] in the same direction of the nerves. The double electricity of the tourmaline is not only located in the whole stone, but also in any single fragment of it. Similarly, in the muscles the supposed double electricity is not only located in their wholeness but in any part of them."⁵¹⁴

This analogy enabled Galvani to conceive of electrical production in the animal at the level of microscopic structures, in regions of the body other than the brain. But if the tourmaline's structural analogies with animal muscles suggested a way to understand the generation of animal electricity, the model of the Leyden jar further suggested how it might be discharged from nerve to muscle. Consisting of a glass jar linked by a hook to a source of static electricity, the Leyden jar could, like the tourmaline, maintain both positive and electric charges. The jar's electric potential was discharged when an experimenter touched the glass and the jar's metal hook simultaneously. For Galvani, the mechanics of the Leyden jar suggested a potential analogy for the interaction of nerve and muscle. "Perhaps the hypothesis is not inconvenient nor wholly discordant from truth," he surmised, "which compares a muscle fibre to something like a minute

⁵¹² Ibid., 213.

⁵¹³ Quoted in *Shocking Frogs*, 134.

⁵¹⁴ Ibid. By "double electricity," Galvani meant that the stone was charged negatively at one end and positively at the other.

Leyden jar or to some other electrical body charged with opposite kinds of electricity, and compares, moreover, a nerve in some measure to the conductor of the jar; in this way on likens the whole muscle, as it were, to a congeries of Leyden jars.”⁵¹⁵ In this model, the muscle fibers functioned like the jar as the place where electricity was stored, the nerves like the hook that conducted this electricity, and some physiological interaction between the two like the touch that discharged the accumulated tension. Bundled together, the muscle fiber-nerve pairs might be imagined to fire in tandem with sufficient force to generate muscular contraction, a “congeries of Leyden jars,” as Galvani puts it. With this hypothesis, Galvani managed to sketch out a reasonable model of how electrical disequilibrium might exist in the animal in a normal state, and how the discharge of this equilibrium acted in muscular contraction.⁵¹⁶

In a similar but contrary way, Volta, as we have seen, drew on the knowledge he had gained of the torpedo fish in his conflict with Galvani to develop the electric pile. After experimenting for some time with frogs, Galvani had begun to experiment with torpedo fish instead, aiming to refute Volta’s speculations that the frog contractions were caused by the presence of metals and other heterogeneous substances by scrutinizing an electricity that seemed indubitably, distinctly “animal.” If Volta could claim that the nervous electricity detected in the frog was a mere laboratory artifact, Galvani reasoned, the torpedo’s known ability to produce shocks might definitively establish the existence and dynamics of animal electricity in nature. Volta’s objections to experimental set-ups in which dead animals were used forced Galvani to find ways to elicit animal electricity in living ones. Galvani observed that the torpedo continued to give shocks with its heart removed and its brain intact, a circumstance that showed it to subsist in the body even when the animal was no longer living.⁵¹⁷ Such a conclusion justified the notion that animal electricity likewise subsisted in the prepared frogs that Galvani had previously been using. But, Volta countered, excising the brain and leaving the heart enabled the torpedo to live for a time while destroying its ability to shock. Reversing Galvani’s experiment showed, in Volta’s view, that both life *and* the presence of the brain were necessary conditions for propagating electric shocks.

At first, Volta and Galvani agreed that the torpedo’s electricity emanated from its brain, even as they disputed whether it acted after the brain’s destruction. Yet Volta’s ongoing work with contact electricity soon gave him other ideas about the source of the torpedo’s shock. Other experts had previously imagined ways of imitating the torpedo’s shock-giving powers, but Volta’s discovery of contact electricity enabled him to conceive a machine, as he put it in the letter to Sir Joseph Banks, that would imitate the organ in both function and form. Where the torpedo’s organ consisted of tightly packed bundles of innervated tissue, stacked one upon the other, Volta imagined a machine in which pairs of metal plates would excite their own electrical current, propagated across “humid” conductors like moistened paper discs. His success in showing that an imitation organ could generate its own electric current suggested that the torpedo’s organ, for its part, could generate electricity in identical fashion. And if the electromotive force of the arti-

⁵¹⁵ Ibid., 136.

⁵¹⁶ Ibid., 137.

⁵¹⁷ *Volta*, 195.

ficial organ could be excited by purely physical means, this further suggested that the torpedo's electricity was nothing more than contact electricity aroused within the animal body.

Volta's uncertainty about the functioning of contact electricity in "humid," or non-metal, conductors meant he could not positively affirm as much. The layering of heterogeneous tissues in the animal's shock organ might not be found to generate much of an electric current after all. Yet even as the possibility of exciting an electric current in a purely humid machine remained a matter of speculation, Volta realized that humid matter played an important role in conducting the electricity of metallic structures. Moistened cardboard interposed between pairs of metal disks contributed to the excitement of the electric current, and attempts to build an all-metal pile consisting of a third metal in place of the cardboard came to naught.⁵¹⁸ Volta had no explanation for why metallic pairs required humid conductors to generate detectable electric currents, but the presence of the moistened cardboard in the pile likewise expressed the machine's origins in the conflict with Galvani. Just as the battery's piles of stacked pairs of disks imitated the form of the torpedo's organ, the use of moistened cardboard "sublimated" Galvani's frogs into a strictly physical presence. In conceiving the frog as the equivalent of a mere moist conductor, Volta completely inverted Galvani's point of view, for where the frog had been the primary target of the doctor's experiments, it now receded into the background, useful only insofar as it facilitated the knowledge of metals. If, as Pancaldi affirms, "the pile of metallic pairs and wet cardboards symbolized what Volta liked to depict as the victory of metallic over animal electricity," this was not because the pile disproved the existence of animal electricity or suggested some alternative agent of neuromuscular function but because it offered compelling grounds for abandoning the physiological point of view on the frog altogether in favor of a distinctly physical one.⁵¹⁹

While Galvani was initially pushed to borrow motifs from physical science and Volta was pushed to borrow motifs from physiology, the dynamics of the polemic eventually compelled each to attenuate the presence of heterogeneous materials in his experiments. As Piccolino and Bresadola point out, Galvani's determination to show that metals played no role in the excitement of animal electricity prompted him to eliminate them from his experimental set-up, first by attempting to generate currents through the use of muscle-nerve and nerve-nerve pairs, then by abandoning prepared frogs and their metallic supports in favor of living fish. Likewise, Volta's determination to show that so-called animal electricity was really generated by the contact between heterogeneous materials compelled him to experiment on metals and humid conductors alone, as well as to attempt to duplicate animal organs with physical materials.

The resort to "analogy" thus establishes an initial chiasm between Volta and Galvani, physiology and physics, before each party moves to purify his science of analogic terms. Gov-

⁵¹⁸ *Volta*, 204. Pancaldi additionally documents some of the difficulties Volta encountered in his attempts to build an "all-wet" battery. "The unexciting results of 1804 suggest," he writes, "that Volta did not publish his previous attempts when announcing his discovery of the battery because they had been indecisive. He did not doubt that a nonmetal battery could work; the electric fish guaranteed as much. Some ideas he had formed while building his batteries (both successful and unsuccessful) helped him to locate the problem with nonmetal batteries. In an all-wet battery, what special body could act as an appropriate gap in conductivity (or increase in resistance) between the couples? If a certain discontinuity was needed between the couples, as ordinary batteries showed, an unknown subclass of wet conductors might be supposed to exist that could act with conductors as wet conductors did with metals in ordinary batteries (205-06)."

⁵¹⁹ *Ibid.*, 205.

erning the protagonists' analogical thinking, this motif of unexpected crossings also crops up in other aspects of the controversy, most notably in the savants' attitudes toward the experimental set-up and the role of metaphysical categories in experimental science. Though Galvani's distinctly physiological perspective (and reputed vitalism) might lead us to believe he would favor experimentation on living animals, the production of life-like effects characteristic of galvanism depended in fact on the use of non-living specimens. The absence of animation in the non-living animal controlled for the interference, as it were, of other sources of electricity than that specifically incited by Galvani's experimentation. And while Volta's physical bent might lead us to expect that he cared little whether the experimental animal was alive or dead, or perhaps that he favored non-living specimens, he insisted *contra* Galvani, as it happens, that proper experimental protocol required the use of living animals. For Volta, the use of non-living animals precluded the possibility of discovering how brain function and other vital causes participated in the physiology of sensation and motion. These attitudes toward experimentation were in turn associated with distinct metaphysical assumptions. From Galvani's perspective, animal electricity could be described in purely physical terms, distinct from common electricity only in its origins in physiologically specific mechanisms. Ironically, it was this purely physical interpretation of animal electricity as an agent of sensation and action that facilitated the production of life-like effects in the non-living animal. In Volta's view, on the contrary, sensation and action could not be explained without reference to the "will," the entity, he imagined, that set the nervous fluid or some other effective agent in motion. Correspondingly, it was this conviction about the bearing of metaphysical categories on physiological functioning that compelled Volta to refute the notion of a purely physical animal electricity.

Both Volta and Galvani acknowledged the role of the "will" in animal physiology, and attributed sensation and action in the animal body to its capacity to set nervous electricity in motion. Galvani's conception of the nerve-muscle fibre pair as an "animal Leyden jar" begged the question of where exactly the electricity stored by the jar was coming from, and the physiologist obliged by speculating that the "soul by acting on the brain in its marvellous and incomprehensible manner may determine and send a greater quantity of electricity through the nerve to that muscle it wants to set in motion, so as to increase the force of the internal torrent" (that is, the flow of electric current).⁵²⁰ But Galvani additionally believed that the electricity produced in the animal while it lived remained within it some time after its death, allowing the physiologist to excite it without the interference of the animal's will. The soul's "marvelousness" was precisely what positioned it beyond the physiologist's brief. If the soul was "an immortal entity that will ever remain well beyond human understanding," wrote Galvani, it behooved the physiologist to confine his efforts to isolating the "material agent" of motion and sensation.⁵²¹ Though Galvani speculated on the likely interactions between the "will" or "soul" and electricity in the animal, experiments conducted on non-living animals offered the advantage, he thought, of sidestepping these questions altogether. Galvani sacrifices his frogs before operating upon them because he wishes to ensure that their own willed actions do not interfere, as it were, with the *mise en évidence* of purely physical mechanisms, the accumulated store of electricity that, produced by the

⁵²⁰ *Shocking Frogs*, 172.

⁵²¹ *Ibid.*

animal while it was alive, remained in its muscles some time after its death. In Galvani's protocol, experimenting on dead animals controlled for the unpredictable effects of the living animal's willing, as it were.

In keeping with the physiological tradition of Albrecht van Haller (1708-1777) and others, on the other hand, Volta insisted that experimentation on animals had to be performed while they were still alive. Having shown that what Galvani thought was animal electricity was actually excited by the contact of metals, Volta argued that the grounds on which Galvani implicitly justified his experimentation on non-living animals were false. Volta concomitantly distinguished a "true and proper Animal Electricity" from Galvani's "pretended Animal Electricity," defining the latter as "that which is excited in the cut limbs with the artifice of metals." "The true electricity that I admit," he continues, "is that of the Torpedo and Trembling Eel and in the other fishes which give the shock; I am now inclined to attribute a similar electricity, in the above mention [sic] way, to all animals; and so much animal as it depends on the *anima* (i.e. soul), i.e. it obeys to the will, and does not properly extend itself--or only poorly--outside its place."⁵²² In this formula "so much animal as it depends on the *anima*" Volta implicitly equates common and animal electricity, animal electricity distinct from common only insofar as the soul continues to act in the body during the animal's life. For Volta, common electricity became "animal" when it was acted upon by the will, "the most noble part in the Economy."⁵²³ Just prior to Galvani's death, Volta would spell out the difference between his and Galvani's conceptions of the electricity located in animal bodies in definitive terms. For Galvani, he wrote, "Electricity is excited by a purely organic force, meaning that the electric fluid which is prepared and works in the brain, is accumulated within these last ones [sic], or inside the interior faces of muscles, and is put in whatsoever condition of unbalance, and because of this unbalance, once discharged, stimulates the muscles themselves." But for Volta, real animal electricity had to be defined as "depending on and moved by the will in the entire and living animal." "For the voluntary muscles, as I say," Volta pronounces categorically, "I believe that the motions are determined and produced at their origin by a movement of electric fluid in the nerves going to the said muscles; and I think that this movement is made at the command . . . of the will where the will has its seat at the beginning of the specific nerves."⁵²⁴

While for Galvani the soul remained extraneous to physiology, for Volta, it played an active role in shaping physiological explanations. Like Descartes positing his famous pineal gland, Volta searches for physiological evidence for the agency of the immaterial will in governing animal sensation and movement. As Volta went about replicating Galvani's experiments, Pancaldi writes, he observed that "four to eight times less electricity was needed to excite leg contractions when the electricity communicated to the frog ran from the nerve to the muscle than when it ran from muscle to nerve." In Volta's view, this circumstance tended to confirm the "rather well-established conjecture," as he put it, that the will governed the body by means of the electricity it directed through the nerves, since the vector from nerve to muscle, requiring less force, could be

⁵²² Ibid., 227.

⁵²³ Ibid., 186.

⁵²⁴ Ibid., 228-29.

seen as the “natural” path of the electricity, while the vector from muscle to nerve, requiring more force, could be seen as going against the grain.⁵²⁵ Volta likewise interpreted his experiments on living torpedo fish to show that the will was a necessary element in the discharge of the electric shock. “This empire of will in moving the electric fluid which exists naturally in nerves is manifest, and appears with effects both vigorous and wonderful in the *Torpedo* and *Gymnotus electricus*,” Volta claims, “endowed as they are with the extraordinary power of giving the true electric shock” When deprived of its heart, Volta observed, the torpedo maintains “the virtue of giving more or less vigorous shocks until the complete cessation of motion with the extinction of life.” When deprived of its brain, on the other hand,” i.e. of the organ where the will resides,” Volta affirms, “the torpedoes at once lose the virtue of giving the shock, although they continue to live apparently well, that is they remain lively for long time, swim as normal, and make all the other movements, etc.”⁵²⁶ While the torpedo might continue to give involuntary signs of life, that is, the animal can no longer propagate the shock. For Volta, the shock is almost certainly voluntary and therefore dependent on the presence of the brain, an assumption supported by nerve electricity’s traditional association with voluntary muscle function.

The metaphysical categories of “soul” and “will,” then, play a role in the physiologies of both Volta and Galvani. For both, animal electricity figures as a “proxy” to the fundamental cause of will or soul, an effect whose very proximity to its cause imbues it with a certain ambivalence. Though purely material in principle, nerve electricity’s determination by a spiritual principle inevitably confuses its materiality. In the seventeenth and eighteenth centuries, Cartesian materialism or the thinking of the “physical and the moral” reached similar aporia in their respective attempts to imagine how matter and spirit might meet. Though ambiguous, this dyad realized a certain metaphysical stability. Galvani’s decision to experiment in the non-living animal, however, upset this dyad, ambiguous as it was. For even as Galvani assiduously avoided speculation as to the physiological pertinence of the will in the living animal, animal electricity’s capers in the non-living animal body could not help but evoke the action of will even in its absence. In experimentation on living animals like that espoused by Volta, vital effects emerge from the living animal as a matter of course, no matter how tormented the animal. But in the non-living animals prepared by Galvani, the excitement of vital effects evoked will’s agency even in its absence, such that for contemporaries the purely material means by which Galvani supposed these effects to be produced tended to assume a certain partial immateriality. Given this mixed materiality, animal electricity tended to take on a peculiar ontic status, distinct from normal electricity in its quasi-supernatural qualities. The special vitality represented by this quasi-material, quasi-immaterial “substance” acted like an autonomous entity in the animal body, a manifestation, as it were, of life itself. This manifestation was only a sort of byproduct of Galvani’s experimental practice, not a tenet of his physiology. But the confused materiality of animal electricity leapt from the otherwise still animal with irresistible spontaneity, a dubious supplement in the animal body, a sort of fascinating “haunting.”

The shift from the physiological perspective on the animal body to the physical one quelled this haunting spontaneity, but it did so only to substitute a new kind of spontaneity in its

⁵²⁵ *Volta*, 192.

⁵²⁶ *Shocking Frogs*, 254-55.

place. In the curious logic of the polemic, Volta could be construed as having defeated Galvani in part because the battery answered the frog's spontaneity with a spontaneity of its own. The degree to which contemporaries marveled at the pile precisely because of its capacity to arouse spontaneous effects from evidently inert materials suggests that "spontaneity" itself was an intensely, singularly cathected phenomenon in this period. Arago himself was far from immune to its appeal. Volta's signal achievement, he marvels, was to have discovered that "*des mouvements spasmodiques*" could be engendered in otherwise inert materials.⁵²⁷ In the beginning of 1800, he declaims in the *Éloge*, Volta

*imagina de former une longue colonne, en superposant successivement une rondelle de cuivre, une rondelle de zinc et une rondelle de drap mouillé, avec la scrupuleuse attention de ne jamais intervertir cet ordre. Qu'attendre à priori d'une telle combinaison? Eh bien! je n'hésite pas à le dire, cette masse en apparence inerte, cet assemblage bizarre, cette pile de tant de couples de métaux dissemblables séparés par un peu de liquide, est, quant à la singularité des effets, le plus merveilleux des instruments que les hommes aient jamais inventé, sans en excepter le télescope et la machine à vapeur."*⁵²⁸

In inadvertent echo, as it were, of the galvanists' own cause of wonder, Arago's profound admiration centers on the pile's capacity to arouse spontaneous effects from inert materials (and not, for instance, on its presumed utility or its potential role in electrochemical investigations). Given the tight links drawn here between the pile's purported status as humankind's single greatest invention and its capacity to engender spontaneous effects, one is almost compelled to suspect that the pile could be celebrated so fervently because it "saved the rule" of spontaneity, perpetuating a magical effect without violating such deeply ingrained presuppositions as the reality of the matter-spirit dyad. Volta's pile preserved spontaneity's associations with animation (versus inanimation) but severed its associations with life (versus death). In converting spontaneity from a physiological to a physical effect, moreover, the pile may have triumphed by aligning spontaneity with a host of dominant values, situating it on the side of the period's increasingly authoritative physical sciences rather than on that of the less authoritative physiological sciences, for instance; or on the side of dryness and hardness, given the pile's metallic construction, rather than on that of wetness and softness, as expressed in the fish's organs; likewise, the male rather than the female, the human rather than the animal, or the rational rather than the irrational. In this imperfect polemic, the spontaneous dispositions of the period's cultural actors miscarried the dialectic of scientific positions.

Though the pile's spontaneity could emerge as an object of admiration in Arago's discourse only insofar as it had been purified of its animal origins, Volta himself, as we have seen, did not hesitate to trumpet the subsistence of animal form and function in the final design. If in galvanism the animal body seemed "haunted" by life, the pile, too, might be imagined to have been subject to its own variety of visitation. After all, as John Heilbron has pointed out, the pile

⁵²⁷ "Éloge," lxxxvi.

⁵²⁸ Ibid., lxxxvii.

“contained the working ghosts of two different animals,” both “Galvani’s frogs, metamorphosed into the soaked cardboard bits,” and “the electric fish, virtually present in the stacking.”⁵²⁹ And while for Volta, the subsistence of these animal inspirations represented the overcoming of physiology, we might from a different point of view see their presence as the imbrication of animality in human technique and physical science.

In the polemic between Volta and Galvani, the authority of the physical sciences was powerful enough to ensure the “universalization” of its point of view at the expense of that of medico-physiology, even with regard to so traditionally a “medical” object as the living body. But if the prestige of the physical sciences in Paris sufficed to extinguish Galvani’s medico-physiological point of view, it also served to kindle alternative points of view in its place. Under Cuvier’s guidance, a new variety of experimental physiology emerged to displace the medico-physiological experimentation embodied by Galvani, a physiology shaped this time by the ideal of exactitude. But if animal electricity more or less disappeared from scientific physiology, how precisely did exactitude shape the study of the animal body in its stead? What kinds of vital objects did exactitude ultimately realize?

In *Les Mots et les choses*, the “superficial” schematization of morphological differences and similarities in classical natural history gives way to a sense that the truth of the organism lies, as Foucault puts it, in the depths of its body, in the ensemble of functions that enable it to remain alive. “*Il y a histoire naturelle,*” Foucault writes, as you will recall, “*lorsque le Même et l’Autre n’appartiennent qu’à un seul espace,*” that is, the space in which differences and similarities of structure can be schematized relative to one another; “*quelque chose comme la biologie devient possible lorsque cette unité de plan commence à se défaire et que les différences surgissent sur fond d’une identité plus profonde et comme plus sérieuse qu’elle.*”⁵³⁰ Cuvier’s comparative anatomy embodies this shift for Foucault because it privileges the study of functions like respiration, digestion, circulation and locomotion over the devising of morphology-based taxonomies. Rather than determining how a specific organ in a given animal differs from the equivalent structure in another, that is, Cuvier wants to know how a given organ participates in maintaining the animal as a viable living whole. Though the gills of the fish and the lungs of the mammal, for instance, may appear dissimilar, they each fulfill the function of respiration, while the fins and the limbs correspondingly fulfill that of locomotion. In the animal science represented by Cuvier, the classical thinking of the similarities and differences of structures cedes to the recognition that entirely heterologous organs might be accomplishing the same task, all other things being equal.

This conception of the animal as an ensemble of functions gives rise, in Foucault’s account, to a notion of “life” as both the goal of function in general and its precondition. Beyond the identification of the particular functions that keep the animal alive and the organs that corre-

⁵²⁹ “Analogy,” 20.

⁵³⁰ 277.

spond to them, the question of just how the animal continues to exist as such retreats like a mirage, as it were, into the “*obscur de l’organisme*.” The question of what precisely keeps the animal alive eludes knowledge, that is, even as, taken to its extreme, the privileging of function inevitably begs it. In place of the zones of vitality or the multiple varieties of “life” posited by some contemporary physiological sciences, life as the function of functions takes on a singular, “synthetic” character, subsisting as one in the individual animal body. Given the notion, moreover, that all living things are the ensemble of their functions, this synthetic acceptance of life additionally expands to encompass the lives of living things in general. Since living is common to organized bodies, “life” is, as well, in its capacity as “*la grande, mystérieuse, invisible unité focale, dont le multiple semble dériver comme par une dispersion incessante*.” With this radicalization of “life,” writes Foucault, “*le vivant*” becomes “*une manifestation de la vie*,” one among other “*figures transitoires*” distinguished by nothing more than “*leur présomption, leur volonté de subsister*.”⁵³¹

Foucault touches briefly on “transitional” figures like Jussieu or Vicq d’Azyr without, however, telling us precisely how these and others working in the period between Buffon and Cuvier contribute to inciting this notion of life. “*C’est ce passage de la notion taxonomique à la notion synthétique de vie*,” he asserts, “*qui est signalé, dans la chronologie des idées et des sciences, par le regain au début du XIXe siècle, des thèmes vitalistes*.”⁵³² We never learn whether this resurgence participates in elaborating synthetic life, whether it retards it in some cases, or whether the figures responsible for it merely respond in their own way to tensions and possibilities whose real import escapes them. Yet if the synthetic notion of life prevails as an effect of the exact physical sciences, its appearance is every bit as contingent as the empire achieved by these sciences. Galvanism and contemporaneous vitalisms participated independently and on their own terms in the competition to monopolize scientific discourse on the animal body, I would argue, figuring roads not taken rather than mere epiphenomena. If Montpellier medicine understands vitality to inhere in the organism as an irreducible whole and Bichat’s anatomical studies identify multiple “lives” in the animal body, galvanism figures vitality as a kind of synthetic “life” projected in and through the body. With Galvani’s effects of reanimation, life seemed to leap indiscreetly from the obscurity of the organism into the light of demonstration, as active as the life in Cuvier is passive. Indeed, where the science of Cuvier and others saw the living thing as a manifestation of life in general, galvanism reversed this scenario in manifesting life in the once-living

⁵³¹ Ibid., 290.

⁵³² Ibid., 281.

thing. In this way, galvanism both anticipates and obstructs the emergence of the specific variety of synthetic life corresponding to positivist biology.⁵³³

For Galvani, as we have seen, animal electricity was strictly physical, nothing more than a physiologically generated agent that remained in the animal's body for a limited time after its death. But as a cultural phenomena, galvanism represented the emergence of a variety of "synthetic" life that troubled the fundamental Western distinction between spirit and matter. With the arousal of galvanic effects, vitality became detached from the categories, will or soul, with which it had been contiguous in the metaphysical tradition. Liberated from its corresponding terms, vitality gave the impression of acting as a discrete agent in the animal body. The singular, autonomous character of this vitality gave animal electricity the allure of a hybrid substance, neither spirit nor matter alone but partaking of each, posing as something like the matter of will or thought, or will or thought made matter. As Foucault argues, the advent of synthetic life marks the transition from a regime of "transcendentals" like soul or will to that of a so-called "quasi-transcendental," an extra-substantial other that nevertheless emerges concomitantly with studies of animal substance. Just as the transcendental categories of soul or will had conditioned the investigation of nerve agents in the earlier physiological discourse, the quasi-transcendental of life helped realize the animal body as a scientific object in positivist terms, separating the animal body into material and immaterial components in a mode that favored the interests of physical science. But if positive biology developed a notion of life as quasi-transcendental, galvanism, on the contrary, exhibited a notion of life as quasi-substantial. The element of synthetic life to which it gave rise complicated the materiality of the animal rather than resolving it, violating the fundamental divide between spirit and matter without proposing an alternative dichotomy to replace it.

Volta's response to galvanism tended to dispel this ambiguous scenario, even when this response is considered in a strictly physiological light. In proposing that a purely physical substance could incite effects otherwise impelled by will, Galvani not only aroused the notion of a quasi-substance but also tended to subvert the sovereignty of will over animal action. Volta, in contrast, reaffirmed will's sovereignty in setting nerve electricity in motion, a metaphysical presupposition that incidentally worked to restore a stable spirit-matter dyad. Though Volta's physiology embraced typically eighteenth-century terms, this restoration of a spirit-matter dyad antici-

⁵³³ With the exception of Linnaeus, Foucault's historiography of the life sciences in *Les Mots et les choses* remains rather narrowly gallic, even Parisian, in character. It construes the passage from natural history to biology in terms of taxonomy and comparative anatomy, projects which stood at the top of the hierarchy of the sciences of living things in France but did not necessarily occupy the same position in places where medical influence on the sciences of living things was stronger. In Chapter One I alluded to work by Mary Terrall and others which has recently elicited the variety of natural history practices in eighteenth-century France and beyond, extending well beyond the borders of both taxonomy and France. Here, I would additionally call attention to the way a look beyond taxonomy and comparative anatomy, as well as beyond French borders, promises to enrich the account of how life emerged in the sciences, given how crucial animal experimentation in particular was likely to have been in generating this notion and how prevalent it was abroad. The heritage of the German-speaking Swiss van Haller (1708-1777) would be particularly key to developing a more nuanced account of this transformation, especially since van Haller's experimental work and didactic poetry were well-known and much-appreciated in France from the inception of his career. After van Haller, the single most influential moment in the history of animal experimentation in France was perhaps none other than the polemic between Volta and Galvani. Along with more engaged readings of Bichat and the Montpellier vitalists, these currents from abroad promise to engender a historically detailed account of the contingencies which led to the entrenchment of a passive, synthetic "life."

pated positivist physiology's matching of life with matter. Volta's notion of will turned out to be functionally analogous to the notion of life developed in positivist biology, since what counted for him was not an instance of will exhibited by a particular experimental animal, nor even the global degree or intensity of will in one animal versus another, but rather the presence or absence of will as a transcendental category that persisted with the animal's life. In this regard, the physiological correlates of will might vary from animal to animal or species to species, but will's own transcendental invariability recused it from direct physiological investigation. In different discursive registers, both Volta's notion of will and positivist physiology's notion of life are consigned to a constitutive yet passive role in the organism. If galvanism incited synthetic life as a physiological category, Volta aimed to recuperate it for the eighteenth-century physiological discourse of will, while positivist biology both embraced it and recast it as an invisible substrate of animal functioning.

Though Cuvier's notion of synthetic life may well have pre-dated the conflict over galvanism, galvanism had to be overcome before this notion of life could predominate. In Volta's and positivist physiology's respective attempts to overcome galvanism, each not only restores galvanic vitality's place in a dyad but also counters Galvani's experiments on non-living animals with a methodological preference for vivisection. In Volta's physiology, as we have seen, the preference for vivisection corresponds with the metaphysics of will; because will alone acts to move nerve electricity and will can only act as long as the animal is alive, the animal must remain alive in experiments on nerve electricity. Positivist physiology similarly affirmed the necessity of vivisection, this time in terms suggested by the discourse of life: if the proper object of physiology was function, and functions only operated as long as the animal was alive, then the animal must likewise remain alive during investigations of function. Though vivisection as an element in the discourse of will differed as a practice from vivisection as an element in the discourse of life, both practices required that an immaterial principle persist in the animal during the study of material processes.

This study of function characterized both Cuvier's comparative anatomy and the experimental physiology that emerged in France toward the end of the Empire. Vivisection became the primary technique for determining physiological function in French experimental physiology thanks in large part to the work of François Magendie (1783-1855). Where Magendie's predecessors in Parisian medicine had also practiced the experimental manipulation of the living animal as a mode of physiological investigation, Magendie pursued this practice in preference to pathological physiology and other techniques, and exercised it with hitherto unknown rigor.⁵³⁴ In keeping with the precedence of function over structure in Cuvier's comparative anatomy, Magendie developed an experimental physiology aimed at revealing the role played by organs in particular functions.⁵³⁵ In his studies of vomiting, for instance, Magendie showed that this action was induced by the diaphragm and the large abdominal muscles, not by the stomach as had previously been presumed. Here and elsewhere, the physiologist's means "are strikingly interventionist," as one commentator euphemistically puts it, "especially if we remember that the animals

⁵³⁴ John Lesch, *Science and Medicine in France: the Emergence of Experimental Physiology* (Cambridge, MA: Harvard University Press, 1984), 166-77.

⁵³⁵ *Ibid.*, 168-69

were not anaesthetised.” Using a succession of dogs and other animals, Magendie lesioned the various elements he suspected might participate in vomiting, then induced it. “The stomach itself is removed from one animal and replaced with a pig’s bladder,” we read; “the diaphragmatic nerves are cut in another animal; the abdominal muscles are cut out in yet another. The experiments are repeated several times, and in different combinations, in different animals.”⁵³⁶ The irreducible intensity of these many instances of suffering become comparable thanks to the positivist notion of life as both synthetic and passive.

In these horrifying experiments, Magendie’s scalpel effectively traces what Bourdieu calls the “*coupure scolastique*” dividing the scientific point of view from everyday existence. If in Bourdieu’s view, academic “epistemocentrism” in general blinds scholastic vision to the practical logic of its subjects, positivist vivisection marks perhaps the most radical instance of such epistemocentrism in the West.⁵³⁷ In vivisection, positivist experimental physiology not only ignores the practical logic of the bodies it examines but denies them as subjects of experience altogether, including painful experience. Like a sociological survey whose questions jar with the system of dispositions incorporated by those surveyed, the physiological experiment exercises a powerful symbolic violence on its subjects, a symbolic violence articulated this time in a physical mode.⁵³⁸ So deeply ingrained is the habit of acquiescing in the authority of scholastic seeing, even among those who do not belong to the field, that in the case of experimental physiology it can seem jejune to acknowledge the experience of the vivisected animal. A passing acquaintance with animal behavior suffices to confirm the animal as the victim of an arbitrary and particularly radical scholastic prerogative, however. In defining what the scholastic divide severs, Bourdieu himself remarks that, “*même s’il n’est pas d’apprentissage, y compris chez les animaux, qui ne fasse une place au jeu (et de plus en plus grande à mesure que l’on avance dans l’évolution), c’est seulement avec l’École que s’instituent les conditions très spéciales qui doivent être réunies pour que les conduites à enseigner puissent être accomplies, en dehors des situations où elles sont pertinentes, sous la forme de “jeux sérieux” et d’exercices “gratuits” . . .*”⁵³⁹ The games which develop practical dispositions in animals do not differ in kind, Bourdieu suggests, from those which accomplish the same in humans. Though they may vary from species to species, these games are alike not only in differing from the specific “gratuitous” play of autonomous fields but also often in remaining invisible to them.

Vivisection became entrenched as the primary technique of experimental physiology as Magendie worked to integrate the notion of function into the investigation of physiological processes. In the 1809 essay “*Quelques idées générales sur les phénomènes particuliers aux corps vivans*,” Magendie locates the specificity of the object of physiology in the animal’s “*force vitale*,” while declaring this force operatively moot in the understanding of the body’s functions.

⁵³⁶ Andrew Cunningham, “The Pen and the Sword: Recovering the Disciplinary Identity of Physiology and Anatomy before 1800. Part I Old Physiology: The Pen,” *Studies in History and Philosophy of Science, Part C: Studies in History and Philosophy of Biology and Biomedical Sciences* 33, no. 4 (December 2002), 660.

⁵³⁷ *Méditations pascaliennes*, 63-72.

⁵³⁸ On the symbolic violence of the survey see *Méditations*, 73-74.

⁵³⁹ *Ibid.*, 29.

The mirror image of Cuvier's comparative anatomy, Magendie's experimental physiology asked which bodily structures were associated with a given function, ligating, lesioning, even ablating structures altogether until the function in question failed; where Cuvier started from fossil structures and worked to induce their roles in the animal's functions, Magendie started with functions and deduced the structures that participated in them. In the 1809 essay, Magendie highlights the affinities between his own project and Cuvier's in a rhapsodic tribute *en creux* to Cuvier in which he admires the "*merveilleuse facilité*" with which "the zoologists" manage to determine "*d'une manière rigoureuse, tous les phénomènes de la vie d'un animal, par la simple considération d'un de ses organes: . . . d'un os du tarse, par exemple.*"⁵⁴⁰ A generation younger than Cuvier, Magendie worked to wrest experimental physiology from the domain of medicine and place it under the aegis of the sciences, an endeavor that eventually succeeded with the sustained patronage of Cuvier, Laplace and other powerful partisans of exactitude.

Magendie's notion that the animal's "*force vitale*" always expressed itself "*en raison directe de l'organisation*" meant that physiology had only to focus on the animal's organization in exclusion of the expression of vitality; potentially variable in action, the vital force inevitably remained proportional to the animal body in effect. Magendie's mathematical rhetoric corresponds to his sense of the superiority of exact physical science as a model of scientific endeavor in general, and his programmatic essay implicitly establishes the notion of life itself as an effect of exactitude. In this essay, Magendie not only affirms the invariability of vital force as an element in the animal body but also explicitly frames experimental physiology as an attempt to adapt the certitudes of physical science to the realm of organized bodies. "*Le caractère d'une science certaine et perfectionnée,*" he begins,

est de n'avoir pour base qu'un petit nombre de principes auxquels se rattachent avec facilité un grand nombre de faits. Les sciences physiques, proprement dites, portent en général ce caractère; la chimie, la physique, et sur-tout l'astronomie, en sont des exemples remarquables. Les sciences physiologiques ayant beaucoup plus de difficultés à vaincre, ne peuvent point encore être placées sur la même ligne; cependant, les progrès qu'elles ont faits depuis cinquante ans, la marche qu'elles suivent actuellement, donnent lieu d'espérer qu'un jour elles pourront soutenir le parallèle.

For Magendie, physiology will remain "*en arrière*" as long as it refuses to emulate the physical sciences, most notably by identifying laws that pertain to all living bodies. If physiology remained inferior to physics, in Magendie's view, this essay aims to determine once and for all the grounds on which "*les sciences physiologiques,*" might find themselves "*rapprochées des sciences physiques,*" he writes, "*au moins pour la marche.*"⁵⁴¹

Flattering Cuvier and extolling the physical sciences, Magendie unmistakably pursues a campaign to secure the protection of the partisans of exactitude. Magendie became Laplace's personal doctor and guest at Arcueil, and Laplace helped Magendie accede to a post at the *Bu-*

⁵⁴⁰ "Quelques idées générales sur les phénomènes particuliers aux corps vivans," *Bulletin des sciences* 4 (1809), 159-60.

⁵⁴¹ *Ibid.*, 145-46.

reau central des hospices of Paris at a time when the doctor lacked an institutional sinecure.⁵⁴² The physicist's direct personal patronage of Magendie overlapped, moreover, with his efforts to create an institutional basis for experimental physiology; if Laplace worked to develop prizes and posts that consecrated experimental physiology as a distinct science, the beneficiary of these efforts was usually Magendie. Most importantly, Laplace persuaded the baron de Montyon to endow a prize specifically for work in experimental physiology, and helped Magendie get elected to the *Académie des sciences* in 1821 over the objections of the existing members of the section of *médecine* and *chirurgie*. As Lesch remarks, "the acquisition of a foothold within the Academy represented a seemingly small but in fact highly significant movement away from the almost exclusively medical institutional context in which physiology had been cultivated three decades earlier."⁵⁴³ Given that the 1821 election marked the first time an experimental physiologist had been invited into the institution as such, it cannot be overestimated as a landmark in the development of positivist biology in France. This election not only marked experimental physiology's recognition as a distinct science in France, but also figured as an important step in the inception of a continuous experimental physiology tradition for the first time in Europe. Though Harvey, van Haller and others had undertaken experiments on animals, these practices never shared a common methodological underpinning or survived long past the deaths of their initiators.⁵⁴⁴ With Magendie, on the other hand, laboratory experimentation on animals became a preponderant element of the positivist life sciences. "From about 1820," writes Lesch, "the ideal of experimental determination of the conditions of living phenomena achieved an ascendancy in

⁵⁴² *Science and Medicine in France*, 117.

⁵⁴³ *Ibid.*, 117-18; *Science under Control*, 274.

⁵⁴⁴ On van Haller's career, see Hubert Steinke, *Irritating Experiments: Haller's Concept and the European Controversy on Irritability and Sensibility, 1750-90* (New York: Editions Rodopi, 2005). Van Haller's experiments on animal sensibility and irritability provoked similar experiments all over Europe, for a time. Steinke estimates that "seventy persons, or rather groups, carried out animal experiments, 27 in Italy, 16 in France, 10 in the German-speaking countries, 6 in the Netherlands, 5 in Great Britain, and 6 elsewhere. They did not constitute one large "experimental community" in the sense that Haller and his pupils in Göttingen had done. Although for the most part surgeons and physicians, they came from varied educational, social, and professional backgrounds, and in their research were driven by various motives. Their only common ground was the performance of experiments. Some of them carried out only a few, others hundreds. The overall amount of animal experiments and their repetition all over Europe was a new phenomenon. No previous debate—not even Harvey's discovery—had provoked such widespread experimental investigation (129, 138-39)." Though van Haller constituted an "experimental community" in Göttingen, Steinke notes that this community did not endure after his departure. "Most of [van Haller's] pupils did not pursue an academic career," he observes, "nor did they perform any substantial research after their graduation. The two exceptions, Johann Gottfried Zinn and Johann Friedrich Meckel, were excellent anatomists but did not continue their experimental investigations" (162).

physiology from which it has never been displaced through successive transformations of physiological theory.”⁵⁴⁵

Magendie forged a field where none had existed before by soliciting the symbolic and material capital of another, more prestigious field. In this respect, his strategy departs markedly from the disciplinary “hybridization” described by Bourdieu as a force for epistemic change. In the scenario of hybridization he describes, the identity of a given kind of cultural production may undergo renegotiation when members of a more prestigious field decamp to a less prestigious one, where they may enjoy a competitive advantage.⁵⁴⁶ The 2000-2001 *Collège de France* lectures published as *Science de la science et réflexivité*, for instance, make occasional references to such scenarios of derogation, including Bourdieu’s own abandonment of philosophy for sociology in the 1960s. Though in *Science de la science* Bourdieu presents hybridization as merely an instance of the mechanics of epistemic change, not as a systematic theory of such change,⁵⁴⁷ the notion nonetheless embodies certain assumptions about fields which typify Bourdieu’s work more generally. In particular, hybridization lends an a priori and transhistorical character to fields by portraying epistemic change as the result of exchanges among pre-existing forms of cultural production. But while in the scenario proposed by Bourdieu, sociology and philosophy already existed as distinct fields, in Magendie’s case we witness the inception of a new field under the aegis of an old one. Magendie works to extract experimental physiology from the inherent hybridity of medicine, divided between clinical and scientific concerns, even as he himself maintained a foot in both camps. Rather than derogating from physics, he aspires to their patronage, freeing experimental physiology from clinical concerns by paying homage to the exact natural

⁵⁴⁵ *Science and Medicine in France*, 100. Magendie’s early career in medicine was marred by professional conflicts with Dupuytren and François Chaussier, professor of anatomy at the Faculty of Medicine, and he resigned his post as “demonstrator” at the Faculty in order to establish himself in clinical practice and give private courses. While Magendie taught anatomy and surgery in his capacity as demonstrator he was thereafter able to abandon these disciplines in favor of physiological research (*Science and Polity*, 672). After his election to the *Académie*, Magendie accumulated various other medical positions. As Gillispie argues, it was only by achieving recognition as a practitioner of “science” that Magendie was able to secure these prestigious medical posts. “Membership of the Institut gave Magendie the standing to secure the two positions in which he exerted formal influence. In 1830 he became head of the women’s ward in the Hôtel-Dieu. Later in the same year he won election to a still more important post, the chair of Medicine in the Collège de France. Magendie there impressed an audience wider by far than ever had heard or read the many memoirs presented before the Academy of Science. The series he delivered between 1832 and 1838, and published in 1842, transformed the perception of physiology among the educated public. The purpose was twofold. On the scientific side, he put all possible emphasis on physical explanations of the functioning of living creatures. On the medical side, he insisted on the necessity of basing therapeutics on exact knowledge of normal and pathological physiology. At the same time he was now in a position to form a new generation of students who later people the new discipline of experimental physiology in direct consequence of their training (674-75).”

⁵⁴⁶ *Science de la science et réflexivité* (Paris: Raisons d’agir, 2001), 133-34.

⁵⁴⁷ No such systematic account of change in a given form of cultural production as a result of subordination to another form of cultural production can be found in Bourdieu’s work, to my knowledge, though the question of the relationships between various fields of cultural production may well have become more prevalent in his work over time. Beyond the influence of politics or religion on various forms of cultural production, examples of the relationships among scientific, literary or artistic fields and sub-fields abound in Bourdieu’s oeuvre, furnishing an extensive repertoire for reflecting further on the means by which such fields act upon each other.

philosophers and their tenets, participating in the network of sociability centered on Laplace, and taking pains to adapt the language of exactitude to vital objects.⁵⁴⁸

Both Cuvier and Magendie adapt the rhetoric of exactitude to physiological studies by construing the animal as a “sum” of its functions. In a text entitled “*La situation de Cuvier dans l’histoire de la biologie*,” Foucault observes that while Cuvier resorts to the notion of “*calcul*” in his studies of function, “*le calcul chez lui est non un calcul de quantité, mais en quelque sorte un calcul logique d’éléments structuraux variables.*”⁵⁴⁹ In Cuvier’s usage, Foucault pursues, “*la taxinomie calcule la nature de chaque espèce, d’après le nombre des organes, leur étendue, leur figure, leurs connexions, leurs directions.*” Despite its non-quantitative acceptance, however, “*calcul*” does operate as a mathematical metaphor here. As an estimation of structural elements, the “*calcul*” of the animal always adds up to the same result in Cuvier’s comparative anatomy, the animal’s capacity to survive. If the end term of a given animal equation lies in the animal’s “*conditions de vie*,” the conditions it has to meet to survive, and the known quantities of the equation are the functions which help the animal meet them, then the equation’s variables are the characteristic structures of the particular animal body. Cuvier determines these variables on the assumption that they fulfill the functions that keep the animal alive, solving for the role of the organs in function by assuming the other elements of the animal equation. This equation remains an estimation, however, given that life, the function of functions, resists expression altogether, constituting the background on which functions emerge but remaining impossible to determine in functional terms per se. Though the life of the animal cannot be reduced to the sum of its functions, it can nevertheless be cancelled out in a way that makes the equation, as it were, solvable. The life of the animal as the function of its functions assumes on one side of the equation the same value assumed on the other by the “*conditions of life*,” together expressing the notion that in meeting the conditions of life the animal has succeeded in living. This tautology is the secret to the equation’s solvability, since it enables Cuvier to assume the reiterated term, life, as a constant, a scenario which correspondingly allows him to “cancel out” life and hence to solve for the animal’s structural variables. The fact that the animal has lived is proof enough that its parts add

⁵⁴⁸ For an account of the institutional relationships between science and medicine during the period, see *Science Under Control*, 162-66. Though there was a section of medicine and surgery in the *Académie*, “the standards and interests of the medical profession,” as Crosland puts it “were very different from the norms of both mathematical and experimental science.” “Although the professional ethos of the section [of medicine and surgery],” he adds, “naturally placed great emphasis on *clinical* considerations, the Academy as a whole had little interest in the clinical dimension and tended to judge candidates for election on the basis of their *scientific* contributions. It was such considerations that allowed the physiologist Magendie (1783-1855) to join the section, in 1821, despite the strong reservations of the section, which regarded him as an outsider.” The differentiation of clinical medicine and medical science continued with the establishment of the *Académie Royale de Médecine* in 1820. Though the “science of man” strain of hygiene was ascendant in medicine in this period, Crosland hypothesizes that the founding of the *Académie Royale de Médecine* “provided the necessary focus for the professional interests of medicine, leaving the Academy of Sciences freer to encourage the application of science to medicine (162-66).” In Magendie’s case, the ambitions of the *Académie* as a whole, acting under the auspices of Laplace, trumped the professional *esprit* of the section of medicine and surgery. “The election turned out to be an occasion where the preference of the Academy as a whole overcame that of the section,” Crosland writes. “In this case the Academy showed that it preferred the study of general scientific principles that could be applied to medicine, rather than a purely clinical approach. This preference, combined with the strong personal support of Laplace, carried the day and Magendie was elected at the second ballot (232).”

⁵⁴⁹ *Dits et écrits I* (Paris: Gallimard, 2001), 918.

up to genuine functionality, if only the anatomist can identify the structures that participate in a given function.

As it happens, the motif of “calculating structures” appears in Magendie’s physiology, as well. If medical physiology often construed physiological processes as the direct “effects” of vitality, Magendie argued that vitality could not be localized in the organs responsible for these processes. Even so-called “*sensibilité animale*,” the faculty associated with functions like sensation or perception, could not be figured as the simple effect of vitality, soul or will, or located in a given structure. “*Dans quels organes réside la sensibilité animale?*” asks Magendie. “*Réside-t-elle dans le sens? Non, car si le nerf est coupé ou comprimé, il n’y a pas de sensation. Dans le nerf? Non, car si le cerveau est malade ou comprimé, point de sensations. Dans le cerveau? Non plus; car s’il n’y a point de sens, si le nerf est coupé, il n’y a pas davantage de sensation.*” Because animal sensitivity cannot be localized in any particular organ, Magendie affirms, it must be considered “*comme une véritable fonction*,” that is, as the concurrence of the action of several organs. Sensation, for instance, “*est le résultat général de l’action de trois organes: le sens, le nerf, le cerveau; l’oeil agit pour recevoir une impression; le nerf optique agit pour la transmettre; le cerveau agit pour la percevoir: somme de ces trois actions, sensation.*”⁵⁵⁰ Dispersed in the animal body, sensation is also focalized as a function, the generalized result of concurrent actions. As Magendie puts it, these actions “add up” to a function, their “*somme*” in this case being sensation. And if the means by which the sum of these actions somehow adds up to sensation ultimately belongs among the secrets of life, physiology is no less competent to identify the actions and the organs which conduce to them.

With the description of organs’ actions, physiology could achieve general laws without descending to the level of such secrets, and the “calculation” of functions partook of such an effort even as it presupposed them. Magendie ultimately imagines life in quasi-Laplacian terms as an aggregate of corpuscular action. In this physiology, vitality was no longer conceptualized as a shock to the animal body, as in galvanism, but instead as a “*force vitale*” at play in its smallest imaginable divisions. The actions which conduce to any given function all entail the movements of tiny vital corpuscles, Magendie presumes, impossible to see or determine mathematically as such. Whether an action facilitates functions like nutrition, shared in common by all living things, or higher functions like the secretion of saliva or the contractions of voluntary muscles, Magendie conceives it as a “*mouvement moléculaire interne*,” a play of vital corpuscles. Without rendering explicit homage to Laplace, Magendie thus conceptualizes physiology as a variant of neo-Newtonian physics, a science whose task was to describe the laws governing vital molecules just as Laplacian physics sought to arrive at the laws governing simple physical ones.⁵⁵¹ But if physical science itself was still quite far from arriving at the description of individual molecules, physiology was even farther still. Just as the fundamental “causes” of the universe’s physical forces lay beyond the knowledge of man, the fundamental “cause” of nutrition, the most basic

⁵⁵⁰ “*Quelques idées générales*,” 165.

⁵⁵¹ This notion may also constitute a remote and perhaps incidental allusion to Buffon’s “*molécules organiques*.” As a natural philosopher, Magendie could not have differed more from Buffon, yet if Buffon was an avid partisan of Newton at a time when his authority in France was still disputable, Magendie inherits his Newtonianism from the authority of the exact sciences under Laplace.

physiological function, lay beyond knowledge as well. “*On n’a encore trouvé aucune analogie, même probable,*” writes Magendie, “*entre le jeu des affinités chimiques ordinaire et le mouvement nutritif; c’est pourquoi on a toujours considéré, et l’on considère encore aujourd’hui, le mouvement comme dépendant d’une cause particulière, qui, de même que l’attraction planétaire et moléculaire, est inconnue dans sa nature, mais manifeste par ses effets. Cette cause particulière a reçu beaucoup de dénominations. La meilleure qui lui ait été donnée, est celle de force vitale.*”⁵⁵² His predecessors erred, he believed, in wanting to describe how “*chaque molécule, animée de la force vitale, se comporte pour produire ce mouvement nutritif*”⁵⁵³ This error drives them to imagine that vitality expresses itself in each molecule of the animal body as sensitivity or the potential for movement, whereas these functions are really the result of the laws of the vital force governing the molecules. Ultimately, he believes, physiology must focus not on describing the molecules but on describing the laws of the vital force which governs them, “*le plus beau et le plus intéressant sujet de travail qu’on pût se proposer.*”

Though Magendie does not himself attempt to describe how vital force governs corpuscles in the living body, his efforts to emulate the physical sciences in their elaboration of general laws leads him to recuse it from investigation altogether. Like Cuvier, Magendie construes the animal as an equation in which “life” can simply be cancelled out. If the *force vitale* was common to all living bodies, it could be treated like a mathematical constant.⁵⁵⁴ Censuring those of his colleagues who viewed this force as acting variably across the animal body, in keeping with the different effects or functions associated with various organs, Magendie argues instead that nutrition and all the other actions of organized bodies proceed from the same force, always identical to itself. If the vital force seems to act variably across the animal organization, this is only a function of the animal organization itself. “*La nature, la disposition, le mode de réunion des molécules vivantes, en un mot, l’organisation, modifient la force vitale de telle manière, que les phénomènes par lesquels elle se manifeste dans les corps vivans, sont toujours en raison directe de l’organisation; en sorte que je crois possible d’établir, même dans l’état actuel de la science, que toutes les fois que la force vitale animera un corps de telle organisation, elle produira tels phénomènes.*”⁵⁵⁵ Just as Laplacian physics, then, presumed that the same force acted in the molecules of physical matter, but produced variable effects based on the shapes of the molecules set in motion, Magendie argues that it is the manner in which living molecules are arranged in the animal body which produces variable effects. In this statement of a physiological law, “*une observation des plus générales qu’il soit possible de faire sur les corps organisés,*” Magendie does

⁵⁵² Ibid., 149-50.

⁵⁵³ Ibid., 150.

⁵⁵⁴ In a curious way, the treatment of life as a sort of constant whose value could be “assumed” echoes what John Heilbron calls Laplacian mathematics’ characteristic recourse to “mathematical fig leaves.” Laplacian physics tended to find solutions by avoiding problems, Heilbron writes. If the effort to describe the microcosm mathematically required that physicists “find the precise dependence of the forces between interacting elements on the distance between them,” Laplace realized that “if the forces are sensible not over very short distances . . . but only over insensible distances, then the form of the force function does not matter at all This very fact, which would have been a blemish in a realist theory,” Heilbron concludes, “was a virtue to Laplace” (*Weighing Imponderables*, 150-57).

⁵⁵⁵ “*Quelques idées générales,*” 159.

not miss the opportunity to express himself in terms of mathematical elegance. For if the vital force manifests itself “in direct proportion” to the animal organization, it follows, in Magendie’s words that “*deux corps vivans d’une organisation différente, présenteront des phénomènes vitaux dont la diversité sera toujours en raison directe de la différence d’organisation.*” Any differences in organic action in one animal relative to another can be entirely attributed, Magendie maintains, to differences in their organization, not at all to variations in the action of the vital force. As an invariable cause, the vital force effectively lies outside the bounds of physiological investigation per se, animating bodies but remaining operatively moot.

Magendie’s allegiance to the discourse of exactitude is triply expressed, then, through his pursuit of the patronage of Laplace, Cuvier and others, through his conception of a physiological version of Laplace’s corpuscularism, and through this application of “mathematical” rhetoric to the study of the animal body. Given this quasi-mathematical rhetoric, the use of “analogy” works in precisely the contrary way in the exact life science of Cuvier or Magendie than it did in the practice of Galvani. In Galvani, the use of objects and motifs drawn from the physical sciences signals a step in the development of a distinctly physiological point of view, while for Cuvier and Magendie the turn to mathematical-physical motifs expresses the domination of the physical point of view on physiological objects. In Galvani’s science the tenor of the analogy subsumed the vehicle, Leyden jars or tourmaline proving of interest only insofar as they advanced a distinctly physiological point of view. In Cuvier or Magendie, on the contrary, the vehicle maintains the upper hand, transferring authority from one field to another—from physics to physiology—while reshaping the grain, as it were, of the tenor. The animal equations suggested by the physical point of view only add up if life is “assumed,” concentrated, that is, as a passive, synthetic constant. Conceiving life as a constant advances the ideal of exactitude insofar as it frees the scientific gaze to concentrate on the animal’s physical aspect alone, opening it up to the idioms and techniques of the physico-chemical sciences. At the same time, the devising of quasi-mathematical analogies courted the protection of key partisans of exactitude while mobilizing the prestige of the exact physical sciences for the benefit of more general audiences.

These transfers of authority mediated the annexation of the science of living things to the greater territory of exactitude, a shift concomitant with the depreciation of medico-physiological points of view on living things in Paris. As I have tried to show, this shift occurs in France following the triumph of Volta’s physical point of view during the polemic with Galvani. If, as Arago remarks, Galvani must have seen “*un nouveau monde*” opening up for him with the discovery of animal electricity, this particular territory was never to be realized as an empire of medical physiology. Volta’s discovery of contact electricity usurped the title to the territory in question, diminishing the authority of the physiological tradition and advancing the understanding of the animal as a physico-chemical terrain.

More broadly, though, such transfers of authority represent the means by which mathematical physics came to dominate knowledge-making in modernity in general, constituting “*the paradigm of sound knowledge*” in the sciences in beyond, as the quote I adopted from Thomas Kuhn at the beginning of this Chapter has it. Just how the ideal of exactitude came to govern fields beyond physics and physiology, in places far beyond France, inevitably depended on local circumstances and historical contingencies. As Chapter Three details, this ascendancy did not go

uncontested. Yet to the degree that quantitative science has maintained its prestige as a ideal of symbolic production today, we are all still living in a singularly Laplacian world.

Chapter THREE

Balzac, Geoffroy Saint-Hilaire and the Virtues of Synthesis

I. Science is One

“In der lebendigen Nature geschieht nichts, was nicht in einer Verbindung mit dem Ganzen stehe.”

—Johann Wolfgang von Goethe, “Der Versuch als Vermittler von Objekt und Subjekt”⁵⁵⁶

As epigraph for the *Notions synthétiques, historiques et physiologiques de philosophie naturelle* (1838), the naturalist Étienne Geoffroy Saint-Hilaire’s chose a quote lifted from the *Livre mystique*, a story collection by his friend Honoré de Balzac: “*La Science est une, et vous l’avez partagée!!!*” laments the half-human, half-angel character Séraphîta in the story of the same name (1834), indicting the fragmentation of the sciences and demanding their reunification. In levying this indictment in a work of fiction, Geoffroy writes, Balzac gives proof of an especially “*riche et féconde imagination;*” yet the writer remains just one discontented voice among many, Geoffroy insists, all decrying the ascendancy of the positive sciences. “*Ces cris, la science est une, et vous l’avez partagée, ces cris éclatent de toute part,*” Geoffroy affirms, “*principalement chez les philosophes. Il faut entendre sur cela les plaintes amères de Ch. Didier, par exemple, dans un article, Paris moderne, celles de l’ingénieur et fécond écrivain du livre mystique, et de bien d’autres encore.*” These “philosophers,” “*esprits synthétiques,*” as Geoffroy terms them, oppose the agglomeration of detailed facts generated by “*la foule des naturalistes positifs ou soi-disant tels,*” facts whose senseless proliferation and narrow exactitude ironically render them “*aussi nombreux qu’inexactes et incompris.*”⁵⁵⁷ And indeed, if Geoffroy portrays himself as developing his “synthetic notions” in complicity with his friend, Balzac would reciprocate by dedicating the 1843 edition of *Le Père Goriot* to Geoffroy and by foregrounding the naturalist’s notion of unified science in the “Avant-propos” to the *Comédie humaine* (1842). In the “Avant-propos” Balzac famously construes the entire *Comédie* as an attempt to work out the details of Geoffroy’s physiological law of the “unity of composition” in fictional form, and additionally vaunts the conception of matter in which Geoffroy grounded his physiological ideas, the so-called law of “attraction *soi pour soi.*” Though this law sought to describe life itself as an effect of material

⁵⁵⁶ “Nothing happens in living Nature that does not bear some relation to the whole.” Johann Wolfgang von Goethe, “The Experiment as Mediator between Object and Subject,” *Goethe*, vol. 12, *Scientific Studies* (New York: Suhrkamp, 1988), 15.

⁵⁵⁷ Étienne Geoffroy Saint-Hilaire, *Notions synthétiques, historiques et physiologiques de philosophie naturelle* (Paris: Dénain, 1838): 58-59.

attraction, it harmonizes with the spiritualist impulse present in *Séraphîta*, for instance, as Balzac insists. “*La proclamation et le soutien de ce système,*” he proclaims, “*en harmonie d’ailleurs avec les idées que nous nous faisons de la puissance divine, sera l’éternel honneur de Geoffroy Saint-Hilaire, le vainqueur de Cuvier sur ce point de la haute science, et dont le triomphe a été salué par le dernier article qu’écrivit le grand Goethe.*”⁵⁵⁸

By means of these mutual borrowings, Geoffroy Saint-Hilaire and Balzac articulate a common agreement on the need to reform what they saw as the cautious, increasingly piecemeal work of the positive sciences, bent on the proliferation of narrowly specialized facts. But in citing each other, they additionally *enact* the kind of exchange among literary, scientific and philosophical figures which they viewed as crucial to realizing a new scientific era. This textual crisscrossing reflected and in turn fomented an impulse agitating the streets and salons of Paris in the eighteen-thirties, an increasingly pronounced urge to redefine the means and ends of official science. For if a certain mysticism had suffused the life of the capital since the days of Mesmer at least, the *esprits synthétiques* cited by Geoffroy shared in the resurgence of Mesmerist, somnambulist and illuminist beliefs that marked the inception of the July Monarchy.⁵⁵⁹ In their opposition to the official sciences, these figures often wished not to abolish the sciences absolutely, but rather, like Balzac and Geoffroy Saint-Hilaire, to fold them into a transcendental whole, expanding the empirical techniques of the exact sciences to encompass a gamut of vital or spiritual intangibles. A diversity of “synthetic notions” sprouted up across the capital, at sites like the salon maintained by Geoffroy Saint-Hilaire himself, attended by a bevy of notables including George Sand and Edgar Quinet, or the headquarters of the newspaper *Le Globe*, composed of disciples of the comte de Saint-Simon.⁵⁶⁰ Though the figures associated with these various sites differed from one another in many ways, they all faulted the positive sciences for being too careful rather than for being too bold, and correspondingly envisioned the transformation of Laplace’s neo-Newtonian science into what might be called a “hyper-Newtonian” order. If the exact sciences had called on the example of Newton in their aim to mathematize the microcosm, these philosophers insisted on the need to extend Newton’s law of attraction beyond the planets and particles to which it had thus far been applied, to intangibles like animation, will, or thought. Far from denying science, they envisioned outdoing it on its own terms.

This chapter arises out of a desire to know why and how this diverse array of cultural actors arrived at similar notions of vital fluids, laws of vital attraction, social physics, and so on. As George Canguilhem contends in the essay “Thought and the Living,” we often presume that there is a “fundamental conflict between knowledge and life,” between the rational and the mystical, the order of the object and that of the subject. In that light, Canguilhem continues, “we are then left with no choice except that between a crystalline (i.e. transparent and inert) intellectualism

⁵⁵⁸ Honoré de Balzac, “Avant-propos” to the *Comédie humaine*, vol. 1 (Paris: Gallimard, 1976), 7.

⁵⁵⁹ See Robert Darnton, *Mesmerism and the End of Enlightenment in France* (Cambridge, MA: Harvard University Press, 1968): 140; and Theresa Levitt, *The Shadow of Enlightenment: Optical and Political Transparency in France, 1789-1848* (Oxford: Oxford University Press, 2009): 106.

⁵⁶⁰ See “Le prophète Geoffroy Saint-Hilaire, George Sand et les saint-simoniens,” *Histoire et nature* 1 (1973): 47-66; and Alan Spitzer, “The *Globe*: Flagship for a Generation,” *The French Generation of 1820* (Princeton, NJ: Princeton University Press, 1987): 97-128.

and a foggy (at once active and muddled) mysticism.”⁵⁶¹ Yet, in spite of the sometimes mystical cast of their assertions, these thinkers seemed intent on forging conceptual entities that partook of both elements: Geoffroy’s law of attraction expressed how particles combined to form animated bodies; Balzac’s notion of “material thought” raised the specter that the empirical sciences might one day manifest intellection itself; Comte envisioned history as culminating in the laws governing human relations. For Canguilhem, knowledge and life reach a truce when knowledge incorporates life into the conditions of its own practice, considering life as a determining factor in the character of the knowledge spontaneously produced. Many of these nineteenth-century thinkers invoke a similarly slippery self-reflexivity; Geoffroy’s vital materialist law of attraction casts thought as an effect of material Nature which in turn reflects on that Nature, and Balzac’s notion of material thought proposes that the object and the agent of thought are one and the same. But what compelled these thinkers to imagine that such figments of vital or spiritual Nature would one day be substantialized? That the language of the sciences would one day rise to the challenge of articulating these figments in empirical form?

The positive sciences themselves are perhaps one source of an explanation for these ambitions. The proponents of a synthetic ideal were as awed by the advances of the positive sciences as anyone else, enthused by inventions as miraculous as the battery or the daguerrotype. Moreover, the epochal magnitude of the rupture these sciences had effected in supplanting hermeneutic discourse only stimulated the imagination of yet more epoch-making change, the incidence of a new language as different from “representation” as representation was from hermeneutics. But this supersessive language would be derived from the sciences of representation themselves, forged in the mathematization of unorthodox objects. This hyper-Newtonian perspective put the advocates of synthesis at odds with their positivist contemporaries, but did not correspondingly establish them as representatives of what Foucault identifies as a literary “counter-discourse.” In *Les mots et les choses*, Foucault frames literature as a counter-discourse insofar as it adopts a regime of analogical correspondences, forming an exception to the general regime of representation and consequently forfeiting any scientific pretensions.⁵⁶² Yet even when uttered in works of a characteristically literary turn, including those written in a fictional mode, the language of synthesis insists on its “scientific” substance. In the terms imagined by the thinkers of synthesis, this substance was not limited to the kinds of knowledge associated with poetic intuition, the “*mode particulier de connaissance*” that in Paul Bénichou’s words made Romantic poetry the “*rivale, émule ou haute auxiliaire de la religion*,” on the one hand, and the “*ennemie de la science moderne*,” on the other.⁵⁶³ Though modern science may have been predicated on the “*exclusion formelle de la connaissance analogique*,” the partisans of synthesis neither limited themselves to generating analogical knowledge nor rejected positivist modes of representation in turn. Instead, they wished to subordinate these modes to a new scientific ideal, overcoming the divide between vital and social phenomena on the one hand and purely physical

⁵⁶¹ George Canguilhem, *Knowledge of Life*, ed. Paola Marrati and Todd Meyers, trans. Stefanos Geroulanos and Daniela Ginsburg (New York: Fordham University Press, 2008), xvii.

⁵⁶² Michel Foucault, *Les mots et les choses: une archéologie des sciences humaines* (Paris: Gallimard, 1966), 58-59.

⁵⁶³ Paul Bénichou, *Romantismes français*, vol. 2, *L'école du désenchantement* (Paris: Gallimard 2004), 2008 and 2012.

phenomena on the other, between scientific specialities, and between philosophers and the practitioners of the positive sciences.

For Geoffroy Saint-Hilaire, synthesis meant dissolving the distinction between physics and physiology, living and purely physical objects. Synthetic philosophers demanded, he writes, “*l'avènement d'une doctrine unitaire qui devienne la conciliation et qui opère la fusion des deux physiques si mal à propos disjointes, la physique des corps bruts et celle des corps vivans.*”⁵⁶⁴ In Geoffroy's view, experimental physiology, comparative anatomy and other positive life sciences artificially isolated the “life” of the organism from its physical being, unjustifiably ejecting the question of just how living matter differed from non-living matter beyond the bounds of legitimate science. Throughout the eighteen-thirties and -forties, Balzac argued for a similarly comprehensive conception of science, predicated on closing the gap between vital and non-vital phenomena. “*Le poète pour être complète,*” we read in the “Introduction” to the *Études de moeurs* (1835), “*doit être le centre intellectuel de toute chose, il doit résumer en lui les lumineuses synthèses de toutes les connaissances humaines.*”⁵⁶⁵ In overcoming the divide that pitted Cuvier against Laplace, the anatomist against the physicist, this figure, Balzac predicts, would succeed in lending “*une consistance mathématique,*” to the study of nervous fluid, magnetic effects, somnambulism and other phenomena of the will.⁵⁶⁶

In Chapter One, I tried to show that the anti-Newtonian rhetoric of Bernardin de Saint-Pierre corresponded to an effort to maintain the grip of the centuries-old virtue of “admiration” on the natural sciences and philosophy; while in Chapter Two I argued that the neo-Newtonian rhetoric of Parisian *physiciens géomètres* like Laplace and his disciples effectively loosened that grip and instituted the ideal of an “exact” science in its place. In this chapter, I show that the reign of the exact sciences encountered yet more resistance during the nineteenth century, in the form of a new ideal of scientific production that rose to contest and perhaps to supersede it. Maximizing certain kinds of knowing while minimizing others, coordinating the relationship between knowledge and knower, “synthesis,” too, fits the description of what Lorraine Daston and Peter Galison term an “epistemic virtue.” Like the rhetorics of “admiration” or “exactitude,” the rhetoric of “synthesis” conveys both an epistemic ideal and a sense of the identity of the corresponding knower. As the writings of Geoffroy and Balzac have already begun to suggest, this virtue's most distinctive epistemic imperative, I would argue, is the assumption that Nature constitutes a unified whole. While each of the other virtues presuppose the unity of Nature in their own ways, synthesis raises this assumption to a primary rule, while transforming the terms according to which “unity” had been understood. “Admiration” incorporated the assumption of Nature's unity by perpetuating a hermeneutic discourse in which Nature takes on the character of an infinitely expandable grammar, hence offering grounds for enfolding human language in the nat-

⁵⁶⁴ *Notions synthétiques*, 58.

⁵⁶⁵ Félix Davin, “Introduction aux *Études de moeurs*,” in Charles de Lovenjoul, *Histoire des oeuvres de H. de Balzac* (Paris: Calmann Lévy), 58. Though this “Introduction” was composed by Balzac's protégé, the young writer Félix Davin, most historians agree that it was directly inspired if not partially dictated by Balzac himself. It is also thematically consistent with Balzac's work, given the construal of the poet as a “center,” an invocation of the dispersal of individuality in milieu which we will see reiterated in *La peau du chagrin*, *Louis Lambert* and other works.

⁵⁶⁶ Honoré de Balzac, “Lettre à M. Ch. Nodier sur son article intitulé “De la palingénésie humaine et de la résurrection,” *Oeuvres diverses*, vol. 2 (Paris: Gallimard, 1996), 1214.

ural order; “exactitude” understands Nature’s unity as a guarantee of its regularity and constancy, conditions that ground the search for universal laws. “Synthesis,” on the other hand, construes Nature’s unity as implying that all phenomena proceed from the very same causes and must therefore be described by the same laws. The “whole” of Nature was a horizon, which might steadily be approached, and the proponents of synthesis brought varying levels of optimism and visionary zeal to imagining the character and implications of Nature as a whole, the means to approach it, and the time frame it would take to get there. The difficulty or impossibility of developing this assumption in empirical terms largely limits the proponents of synthesis to prophesying the advent of a new scientific mode, without being able to practice the mode itself. This deferral of synthetic language arises from both intrinsic and historical conditions, relating to the visionary character of the ideal itself and the cultural entrenchment of the positive sciences. While the “prophet” is central to the initiation of symbolic revolutions of all kinds, as Pierre Bourdieu shows, prophecy seems the characteristic mode of synthesis, a way of affirming the unity of Nature while deferring its expression in empirical terms.⁵⁶⁷

While the sciences of “admiration” presumed the inherent commensurability of the human and natural orders, providentially guaranteed, and the exact sciences generally isolated the self from the scene of knowledge-production, the sciences of “synthesis” set in motion a dialectic between self and Nature, grounding the advent of the kind of knowledge they sought in transformations in both the human individual and in the human species, and effectively binding the epistemic and ethical elements of synthesis in the process. If the partisans of synthesis fall short of realizing an actionable scientific program, this is an effect not only of the difficulty of displacing or altering the Parisian positive sciences in their heyday but also of the dynamics supposed by the alternative notion of “progress” that many of them espoused. While the partisans of positive science viewed their mission as the accumulation of enduring facts, the synthetic philosophers frequently imagined “knowing” as a permanent revolution in which knowledge transformed the knower and the knower generated supersessive knowledge in turn. Given this self-reflexive element, the difficulty of arriving at a definitive answer to the questions they posed is drafted into the “constitution” of the virtue itself.⁵⁶⁸

Balzac’s nod to “*le grand Goethe*” in the “Avant-propos” evokes the synthetic position’s debt to Goethean science, including the element of self-reflection Goethe often foregrounded. For Goethe, Nature was rightly conceived as a dynamic whole, whose action engulfed the natural philosopher as well as his objects of observation. In the essay “Judgment through Intuitive Perception,” for instance, Goethe contrasts a dynamic, self-reflexive science with the fixed conditions of Kantian philosophy, affirming that afflatus Kant imagines to be possible in the moral realm can take shape in the intellectual realm, as well. “In the moral area,” writes Goethe, of

⁵⁶⁷ For a brief elucidation of the relationship between the “prophet” and symbolic revolution in Bourdieu’s thought, see *Méditations pascaliennes*, 103-09.

⁵⁶⁸ For Bourdieu, the “constitution” of the field is the principle which lends it its specific difference from any other field, a principle at once arbitrary and necessary. “L’arbitraire est aussi au principe de tous les champs, même les plus “purs”, comme les mondes artistique ou scientifique: chacun d’eux a sa “loi fondamentale”, son *nomos* (mot que l’on traduit d’ordinaire par “loi” et qu’il vaudrait mieux rendre par “constitution”, qui rappelle mieux l’acte d’institution arbitraire, ou par “principe de vision et de division”, plus proche de l’étymologie).” *Méditations pascaliennes* (Paris: Éditions du Seuil, 1997), 116.

Kant's philosophy, "we are expected to ascend to a higher realm and approach the primal being through faith in God, virtue, and immortality. Why should it not also hold true in the intellectual area that through an intuitive perception of eternally creative nature we may become worthy of participating spiritually in its creative processes?"⁵⁶⁹ This conception of intellectual growth seems all the more feasible to Goethe, given that Kant himself posits the existence of an intuitive perception of Nature. In the *First Critique*, Goethe recalls, Kant evokes the existence of "an understanding which being, not like ours, discursive, but intuitive, proceeds from the *synthetical-universal* (the intuition of the whole as such) to the particular, i.e. from the whole to the parts" ⁵⁷⁰ For Goethe, Kant's insistence that such an understanding can only be notional for the human intellect, not real, is inexplicably arbitrary. The human mind *can* experience an intuitive perception of the whole, he believes, an understanding with both moral and intellectual implications. The intellectual afflatus which Goethe designates advances the thinker's moral being, even as moral growth advances the thinker's intellectual faculties, engendering both knowledge of Nature and the capacity to participate "spiritually," as Goethe says, "in its creative processes."

Goethe's conceptions of an "eternally creative Nature" and of a kind of intuition that might reveal it to us powerfully shaped the articulation of a synthetic position in France. Geoffroy's doctrine of the unity of composition in animals paralleled Goethe's own studies on the metamorphosis of plants, where in each case the gradual unfolding of an original archetype drove changes in organic form over time. Along with Goethe, the French thinkers believed that it was high time to correct the balance between the practice of analytic modes and that of synthetic ones, to move away from the eighteenth century's compulsion to reduce Nature to its component parts and to renew the search for ways of conceiving natural wholes, to "restore to the human spirit its ancient right *to come face to face with nature*," as Goethe puts it, no longer alienated by a professional scientific caste and their technical instruments.⁵⁷¹ And just as with Goethe, they often found the experience of coming face to face with Nature to entail more than a simple confrontation between subject and object, but rather set the initiation of a dynamic in which one might recognize oneself in Nature and Nature in oneself. The dynamism and reflexivity of Goethean science is encoded in what the synthetic thinkers frequently refer to as an "*esprit progressif*," where the ongoing dialectic between knowledge and knower and Nature's transformations in time are pitted against the fixed representations and regular Nature of the "*esprits positifs*." Like Goethe in his work on plants, the Geoffroy of the *Notions synthétiques* and the somewhat earlier *Études progressives d'un naturaliste* (1835) seeks to convey not a collection of static representations but a means of perceiving Nature as a dynamic process.⁵⁷² And Balzac, too, develops this motif, vaunting the ideas of Goethe and Geoffroy but also highlighting the "abyssal" nature of self-reflexive knowledge, the vertiginous trip one takes en route to the far off synthesis.

⁵⁶⁹ "Judgement through Intuitive Perception," *Goethe*, vol. 12, *Scientific Studies* (New York: Suhrkamp, 1988), 31.

⁵⁷⁰ *Ibid.*

⁵⁷¹ "Analysis and Synthesis," *Goethe*, vol. 12, *Scientific Studies* (New York: Suhrkamp, 1988), 48. Goethe's italics.

⁵⁷² Though Daston and Galison assimilate Goethe to the regime of the epistemic virtue "truth-to-Nature" this focus on Nature as a dynamic creative force and on the incorporation of the observer as an element within this force suggest the degree to which he differs from the "atlas makers" of the virtue. See *Objectivity* (New York: Zone Books, 2007), 69-70.

In this respect, the motif of self-reflexivity often takes on a fatalistic character in Balzac's work, similar to that adopted by "disenchanted" thinkers like Sénancour or Nodier; like these predecessors, Balzac frequently juxtaposed the weakness of human faculties with the grandeur of the ideals humankind was nevertheless saddled with conceiving. In texts like *La recherche de l'absolu* (1834) and *Le chef-d'oeuvre inconnu* (1831), the intuition of the whole consumes Balzac's protagonists, rather than elevating them spiritually as the pacific Goethe envisaged. In the essay-tale "La Théorie de la démarche" Balzac contrasts the abyss invoked by self-reflexive science with the fixity of positive knowledge. "*Un homme devint fou,*" declares the narrator, "*pour avoir réfléchi trop profondément à l'action d'ouvrir ou de fermer une porte.*" The knowledge of where motion comes from in one's own body supposes an imagination of the organic whole that is oneself, an impossible ambition. And if, as the narrator of this tale pursues, "*il n'y a pas un seule de nos mouvements, ni une seule de nos actions, qui ne soient un abîme, où l'homme le plus sage ne puisse laisser sa raison,*" the savant, as he has it, ignores such questions altogether, measuring what can be measured and leaving the rest aside: "*cet abîme a dix-huit cent deux pieds de profondeur,*" pronounces Balzac's savant, "*la température du fond est de deux degrés plus chaude que celle de notre atmosphère.*"⁵⁷³ In spite of the fatalism of the motif of the abyss, Balzac, like Goethe or Geoffroy Saint-Hilaire construes right knowledge as fundamentally self-reflexive in character. What is most interesting about the synthetic ideal is what happens on the way to its realization; for if the realization of the ideal can be imagined as a near-apocalyptic event, these progressive or self-reflexive dynamics cast its realization not as an accumulation of knowledge but as a process, an emphasis on creative action that sets this virtue apart from any other scientific ideal in modernity.

The motif of self-reflexivity binds the epistemic and ethical elements of synthesis in a distinctive way. Within this dual epistemic and ethical order, the intuition of a creative, unified Nature guides the epistemic element of synthesis, while the notion of "genius" qualifies its ethical content. The notion of intuition which characterizes Goethe's re-writing of Kantian judgment evokes the faculties and disposition of the genius as a student of Nature, a conception which partakes in a broader redefinition of "genius" as an element in the investigation of Nature in the seventeen-nineties and the first decades of the nineteenth century. As Simon Schaffer argues, the notion of genius produced in this period's historiographies of science arbitrated the transition from "natural philosophy" to "science" as we know it, underpinning the economy of discovery which still orders the attribution of scientific distinction.⁵⁷⁴ Yet as he also acknowledges, the notion of genius underwrites conceptions of scientific inquiry which conflicted with those of the positive sciences and remain at odds with our own expectations. As he observes, the motifs of intellectual progress and self-reflexivity often occur together in the writings of Romantic philosophers and natural philosophers, in ways which seem quite foreign to our own assumptions about scientific practice. In Alexander von Humboldt's reports on the electrical experiments he undertook on his own body, for instance, he calls attention to the possible interaction of electrici-

⁵⁷³Honoré de Balzac, "Théorie de la démarche," *Comédie humaine*, vol. 12 (Paris: Gallimard, 1981), 265.

⁵⁷⁴ Simon Schaffer, "Scientific Discoveries and the End of Natural Philosophy," *History and Philosophy of Science* 16.3 (1986), 387-420; and "Genius in Romantic natural philosophy," *Romanticism and the Sciences*, ed. Andrew Cunningham and Nicholas Jardine (Cambridge: Cambridge University Press, 1990), 82-98.

ty and the agent of thought in his mind; in a similar mode, the Danish experimentalist Hans Christian Ørsted claimed that “the development of the Earth was the same as that of the human mind,” and that “the development of science is itself part of natural science.”⁵⁷⁵

The notion of genius that pervades the works of Balzac and Geoffroy Saint-Hilaire reflects these constructions, and often inflects them with a fatalistic bent. For each, discovery was something like revelation, the incidence of an unsolicited “idea.” This notion of the “idea” as an unprompted and sometimes dangerous matrix of insights about Nature is abundantly illustrated in Balzac's “Théorie de la démarche,” in which the narrator recounts the inception of a scientific theory of walking. In this story about the advent and development of an idea, the protagonist of the “Théorie” is in many respects the “theory” itself, since this theory is personified as a fickle woman (among other figures) and its life-course determines the content of the narrator’s ideas about how walking and other kinds of human motion correlate with the walker’s thoughts. Beginning as what the narrator calls the “*sublime paroxysme de l’intelligence fouettée*,” the idea continues to disrupt the the life of the person who hosts it, as it grows in the mind. Ideas maintain a grip on you, laments the narrator, even when you try to ignore them: “*ce sont vos idées qui vous brisent*,” he writes, “*vous lassent, vous sanglent des coups sifflants aux oreilles, et contre lesquels vous regimbez*.”⁵⁷⁶ This conception of inspiration likewise colors Geoffroy Saint-Hilaire’s account of the circumstances under which he first conceived of a generalized law of attraction. “*Je remplis un devoir de sincérité et d’honnête homme*,” he writes in the *Études progressives d’un naturaliste*, “*dans le soin que je prends en racontant cet évènement de ma vie, et en me montrant posé un instant sous l’action presque exclusive de mes sens intérieurs: c’est livrer un fait d’une information scientifique que de faire connoître que mes sens extérieurs avoient, en effet, été momentanément à demi paralysés. Ce ne fut donc qu’à la suite de ces opérations de l’esprit, qu’à peine j’avois été le maître de gouverner, que le principe de l’attraction de SOI pour SOI me fut révélé, et qu’ils s’est trouvé définitivement former la plus haute conséquence de mes vues et de mes aperçus sur tous les branches des sciences; vues que j’ai recueillies en tel nombre, que je n’essaie point d’en présenter l’énumération*.”⁵⁷⁷ As in Balzac, the idea arises for Geoffroy as a paralysis or paroxysm, a moment of violence which is itself worthy of scientific study and which proves to be the matrix of a swarm of deductions, the “*vues*” and “*aperçus*” whose abundance Geoffroy can barely capture.

What demarcates the French partisans of synthesis from Goethe, their hero, is the role they envision for positive science in the science of the future. If a given epistemic virtue inevitably enters into relationships with other virtues, as Daston and Galison affirm, defining themselves against one another, sometimes co-existing with each other, sometimes even reshaping each other, the relationship between “synthesis” and “exactitude” proves particularly intimate and sustained. The dynamic, self-reflexive science developed by Goethe remained profoundly incommensurable with the exact sciences. The universal knowledge it wished to achieve did not

⁵⁷⁵ “Genius in Romantic natural philosophy,” 94.

⁵⁷⁶ “Théorie de la démarche,” 264.

⁵⁷⁷ Étienne Geoffroy Saint-Hilaire, *Études progressive d’un naturaliste pendant les années 1834 et 1835* (Paris: Roret, 1835), 150.

take the form of fixed mathematical laws, and mathematics served most importantly as an ideal of rigor in the drawing of relations among natural phenomena; meanwhile, for Goethe, the human body, not artificial matériel, constituted the most “exact” possible instrument.⁵⁷⁸ Most importantly, the relationship Goethe established between analytic and synthetic modes resembled systole and diastole or the mechanics of breathing, alternating between periods in which synthesis was necessary and others when the analysis of the general intuition might be the requisite response. “A century has taken the wrong road if it applies itself exclusively to analysis while exhibiting an apparent fear of synthesis,” writes Goethe in an essay entitled “Analysis and Synthesis”: “the sciences come to life only when the two exist side by side like exhaling and inhaling.”⁵⁷⁹ In the image of “sciences coming to life,” Goethe evokes the figure of knowledge incorporating life into the conditions of its production, in terms similar to those adopted by Canguilhem. If science for Goethe participates in a dynamic like that of exhaling and inhaling precisely because it is a function of living things, the French partisans of synthesis often press this gentle alternation into a sort of anxious superimposition, envisioning an application of analytic means to synthetic objects in the mode of Balzac’s material thought or Comte’s social physics.

These concrete, perhaps neurotic conceptions express the prevalence of exact means and modes in synthetic thought, even when it putatively superseded them. The categories of the positive sciences form their point of departure, in most cases, structuring their vocabulary and conceptions in spite of their antipathy for positive thought as such. The motif of the exact knowledge of vital or spiritual intangibles that pervades the rhetoric of synthesis captures this pairing of positivist means and heterodox ends; Geoffroy wants to mathematize the forces responsible for vital matter, while Balzac wants to lend “*une consistance mathématique*,” as we have seen, to the study of vital fluid. This penchant for applying positivist means to heterodox objects ended up producing wholly novel conceptions of vitality. If the synthetic thinkers inherit life itself as a quasi-transcendental entity, as Foucault puts it, they leave it as a queer “substance” in the case of Balzac or as an effect of certain material assemblages in the case of Geoffroy Saint-Hilaire. In each case the motif of the “representation of life itself” entails a redefinition of both “representation” and “life.” Where Kant had contrasted the necessarily plodding, discursive character of human understanding with the immediate intuition of the whole, the proponents of synthesis imagined the advent of a discourse that would be adequate to intuition, a language of life itself. And life itself comes under pressure from the imperative to represent it, no longer the discrete, obscure entity precipitated from the animal body by positive science but dispersed and manifested in various ways. The language of life itself often posited by the proponents of synthesis is neither language as we know it, nor life itself as the positive sciences imagined it to be.

⁵⁷⁸This is the message of one of Goethe’s *Maxims and Reflections*: “Insofar as he makes use of his healthy senses, man himself is the best and most exact scientific instrument possible. The greatest misfortune of modern physics is that its experiments have been set apart from man, as it were; physics refuses to recognize nature in anything not shown by artificial instruments, and even uses this as a measure of its accomplishments.” *Scientific Studies*, 311.

⁵⁷⁹ *Ibid.*, 49.

As the notion of “genius” suggests, the experience of a transcendent intuition of such a language is all the more persuasive the more unexpected, the more visionary it may be. Along with the self-reflexive pursuit of the ideal, the paroxysms of intuition recounted by Geoffroy or Balzac characterize the virtue of synthesis in much the same way that the experience of providential “wonder” had characterized the virtue of admiration or that the values of “rectitude” characterized the practitioners of exactitude. Such moments of inspiration order the personae of synthesis just as these other central values order the personae common to their respective virtues. The interrelated figures of the “martyr” and the “prophet” further typify the rhetoric of synthesis further, casting martyrdom as the physical suffering attendant on “hosting” the idea as well as the corollary to the themes of displacement and persecution evoked by the obligation to make the idea known to the wider world. The prophet is the figure who heralds the institution of a new order, breaking with orthodoxy and suffering the temporal consequences of doing so. In the rhetoric of synthesis, prophecy pertains specifically to the advent of a new language capable of answering, as I am suggesting, both the imperatives of empirical science and the knowledge of ideation, volition and other intangibles. To the proponents of synthesis, it did not matter whether the development of such a language was imminent or not, or even whether a philosophy of history could be invented to predict how and when this language might come about; the necessity of constituting these intangibles as scientific objects sufficed to justify the ambition to them. Besides, as the logic of genius suggested, a superior figure would one day appear on earth to achieve this synthesis, an event sometimes conceived as an inevitable ramification of the creative power of Nature itself.

Given the predominance of this motif of prophecy in the rhetoric of synthesis, the personae we can identify with the virtue pertain on the one hand to the genius who is prophesied and on the other hand to the prophets themselves. The genius who is prophesied takes on a mystical, nearly apocalyptic aura, the figure who might one day devise Geoffroy’s law of vital material attraction, for instance, or the “*poète*” evoked in the “Preface” to Balzac’s *Études philosophiques* as “*le centre intelligent de toute chose.*” As for the prophets themselves, they affirm the values of synthesis in a world of increasing specialization, a conjuncture that lends them what Pierre Bourdieu calls a divided or broken habitus, a “*habitus clivé.*”⁵⁸⁰ In Geoffroy’s later works, he confesses to having concealed his conception of the law of “*soi pour soi*” for decades, never daring to disclose it in print; and its subsequent rejection by the scientific establishment compels him to abandon the scientific field in search of a community of like-minded thinkers. For his part, Balzac integrates his scientific conceptions into his novels and other writings, yet few readers or critics seem to have acknowledged him as the synthetic thinker he intended to be. Both Geoffroy and Balzac straddle scientific, literary and philosophical worlds, belonging fully to none.

Their unresolved personae, cloven in two or three, diagnose the irresolution of the virtue itself. The very notion of a self-reflexive science suggests the provisional, changeable notion of the ideal, and the tentative coalescence of a class of synthetic thinkers around 1830 implies that it remains in an unfinished state at that date, still ill-defined per se. Unresolved as this tension be-

⁵⁸⁰ See, for instance, *Méditations pascaliennes*, 190.

tween mathematical means and vital ends, matter and life, or the scientific and literary fields remained, synthesis might perhaps be best understood as both a progressive virtue and a virtue in progress, an ideal which placed an emphasis on the process of knowing and an ideal which was in the process of acquiring the consistency and coherency we have remarked in the virtues of “admiration” and “exactitude.” Yet if the element of deferral implied by this notion of progress distinguishes synthesis from other epistemic virtues to some degree, the difference is by no means absolute. As Daston and Galison observe, every virtue remains an ideal which its practitioners strive but inevitably fall short of fulfilling; exactitude posits an asymptote toward absolute precision that could never be followed to its terminus, and the proponents of objectivity could never have achieved the complete neutralization of self they desired. In this light, the deferral which gives synthesis its curious air may only be a matter of the degree to which the ideal and its fulfillment remained at variance. In the meantime, the virtue of synthesis ordered the ideals and lives of a broad and otherwise diverse constituency of cultural agents, constituting the conditions of legibility of the works of Geoffroy and Balzac, Saint-Simon or Comte. Whether or not the synthesis these figures imagined is really feasible, it was their willingness to *believe* in it that lifts it to the status of an epistemic ideal.

The broad and diverse crowd of thinkers who espoused variations of a synthetic ideal suggests that this ideal was in the process of becoming a social rule, a common ground for cultural production. No discrete “field” associated with this rule ever finally coalesced, it seems; yet in the convergence of a variety of thinkers toward a similar ideal I think we can distinguish the beginnings of field formation. In Bourdieu’s sociology of cultural production, the field emerges when an ideal like synthesis galvanizes a measure of collective belief; and the “point of view” corresponding to this belief is instituted insofar as it organizes the cultural production and the personal dispositions of a group of actors. As Bourdieu writes, “*Les structures de la pensée du philosophe, de l’écrivain, de l’artiste ou du savant, donc les limites de ce qui s’impose à eux comme pensable ou impensable, sont toujours pour une part dépendantes des structures de leur champ, donc de l’histoire des positions constitutives de ce champ et des dispositions qu’elles favorisent. L’inconscient épistémique, c’est l’histoire du champ.*”⁵⁸¹ In Bourdieu’s terms, both admiration and exactitude were “instituted” points of view, in that they effectively organized scientific production in their time and endured for long enough to acquire a historical memory. But the initial emergence of a wholly new field departs from this scenario, since no field history as such exists to inform an “epistemic unconscious.” The new field appropriates objects and theoretico-symbolic resources from the formations it wishes to supplant, while also realizing altogether new instances of such elements. At the inception of exact science, for instance, the new formation drew on the mathematics of *géomètres philosophes* like d’Alembert and Condorcet, but redistributed this inheritance according to the terms suggested by a new ideal, notably by applying mathematics to the objects of the microcosm. Though the virtue of synthesis countered the trend toward specialization advanced by the exact sciences, it assimilates aspects of other fields in much the same way, integrating elements of the philosophy, sciences and literary art of the preceding decades into a point of view whose vistas and blind spots are nevertheless all its own. Despite borrowing mathematical resources from the exact sciences, for instance, and notions of

⁵⁸¹ Ibid., 120.

“inspiration” or intuition from the sciences, philosophy and the arts, the point of view of synthesis is incommensurable with the points of view of each of these fields, illusory for the agents working within them just as the point of view of these fields is illusory to the proponents of synthesis. As we have seen, the points of view of exactitude and admiration shared so little in common that no real debate could take place between them, on a given scientific issue. In much the same way, the point of view of synthesis departs so substantially from that of the positive sciences and certain positions in the other fields from which it draws that no spontaneous mutual recognition of the viability of these points of view is able to take place.

The tendency of the synthetic ideal to appropriate the symbolic resources of existing fields is part of what gives the virtue its “total” scope. If the exact sciences assimilated certain elements of the culture of letters, they did so in order to initiate a narrower, more self-enclosed field; but the assimilation of elements of the sciences, philosophy and art on the part of “synthesis” is meant to replace these narrower fields with a general category of cultural production. While the virtue of “admiration” had sustained just such a general category under the guise of “letters,” the proponents of synthesis find new grounds for organizing the gamut of lettered pursuits. The effectuation of a new regime of totality entailed reversing the processes of autonomization shaping each of its “rival” fields, a process of autonomization that had of course achieved a particularly advanced state in the sciences. Where the autonomization of the sciences was characterized by a scenario in which scientific producers’ competitors were also their primary clients, the proponents of synthesis envisaged expanding the population of scientific producers’ clients once more, to encompass non-specialists like themselves. In their view, the public had an important part to play in this process. While autonomous fields absorb external sanctions into the dialectic of positions which constitutes them, the persistence of the field as such hinges on the public’s acquiescence in the process of autonomization. Geoffroy and Balzac both offer grounds for why the public should refuse to legitimate the knowledge produced by scientific specialists. The rise of scientific coverage in the press gives Geoffroy a platform for airing his views publicly, and the publication of the *Études progressives* and the *Notions synthétiques* marks his determination to cease writing for the “*savans de profession*,” as he puts it, in order to reach a wider audience.⁵⁸² In the “Lettre à Nodier” (1832) and other articles, Balzac, for his part, makes known his reasons for objecting to the narrow specialization of the official Parisian sciences and outlines a science that would exploit the powers of professional savants as well as writers like himself. In the chapter ahead, I show that Balzac’s novels, for their part, can be construed as machines for producing public allegiance to a new scientific ideal.

As Geoffroy ended his career and Balzac began his, each sought to forge a public identity which embodied the imperatives of synthesis. The pattern of mutual acknowledgment apparent in their volley of epigraphs and dedications marks a degree of coordination in the articulation of what would otherwise be, for its novelty, an “impossible” position, an as yet non-legitimated public stance.⁵⁸³ This chapter examines just why Geoffroy and Balzac both came to believe that science was “one,” and how they imagined this unity might be effected. As I try to show, the

⁵⁸² *Notions synthétiques*, 28.

⁵⁸³ On the question of the impossible position, the “*position à faire*,” see “Comment lire un auteur?” in *Méditations pascaliennes*, 101-09.

convergence of Geoffroy's and Balzac's points of view on scientific inquiry exemplifies the processes by which the synthetic ideal became the *illusio* of a coalescing field. Beginning with a look at Geoffroy's trajectory from esteemed naturalist to scientific defector, I go on to examine how Balzac constructed his authorial identity in the early eighteen-thirties, working to expand the space of possibilities then encompassed by the literary field. Balzac's novel-writing practice became a powerful, if improbable means of promoting the synthetic ideal, and I go on to detail how Balzac's novels worked to produce public recognition for this ideal through a reading of *La peau de chagrin* (1831), one of the *Comédie humaine*'s earliest novels. While the texts we have examined in previous chapters have all been expository in nature, Balzac's production additionally compels us to ask how the mode of fiction might work to advance, as well as to formulate and develop, an epistemic point of view. In this reading of *La peau de chagrin*, I show that in Balzac's hands novelistic discourse embraces a variety of means for articulating and publicizing scientific notions, a mode of operation that becomes ever more sophisticated with the novel's integration into the cycle of the *Comédie humaine*. I conclude, finally by asking what Balzac's and Geoffroy's "moment" tells us about the prehistory of the regime of autonomy, when the array of fields typical of modernity had not yet been achieved. As the renewed affirmation of a total ideal, the convergence of Geoffroy and Balzac and others like them represented a crucial test for the drive toward autonomy, I maintain, a test that is often omitted from cultural histories of the nineteenth-century sciences and literature but which posed a substantial obstacle to their ongoing differentiation.

While the knowledge claims of synthetic writers, philosophers and savants have conventionally been dismissed as "scientistic," as arising, that is, from a misapplication of scientific means, the task prescribed by a cultural history of emergent fields is to fix the contours and gauge the intensity of the ideal, rather than to adjudge it per se. Even so, synthesis is surely not the least plausible ideal imagined by the species since it first ventured to "know." If the desire to know where life comes from or what thought really is seems outrageous in its ambition, the value of a question is not always determined, we might imagine, by the ease of an answer.

Though this chapter focuses primarily on the work of Balzac and Geoffroy Saint-Hilaire, the convergence of these two figures is just one possible means of telling the story of synthesis. Variations on the synthetic ideal prevailed among a wide and diverse population of French thinkers in the first decades of the nineteenth century, some directly or indirectly connected to these two thinkers, others not. The Charles Didier whom Geoffroy cites as author of an article entitled "Paris moderne," for example, was to know him through George Sand, a friend and fellow enthusiast of scientific reform.⁵⁸⁴ The article by Goethe which Balzac cites in the "Avant-propos" to the *Comédie humaine* appeared in one of the volumes of the *Livres des cent-et-un* (1831-34), a major editorial enterprise whose contributors included somnambulists, illuminists and other proponents of spiritualist science. As Paul Bénichou observes in *Le Temps des*

⁵⁸⁴ Bourdier, "Le prophète Geoffroy Saint-Hilaire."

prophètes, both “*la littérature de création*” (that is to say, poetry and fiction) and “*la littérature de doctrine*” of the first decades of the nineteenth century abound in attempts to define a new relationship between the scientific and the spiritual, one which frequently linked the progress of the sciences and of society in general to transformations in the conditions of production, or, alternately, to the organic progress of the human species. Insofar as this literature linked personal, social or phylogenetic transformations to the progress of knowledge, it exhibits the reflexivity that likewise inheres in Geoffroy or Balzac. But while Geoffroy or Balzac prophesied open-ended futures, progressive but not teleological, many French post-Enlightenment thinkers develop dogmas of social progress, terminating, as Bénichou puts it, in “*une coïncidence entre la vision scientifique des choses et le pronostic d’accomplissement d’une humanité idéale*”.⁵⁸⁵

Where Geoffroy and Balzac typically recognize scientific concerns to have their own determining logic, dogmatic, utopian thinkers like Charles Fourier (1772-1837), Claude Henri de Rouvroy, comte de Saint-Simon (1760-1825), and Auguste Comte (1798-1857) subordinate scientific interests to the well-being of humankind. For these three thinkers and others like them, the sciences’ highest calling was to usher in the era of an “ideal humanity,” a social order which each associated with the advent of a so-called social physics. In Fourier’s view, Newton’s force of attraction ordered motion in the “organic, animal and social worlds,” as well as in the material world, the analogical links among these worlds offering means, he thought, of arriving “*gradativement jusqu’au calcul des destinées universelles, ou détermination du système fondamental sur lequel furent réglées les lois de tous les mouvements présents, passés et à venir*.”⁵⁸⁶ Fourier’s writings thus realize in both the moral and the physical realms, the calculation of all probabilities that Laplace’s demon was meant to work out in a hypothetical mode in the physical realm alone.

Saint-Simon and Comte share Fourier’s enthusiasm for a social physics, as well as a more intensive knowledge of nineteenth-century physical science than Fourier himself possessed. Like Fourier, Saint-Simon envisions the generalization of Newton’s law beyond the physical order, as a means of mathematizing vital objects and social relationships. In the *Introduction aux travaux scientifiques du XIXe siècle* (1803), he insists on the inseparability of the physical and the moral orders, asserting, for example, that “*la pensée est une attraction matérielle: elle est un résultat du mouvement du fluide nerveux*.”⁵⁸⁷ Though Saint-Simon’s system is entirely predicated on Newtonian attraction, Saint-Simon criticizes Newton for failing to recognize the general scope of his own discovery. “*Newton, grand physicien, grand géomètre et grand astronome,*” declares Saint-Simon, “*n’a su ni généraliser, ni coordonner ses pensées; leur valeur philosophique lui fut entièrement inconnue.*” In Saint-Simon’s view, the philosophical content of Newton’s thought pertained to the “causes” of universal gravitation and not just to their apparent effects. By penetrating to the cause of attraction as a universal force, he thought, science would redeem Newton’s unfulfilled promise. “*Comme Astronome, il a tiré un grand parti de son idée sur la gravitation universelle; comme Géomètre, il a inventé les moyens d’en calculer les effets. Mais il n’a point*

⁵⁸⁵ Paul Bénichou, *Romantismes français*, vol. 1, *Le temps des prophètes* (Paris: Gallimard, 2004), 447.

⁵⁸⁶ Cited in Bénichou, *Le temps des prophètes*, 671.

⁵⁸⁷ Claude-Henri de Rouvroy, comte de Saint-Simon, *Introduction aux travaux scientifiques du XIXe siècle*, vol. 1, *Oeuvres choisies de C.-H. de Saint-Simon* (Brussels: Van Meenen, 1859), 170.

eu conscience de l'important de sa découverte; il n'a point vu que les phénomènes de toutes les classes étaient des effets de cette cause . . ."⁵⁸⁸ For Saint-Simon, moral and social life necessarily figure among the classes of objects subject to this cause, as the unity of Nature entails. As Bénichou writes, Saint-Simon "*entend que la méthode et les résultats des sciences physiques conquièrent effectivement la connaissance de l'être vivant, c'est-à-dire la physiologie, et, sur cette base, la vie morale réduite au jeu des organes, et la vie social qui en dépend.*"⁵⁸⁹

Though Comte ultimately broke with Saint-Simon, his positivist philosophy recapitulates Saint-Simon's conviction that the progress of the sciences would culminate in a social physics, and comports a systematization of scientific disciplines to promote the advent of this order. In the *Cours de philosophie positif* (1830), Comte lays out the task ahead with breathtaking optimism: "*Maintenant que l'esprit humain a fondé la physique céleste, la physique terrestre, soit mécanique, soit chimique; la physique organique; soit végétale, soit animale, il lui reste à terminer le système des sciences d'observation en fondant la physique sociale.*"⁵⁹⁰ For Comte, as for Fourier or Saint-Simon, the future social physics would be patterned on Newtonian cosmology; yet while Comte's forebears seem to imagine the law of social physics as a sort of variant or modification of the law of universal gravitation itself, Comte construes gravitation as a something like the model for the general sort of thinking the achievement of a social physics would require. The ultimate goal, Comte writes, would be to arrive at "*des lois naturelles invariables, dont la découverte précise et la réduction au moindre nombre possible*" would usher in a fully rationalized social order.⁵⁹¹

These thinkers' astonishing optimism comes into focus as a reaction to the limitations placed on thought by the modern positivist regime. Their disregard for these limitations echoes Goethe's response to Kantian philosophy, his refusal to consent to an order in which both the object (the "noumenon") and the transcendental subject were to remain fundamentally unknowable. Indeed, as reactions to Kantian philosophy or the regime of positivities, Goethe's position and that of the synthetic philosophers share a certain family resemblance. This likeness is perhaps a result of the commensurable ways in which, as Foucault observes, Kantian philosophy and the positivist regime presume the finitude of knowledge. Where Kantian philosophy posits both a transcendental object and a transcendental subject, the positivities of labor, life and language distribute transcendence on the side of the object alone; yet they arrive at a similar result insofar as they totalize the object, while placing limits on the knowledge that can be gained of it. "*Le travail, la vie et le langage apparaissent comme autant de "transcendants" qui rendent possible la connaissance objective des êtres vivants, des lois de la production, des formes du langage,*" Foucault writes. "*En leur être, ils sont hors connaissance, mais ils sont, par cela même, conditions de connaissances.* Corresponding to Kant's discovery of "*un champ transcendantal*" they nevertheless pertain only to the nature of the object, shaping the character of the knowing subject by implication alone. The positive unities "*totalisent les phénomènes et disent la cohérence a*

⁵⁸⁸ Ibid., 161.

⁵⁸⁹ *Le temps des prophètes*, 680.

⁵⁹⁰ Auguste Comte, *Cours de philosophie positive*, vol. 1 (Paris: Bachelier, 1830), 22.

⁵⁹¹ Ibid., 14. His emphasis.

priori des multiplicités empiriques,” Foucault continues; “mais ils les fondent dans un être dont la réalité énigmatique constitue avant toute connaissance l’ordre et le lien de ce qu’elle a à connaître.”⁵⁹² Foucault suggests here that the limits which the empirical positivities place on knowledge participate in constituting them as objects of knowledge; but thinkers like Saint-Simon or Comte react to this order by introducing strokes of intuition or philosophies of history which advance the knowledge of the object “en son être” without transforming the être posited for the object by this order.

The resemblance between Goethe’s position and that of the synthetic philosophers only goes so far, however. While Goethe rejects the limits placed by Kant on knowledge, and therein defines his against Kant to some degree, Goethean science is altogether innocent of the categories presupposed by the positivities, most pertinently of the positivist construction of “life itself.” Goethe’s thinking of organic form takes place within a dialectic between the observing subject and the animate object in which a mutual imbrication in the dynamic creative process of Nature preempts the “totalization” of the living phenomenon concomitant with the modern positive regime. In contrast, the synthetic philosophers assume the empirical positivities as a point of departure, deliberately or not, even as they each find ways to transcend the limits on knowledge presupposed by this regime. “L’évolution de l’espèce n’est peut-être pas achevée,” Foucault writes, voicing the position of these thinkers; “les formes de la production et du travail ne cessent de se modifier et peut-être un jour l’homme ne trouvera plus dans son labeur le principe de son aliénation, ni dans ses besoins le constant rappel de ses limites; et rien ne prouve non plus qu’il ne découvrira pas des systèmes symboliques suffisamment purs pour dissoudre la vieille opacité des langages historiques.”⁵⁹³ For utopians like Saint-Simon or Comte, the philosophy of history takes shape as a dialectical overcoming of these fundamental limits. “Annoncée dans la positivité,” Foucault affirms with regard to these utopian aspirations, “la finitude de l’homme se profile sous la forme paradoxale de l’indéfini; elle indique, plutôt que la rigueur de la limite, la monotonie d’un cheminement, qui n’a sans doute pas de borne mais n’est peut-être pas sans espoir.”⁵⁹⁴ As Foucault asserts, “progress” in these thinkers’ writings is only change within the order of the same, movement toward the limits of finite man.

Yet I would argue that while utopians like Comte or Saint-Simon unwittingly embrace this fundamental monotony, not all synthetic thinkers remain constrained by the limits placed on “man” by the positive order. For if Saint-Simon or Comte anticipate the advent of an “humanité idéale,” Geoffroy and Balzac envision the realization of the synthetic ideal in what might be called “post-human” terms. As Foucault contends, the emergence of the positivities heralds the appearance of “man” as a historical protagonist, a figure who remains central to the utopian eschatologies of Saint-Simon or Comte but is disfigured and refigured in the post-human prophecies of Geoffroy or Balzac. For Foucault, “man” guarantees the coherence of the regime of positivity; it is the form of human existence which corresponds to life, labor and language as conditions of knowledge. Though the positivities pertain to empirical objects, they incidentally but

⁵⁹² *Les mots et les choses*, 257.

⁵⁹³ *Ibid.*, 325.

⁵⁹⁴ *Ibid.*

quite organically realize man in a particular ontic form. “*Au fondement de toutes les positivités empiriques,*” Foucault writes to this effect, “*et de ce qui peut s’indiquer de limitations concrètes à l’existence de l’homme, on découvre une finitude—qui en un sens est la même: elle est marquée par la spatialité du corps, la béance du désir, et le temps du langage; et pourtant elle est radicalement autre: là la limite ne se manifeste pas comme détermination imposée à l’homme de l’extérieur (parce qu’il a une nature ou une histoire), mais comme finitude fondamentale qui ne repose que sur son propre fait et s’ouvre sur la positivité de toute limite concrète.*”⁵⁹⁵ Given that utopian eschatologists like Comte or Marx work within these fundamental limits, utopia for them constitutes the apotheosis of “man” in his current form rather than a passage into a radical otherness. The evolution of the species, the rationalization of conditions of production, and the search for a transparent language each power shifts in the knowledge of the empirical world without determining the transformation of the positivities themselves, or of the subject of transcendental knowledge in its positivist iteration.

As Foucault points out, Comte grounds the advent of an ideal humanity in the progress of empirical knowledge, while Marx grounds the truth and the value of the theory of history in the authority of philosophical discourse.⁵⁹⁶ In spite of this difference, however, they both locate the motor of history in advances in the means of production. The advent of social physics occurs thanks to transformations in the material bases of thought, in keeping with the development of the human mind and humankind’s correspondingly greater capacity to act upon Nature. “*Cet enchaînement de structures,*” notes Bénichou, of Comte’s philosophy, “*où le degré d’avancement de la connaissance détermine celui de la technique et des possibilités d’action sur la nature— nous dirions la productivité—, et où tous deux conditionnent les formes sociales, constitue l’essentiel de la prétendue réduction comtienne de l’ordre politique à la science.*”⁵⁹⁷ In Comte, the relationship between the progress of the natural sciences and of industry and the advent of the “subjective synthesis” remains ambiguous. The laws of the “*physique sociale*” which institute the subjective synthesis do not arise inevitably from the progress of the natural sciences but are in some sense “given” by Comte’s transcendent Philosopher. Even though Comte founds the truth of his discourse in the empirical world, as Bénichou notes, he ultimately resorts to casting inspiration or intuition as the source of the law itself. Neither Comte nor Saint-Simon have any doubt, Bénichou observes, that one can “*déduire d’une connaissance scientifique les fins de l’existence sociale,*” but, “*nécessairement impuissants à opérer cette déduction sans recourir à un principe extrascientifique, ils portent aussi allègrement l’un que l’autre cette contradiction.*”⁵⁹⁸

As Foucault observes, these philosophies ground the advent of an ideal humanity in transformations in the conditions of production. But I would argue that in certain cases, synthetic philosophers prophesy reformulations in “man” himself as a historical protagonist, particularly in tandem with reconceptualizations of “life itself.” Where Saint-Simon or Comte imagine the indefinite progression toward the human limit as an effect of changes in the conditions of produc-

⁵⁹⁵ Ibid., 326.

⁵⁹⁶ Ibid., 331.

⁵⁹⁷ *Le temps des prophètes*, 692.

⁵⁹⁸ Ibid., Bénichou.

tion, Geoffroy, for one, often imagines progress as an effect of fundamental change in “life” as a condition of human existence. Though Foucault includes “the evolution of the species” among the motors of humankind’s progression toward its inevitable limit, this motif intervenes in the work of some romantic thinkers to destabilize the identity of humankind, rather than to reinforce it.⁵⁹⁹ In Geoffroy and Balzac, the destabilization is a function of two distinct “life” motifs: the development of a transcendental organic archetype and the combinations of a radical vital materialism. Following Goethe, Geoffroy and Balzac posit the existence of a universal living archetype which develops in contact with changes in material environments, a kind of unfurling or unfolding of living potentials which manifests itself in changes in the forms of species. Where the “palingenesis” of Charles Bonnet had envisioned the transformation of organic forms in terms defined by the scale of beings, the palingenesis of these romantic thinkers envision species transformation as an open-ended, non-providential process.⁶⁰⁰ Their “progressive” thinking is powered by the notion that human life, too, is susceptible to transformation, that changes in the life conditioning human existence power changes in the very conditions of knowledge.

The ideal of synthesis thus underpins the work of what might be identified as two distinct camps, one of which grounds the apotheosis of “man” in transformations in the conditions of production, the other of which contemplates his radical transfiguration in Nature’s creative processes. In spite of these differences, each camp subscribes to the same *illusio*, as it were, evincing the same ambition to transform the knowledge of vital phenomena by realizing them as objects of empirical, mathematized inquiry. In their different styles of conceiving this goal, Geoffroy and Balzac, on the one hand, and Saint-Simon, Comte and others on the other hand, designate something like the opposing poles of a coalescing field.

II. The Zoologist’s Progress

“Quelle grandeur! quelle amplitude naturelle dans les conceptions! quelle simplicité patriarcale! quel élan, quel ravissement intérieur de l’homme qui passe sa vie à découvrir et à créer! Il est de la famille des Archimède et des Kepler! On l’a accusé d’être poète; oui, sans doute, il l’était comme ces grands hommes, par un pressentiment plus soudain, plus impérieux, plus divinatoire de l’exacte vérité.”

—Edgar Quinet, “Discours sur Geoffroy Saint-Hilaire”⁶⁰¹

⁵⁹⁹ In Balzac’s oeuvre, “utopian” novels like *Le médecin de campagne* (1833) or *Le curé du village* (1839) add to the array of human figures in the *Comédie* by envisaging humanity as subordinated to a heterodox Catholicism. But the spiritualized human community itself is undercut with “creaturely” motifs in this work, a dynamic crystallized in the image of the human “flock.” Moreover, the narration of these novels comports no philosophy of history which might set tell us when and how an extra-textual utopia would arrive.

⁶⁰⁰ See Chapter One, “Stranger Uses of Spectacle” for an account of Bonnet’s palingenesis.

⁶⁰¹ Edgar Quinet, *Oeuvres complètes*, vols 1-2 (Paris: Pagnerre, 1857), 341. The “Discours” was Quinet’s funeral oration for Geoffroy. For details on Quinet’s participation in the ceremony, see Toby Appel, *The Cuvier-Geoffroy Debate: French Biology in the Decades Before Darwin* (New York: Oxford University Press, 1987), 192-93.

The process which culminated in Geoffroy Saint-Hilaire's "convergence" with Balzac began on Geoffroy's part in August 1801, as he awaited evacuation from Egypt, then under British siege. Having accompanied Bonaparte on the Egyptian expedition, Geoffroy stayed on two years longer than the general himself, while the military situation there deteriorated and the general himself rose to the office of First Consul. Geoffroy busied himself with a series of experiments on the electric shocks administered by the torpedo fish, oblivious of "*tous les événements militaires,*" he recounts in the *Études progressives*, "*et le jet des bombes, et les incendies locaux, et les surprises des assiégeants, et les cris plaintifs des victimes succombant dans la lutte.*"⁶⁰² Just a few years before, Volta's and Galvani's experiments on the torpedo had marked the final stage in their dispute over "animal electricity," as we have seen; in this war of experiments, Galvani was seeking to prove that the animal produced a distinct kind of electricity, while Volta wanted to reproduce the fish's shock organ with metals so as to show that even physical materials could produce Galvani's electricity. Volta's experiments with this metal "organ" resulted in the invention of the battery, an invention which facilitated the grasp of the physical sciences over living objects, as I argued in Chapter Two. But Geoffroy's experiments on the torpedo took an entirely different tack. Geoffroy wanted to look beyond the mere "*manifestations phénoménales*" of the fish to reflect on the action of the nerves "*et, de ces faits de l'animalité, à toutes les productions phénoménales du monde matériel.*"⁶⁰³ The "*possession d'idées*" that he would recall thirty years seized him while he was in the midst of this research, working in a state of feverish exhaustion and unnerved by the proximity of enemy forces. This intuition afforded Geoffroy a glimpse at the means by which matter takes on particular forms, some inert, others endowed with life. Living bodies, Geoffroy came to believe, result from combinations of molecules guided by what he would call the law of "*attraction Soi pour Soi.*" "*Le sentiment de l'attraction de la matière pour elle-même,*" he declares, "*acquis démonstrativement par les admirables calculs de Newton, est dans tous les esprits; et pour qu'il dût s'étendre en outre aux choses de minime volume, cette démonstration seule de soi pour soi manquoit.*"⁶⁰⁴

In spite of this initial revelation, Geoffroy refrained from publicizing his views until the eighteen-thirties, around the same time that Balzac began to articulate a congruent point of view. Following his return from Egypt, Geoffroy tried to share his discovery with his colleagues; but it only served to undermine his standing among them, and he was thenceforth obliged to limit himself to more narrow zoological investigations. The process that ordered Geoffroy's and Balzac's "convergence" of views only began to accelerate thirty years later, as Geoffroy undertook the first steps in what resembles an intellectual "coming out." In this process, the open conflict that flared up between Cuvier and Geoffroy in the *Académie des sciences* proved a turning point: the months-long public dispute he waged with Cuvier over his doctrine of "unity of composition" riveted the savant community and the public, and ultimately emboldened Geoffroy to publicize the visionary turn his thought had taken thirty years before. Over the course of the eighteen-thirties, the zoologist moves beyond the defense of the "facts of animality" associated with the unity

⁶⁰² *Études progressives*, 149.

⁶⁰³ *Ibid.*, 150-51.

⁶⁰⁴ *Ibid.*, 158-59.

of composition to the public exposition of “all the phenomenal productions of the material world” supposed by the law of “*attraction Soi pour Soi*.” In the process, he derogates from the scientific community, suffering the slights and snubs of Cuvier’s successors (Cuvier himself died in 1832), and increasingly choosing to write for the public rather than for the community of savants.

Geoffroy’s doctrine of attraction marks a departure in his thinking of organic form, diverging not only from the functionalist perspective developed by Cuvier but also from his own conception of a transcendental animal archetype. As Deleuze and Guattari observe, Geoffroy’s two positions arise from incongruent philosophical imperatives. In the doctrine of attraction, Geoffroy’s thinking of organic form takes place in terms defined by the category of “composition” (or even disposition), Deleuze and Guattari point out, no longer by that of “organization.” “*La question n’est plus du tout des organes et des fonctions,*” they write of Geoffroy’s theory of physical attraction, “*et d’un Plan transcendant qui ne pourrait présider à leur organisation que sous des rapports analogiques et des types de développement divergents. La question n’est pas celle de l’organisation, mais de la composition; pas celle du développement ou de la différenciation, mais du mouvement et du repos, de la vitesse et de la lenteur.*”⁶⁰⁵

Though Geoffroy’s conception of vital material attraction predates his most famous zoological work, he presents the zoological work as gradually ceding to a need to conceive of animation in terms of material flows. “*Dans ma profession spéciale de zoologiste, je ne visai d’abord qu’à rester lentement progressif,*” he recounts, “*et à me faire petit à petit producteur d’idées dans ce cercle ainsi restreint. Tout aux études de détail, il se fit cependant en moi une révolution à mon insu. Le classement de ces faits en mon esprit et par suite des idées qu’ils engendraient me valut plus d’étendue de jugement, et définitivement les satisfactions d’un savoir synthétique.*”⁶⁰⁶ The gradual zoological studies he envisions pertain to the task of determining which species exhibit formal homologies, according to the doctrine of “unity of composition.” These studies were progressive in the sense that they solicited such homologies among increasingly distant families of organisms, for example, cephalopods and vertebrates; and they are also progressive in the sense that they elicit the path that “life” has taken in the development of these radically different forms from a single presiding archetype, a process that necessarily continues in the present day. As this last element suggests, the notions of “life” presupposed in Cuvier’s functionalist perspective and in Geoffroy’s transcendental one diverge. In a sense, life remains a discrete entity in each, the conception of life “itself” that Foucault associates with the advent of positive science. Yet while “life” remained a silent support for the functioning of the animal and for the study of animal function in Cuvier’s work, a sort of mathematical constant that could effectively be canceled out of the animal equation, it takes on a much more active role in Geoffroy’s thinking of organic form. Its participation in the processes which alter organic form mean that it can no longer be isolated from the study of the animal body; rather, the animal body fundamentally depends for its integrity on the unfolding of “life” as a transcendental force. For Geoffroy, “life” did not just act to prescribe the organization of a given species, as it did in Cuvier,

⁶⁰⁵ Gilles Deleuze and Félix Guattari, *Mille plateaux* (Paris: Les Éditions de minuit, 1980), 312.

⁶⁰⁶ *Notions synthétiques*, 108.

fixing it in a particular, unchanging form; it also acted to produce changes over time, in response to changes in external milieu.

This conception of life remains fundamentally indebted to the study of the animal body, the privileged object of Geoffroy's specialized zoology. But as Deleuze and Guattari remark, the doctrine of attraction to which Geoffroy simultaneously adheres posits "life" as the effect of combinations of material particles, atomizing the animal body. This materialization of the animal body lends it an initial resemblance to positivist conceptions of the animal. As we saw in Chapter Two, the experimental physiologist François Magendie casts the animal body as a composite of material particles, in tune with the neo-Newtonian imaginary of Laplacian physics. In the essay "Quelques idées générales sur les phénomènes particuliers aux corps vivans" (1809), Magendie speculated that the actions of living bodies were most likely impelled by a "vital force" that, "*de même que l'attraction planétaire et moléculaire,*" he writes, "*est inconnue dans sa nature, mais manifeste par ses effets.*"⁶⁰⁷ Though the supposition of such a vital force had the advantage of associating Magendie's physiology with the neo-Newtonian exactitude of Laplace and his disciples, this supposition was of little empirical value, Magendie thought, since the molecules in question were unlikely to be brought within the realm of empirical observation any time soon. In asserting the reality of a "*force vitale*" writes Magendie, "*on désigne aucun phénomène appréciable, mais bien de pures suppositions, de simples manières de concevoir; il serait peut-être aussi avantageux de commencer l'étude de la physiologie, à l'instant où les phénomènes des corps vivans, deviennent appréciables par nos sens.*" In confining physiology to the study of "appreciable" phenomena, Magendie intends to reconceptualize it as an exact science, or at least as a science that practices the degree of exactitude that the living objects to which it was devoted would allow. Given this ambition, speculations about the molecular basis of life would only retard the progress of positive science. "*La partie de la science qui explique les mouvemens intimes, moléculaires, des organes, n'est en ce moment, et ne sera probablement long-tems qu'une réunion de conjectures plus ou moins rapprochées de la vérité; elle a toujours donné lieu à des discussions dont le moindre inconvénient a été de faire perdre un tems qui aurait dû être employé à faire des expériences, et à décrire avec exactitude des phénomènes importans.*"⁶⁰⁸ Though physiology ought to imitate the exact sciences insofar as possible, Magendie insists, there were limits to the degree to which exact science could be applied to living bodies as such. If physiology could be considered a physics of vital matter, in his view, the overriding irony of this new science was that in order to exhibit solidarity with the exact physical sciences it had to eschew the mathematization of molecules which that science presupposed. The atomization of the animal body envisioned by Geoffroy is advanced but ultimately recused by Magendie, maintaining the animal body (rather than its constituent particles) as physiology's privileged object.

As Foucault points out, the incidence of "life" as the constitutive element of living things in the last few decades of the eighteenth century radicalizes the earlier distinction between organized and non-organized bodies, inaugurating a regime in which the distinction between living and brute matter predominates instead. This transition from a natural historical regime ordered

⁶⁰⁷ François Magendie, "Quelques idées générales sur les phénomènes particuliers aux corps vivans," *Bulletin des sciences médicales* (1809), 149-150.

⁶⁰⁸ *Ibid.*, 169-70.

by the difference between the “organized” and the “non-organized” and a positive regime ordered by the difference between the “living” and the “non-living” appears clearly in Magendie’s essay. Though the physiologist posits a vital force patterned on the short-range molecular forces posited by Laplacian physics, this force could not simply be identified with “*les lois générales de la nature*,” Magendie writes;⁶⁰⁹ not only was it impossible to observe animals’ molecules in action, but the special nature of the effects it produced—nutrition, for instance, or sensation—differentiated it from other attractive forces. Geoffroy Saint-Hilaire disagrees on both counts. Where Magendie had set the limits of physiology at the limits of the observer’s senses, Geoffroy brooked no such constraint. “*La grossièreté de nos sens*,” he laments, “*nous donne ce genre d’incapacité, que les fluides impondérés, étant portés aux dernières limites de leur divisibilité, nous ne pouvons plus percevoir la relation et les différences des éléments atomiques.*” It mattered little that such “imponderable fluids” were impossible to verify as such in the first place. Flouting this handicap, Geoffroy made bold to speculate on the nature of the relationships among the atomic elements of which they were made. It seemed clear to him that the relations among material particles fluctuated with the effects of “combustion” and “electrification,” “*la Combustion d’un corps solide*,” restituting “*ses formes originelles, qui est son état d’une atténuation extrême des molécules*,” “*l’Électrification*” seizing hold of these molecules once more, “*en y procédant par une suite progressive de translations, et refait les corps.*”⁶¹⁰ In making bold to posit the kinds of physical processes which ordered the making and unmaking of organized bodies, Geoffroy effectively dissolves the reigning distinction between living and non-living matter. For Geoffroy, all bodies are governed by these processes, living and non-living alike. The rules governing the formation and dissolution of living bodies do indeed belong to the general laws of Nature posited by Magendie. In this way, Geoffroy hoped to abolish the distinction between physics and physiology, situating all natural phenomena under a single set of natural laws.

Like Laplace or Berthollet, Geoffroy imagines processes like combustion and electrification as the chemical expression of molecular events. But what was the nature of the force manipulating these molecules? As Geoffroy avows, the establishment of a research program dedicated to eliciting this force lay beyond his powers, not only because the molecules could not be observed but also because, like other naturalists, he laments, he lacks the use of the “*instrument mathématique*.”⁶¹¹ Without the professional training to express his intuition in analytical form, he resorts to *a priori* speculations about the styles of movement which particles under the influence of the particular force he posits adopt, positing “attraction” as the affinity which particles of various forms discover amongst themselves. Geoffroy imagines matter as a teeming pattern of “atoms” of different sizes, shapes and other characteristics, and additionally supposes that different kinds of matter are composed of combinations of different kinds of atoms. The “*soi*” in Geoffroy’s theory of “*attraction soi pour soi*” corresponds to his notion that patterns of affinity are determined by the attraction of like particles, a pattern that is expressed in even so advanced a formal arrangement as the bilateral symmetry of organisms. Before him, he boasts, no one had

⁶⁰⁹ Ibid., 152.

⁶¹⁰ *Notions synthétiques*, 94.

⁶¹¹ Ibid., 7.

ever intuited the relationship between organic wholes and the events of the molecular world: “*Qui avait fait attention à cette loi de correspondance,*” he demands, “*à ce principe de la coordination harmonique et de formation des organes? C’était la révélation de notre loi d’affrontement des parties semblables, allant nécessairement gagner les soi exactement similaires de l’autre côté.*”⁶¹² This confrontation of like parts organizes the accumulation of increasingly complex forms, up to and including the whole animal. “*Ces mots, soi pour soi, dont est venu me demander de donner une explication lucide, correspondent à ces locutions comme en présente le langage de l’algèbre,*” Geoffroy asserts, as though taking an initial step in the mathematization of this fundamental insight. “*Ainsi, les choses y sont réciproquement posées vis-à-vis les unes des autres, c’est-à-dire les nerf A, artère B, veine C, filet aponévrotique D, etc., de la partie gauche, se trouvent respectivement devant nerf a, artère b, veine c, filet aponévrotique d, de la partie droite.*”⁶¹³ The sciences of Cuvier or Magnedie glided over the question of how the animal body came together, preferring to dismantle it in the search for the physical correlates to life functions. But Geoffroy distinguishes even so advanced a formal arrangement as the bilateral symmetry of animals as a reflection of the way in which individual particles adhere to one another. From the level of molecules to that of whole organisms, form is determined by the conjunction of progressively elaborate composites of material particles, like combining with like.

Though Geoffroy confesses his inability to detail how the law of attraction composes living forms, the understanding of organic form as the result of the “composition” of elements rather than as the expression of a particular “organization” completely redefines the meaning of life, he suggests. The self-organizing capacity of matter is such that while particles sometimes accumulate in inert bodies, as he believes, they at other times arrange themselves in bodies capable of spontaneous action. In a sense, Geoffroy revives the distinction between organized and non-organized bodies that characterized the regime of natural history, in contrast to the distinction between living and non-living bodies that proved constitutive of the regime of “biology.” But in effacing the ontological distinction between living and non-living matter posed by the positive life sciences, Geoffroy also amends the notion of organization that had inhered in natural history, differentiating only between bodies that can produce spontaneous effects and those that cannot. This reduction of vital phenomena to effects of specific forms radicalizes the “formal” position Geoffroy sustains against the “functional” position represented by Cuvier. For if Cuvier envisions certain formal similarities among animals as the result of a need to fulfill similar functions, Geoffroy envisions the functions animals fulfill as determined by formal considerations. In pushing the thinking of form to its limit, transposing it from the level of organization supposed by his zoological research to the level of composition supposed by the law of material attraction, Geoffroy discovers that he must rethink his assumptions about the animating principle, no longer particular to animal or plant bodies but general in Nature as a whole.

In this vital materialist physiology, “life” is reduced to mere animation, an effect of certain kinds of material arrangements. As such, the battery becomes one of Geoffroy’s principle emblems in the championing of “animation” over “life.” On its presentation to the *Institut* in 1801, as we have seen, the very year when Geoffroy conceived of his vital law, the battery was

⁶¹² Ibid., 83.

⁶¹³ Ibid., 80.

quickly assimilated to the ideal of exactitude, and later celebrated by Arago as the signature achievement of the positive sciences. Yet for Geoffroy it heralded something altogether different, an age of artificial bodies—“*admirables machines*”— whose spontaneity confused the distinction between living and non-living things. Along with other such machines, it showed that animation could take shape as the result of a variety of material conditions and produce a variety of spontaneous effects. In keeping with Geoffroy’s notion of the attraction of like parts, these machines could be construed, he thought, as “*autant d’espèces qui apportent en elles ce caractère d’une double ou multiple personnalité et qui sont, d’abord, les deux moitiés dont chacune, être simple, préexiste à leur jonction.*”⁶¹⁴ It was the character of the machines’ component parts which determined their future conjunctions. “*Celles-ci astreintes aux conséquences de leur préexistence, à une nécessité de rapports, à des règles de coordination, opèrent un double ou multiple système; et alors il y a nécessairement, ou du moins il peut se rencontrer dans ces composés, en vertu de leurs entités primitives et diverses, des raisons de vouloirs ou de résistances.*” The molecular system resulting in the battery might be simpler than that ordering living animals, but Geoffroy proposes that both kinds of bodies arise from the same self-organizing character of matter. (Perhaps we might imagine that in this case the contact of various metals in the battery constituted the effectuation of a “double or multiple system” Geoffroy speaks of.) And if animals could act or resist at will, so, in a sense could the class of “admirable machines” and other spontaneous non-animal systems, themselves tending to exhibit “*des raisons de vouloirs ou de résistances.*” Though the invention of the battery played a role in advancing the very sciences of life Geoffroy wished to reform or supplant, the naturalist recasts it as evidence that the ontological distinction between living and non-living matter which these sciences sustained would have to be effaced.

As Geoffroy acknowledges, this reconceptualization of life as animation, of will as “*des raisons de vouloirs,*” redounds to redefine man himself. If the historical protagonist “man” emerges with the regime of modern positivities, as Foucault contends, Geoffroy’s rejection of “life” as an element in the study of living things inevitably alters his understanding of human living in turn. This notion of animation and the reformulation of humankind’s place in Nature which it provokes constitutes the “post-human” element of Geoffroy’s thought. A distorting anthropocentrism has characterized the human of study of Nature in general, Geoffroy observes. The “*vie sociale,*” of man, he writes, “*ses arts, et ses études sur les choses, lui ont donné le sentiment de sa capacité, inspiré les présomptions de sa toute-puissance d’intelligence, et révélé le secret de sa mission, comme coadjuteur de Dieu dans l’administration et le règlement des choses à la surface de la terre.*” Yet man’s intelligence is neither all-powerful nor divinely guaranteed; like every living thing he receives “*de principaux motifs d’intelligence du concours de son monde ambiant,*”⁶¹⁵ such that man’s knowing arises from the conditions of his existence, to the degree that he can be said to know at all. Christian and vitalist doctrines presume that matter is imbued with spirit or life, Geoffroy notes, where these entities remain a thing apart from matter and underwrite the exceptional status of man in Nature; yet man as a living, thinking thing inevitably reflects on the conditions of his existence according to the terms that his coalescence as

⁶¹⁴ *Études progressives*, 176.

⁶¹⁵ *Ibid.*, 188.

a living thing allows. Anthropocentric systems, Geoffroy remarks, all find means to demarcate the life of man as such from the Nature around him, defining an empire within an empire, as it were. Anticipating Foucault, Geoffroy identifies positivist notions of life as an element undergirding man's exceptional status in Nature, constituting a sort of "*privilège*," or a "point of honor," as Bourdieu would put it, which poses an obstacle to self-reflexive thinking. Man "*a imaginé qu'il participait de l'essence divine*," Geoffroy concludes; "*et voilà comment il n'a jamais voulu réfléchir à ses conditions propres comme l'une des créations sur la terre, comment il a imaginé des doctrines d'animation, de forces vitales et de principes surnaturels, afin de rester un être à part, un privilège au milieu de toutes les créatures de l'univers.*"⁶¹⁶

In this remarkable passage, Geoffroy redefines reason, intelligence, language and so on as functions of a material surround, emerging from the play "*du mouvement et du repos, de la vitesse et de la lenteur*," which Deleuze and Guattari identify with this conception of material processes. The revalorization of the symbolic order of man which Geoffroy instigates here courts a symbolic revolution of a particular kind, for it not only presupposes the redistribution of authority in the scientific field but also a revolution in the symbolic order itself. Though Geoffroy does not have much more to say on the subject of language or thought per se, his reconceptualization of the symbolic order as an effect of material processes establishes a scenario in which the subject of knowing and speaking can no longer be isolated from the objects it studies or speaks. As we shall see, this scenario resembles that established by Balzac in positing thought as a material entity, an object of thought which is simultaneously an element of the subject of thought. As a symbolic revolution that would upend the symbolic order itself, the synthetic movement which Geoffroy advocates here entails a redefinition of language quite as dramatic as that marking the end of the "hermeneutic" regime and the inception of a regime of "representation." If Geoffroy's law of vital material attraction can be construed as an attempt to represent life itself, life and representation are themselves redefined by this scheme: life dispersed into the play of molecules, and representation, too, rethought on the pattern of action. In this regime, language would not be a natural object like any other, as it had been in the age of hermeneutics; nor would it be bound up in a conventional system matching word to thing. Instead, it would be symbolic motion, a movement acting to superimpose itself on the movement of the world, a regime in which the event of language is to follow as closely as possible on the heels of the event it wants to speak. If, as Foucault writes, the nineteenth-century utopians responded to the fundamental limits on knowledge posited by the positivists by imagining that life itself had not yet revealed its full potential, and that language itself might take the form of "*des systèmes symboliques suffisamment purs pour dissoudre la vieille opacité des langages historiques*," Geoffroy's vital materialist thinking implies the redistribution of the possibilities of both elements. Animation becomes the general conditions of the universe; and language abandons an order structured by the opposition of opacity and transparency to enter an order structured by that of slowness and speed. The question for language would thenceforth be not whether it was transparent enough to reveal the Origin whole but whether it was swift enough to catch up to the event.

⁶¹⁶ Ibid.

If the symbolic revolution envisioned by Geoffroy comported both a general revolution in the symbolic order and a narrower revolution in the order of the sciences, his writings primarily address the latter element. The general implications of this revolution are captured, however, in Geoffroy's use of Napoleon Bonaparte as a symbol of synthetic values. Geoffroy himself had had the genius to intuit the law of attraction "*soi pour soi*," but a genius of another order would be required, he confesses, to realize this law as such and to reform the sciences and the social order in its image. Though Napoleon proved instrumental in forging the positive order, as Geoffroy must surely have known, the naturalist routinely casts Napoleon as a would-be "synthetic" philosopher, regrettably distracted by his military and political obligations. In an anecdote which Geoffroy frequently repeats, Napoleon declares to the savants gathered in Egypt that as a boy he hesitated between a scientific and a military career, moved to emulate Newton almost as much as he was to emulate Alexander the Great. Newton had mathematized the cosmos, but Napoleon himself dreamed of doing the same for the microcosm, Geoffroy tells us, a virgin domain he termed "*le Monde des détails*."⁶¹⁷ For Foucault, the notion of "detail" which Geoffroy evokes here identifies Napoleon with the inauguration of a political apparatus designed to achieve ever-finer units of administrative control; for Geoffroy, on the other hand, it bespeaks a will to out-Newton Newton, to locate the life of the universe in the sub-microscopic swarms of material particles. The discovery of the "world of detail" would entail not only the mathematization of brute matter as such but also the arrays of material elements that generated vital phenomena. "*Newton se trouve avoir résolu le problème du mouvement en général par la découverte du système planétaire*," Geoffroy cites Napoleon as having proclaimed. "*Mais que, moi, j'en fusse venu à apprendre aux hommes comment s'opère le mouvement qui se communique et se détermine par l'intervention des plus petits corps, j'aurais résolu le problème de la vie de l'univers. Et cela fait, ce que je tiens chose possible, j'eusse dépassé Newton de toute la distance qu'il y a entre la matière et l'intelligence.*"⁶¹⁸

Insofar as Geoffroy's Napoleon straddles the political and scientific worlds, he is a timely symbol for a period riven with political and scientific instability. As Bourdieu suggests in general terms, circumstances beyond the field may prove propitious to symbolic revolutions within them. The Revolution of 1789 set the stage for the rise of the modern sciences, as we have seen, rending the patronage networks that had sustained the general culture of letters, including the sciences of spectacle and utility, and heralding the rise of exact physical science. In so doing, it relegated the hermeneutic style of discourse to the past and inaugurated a new order of knowledge, predicated on representation alone. The political and scientific turmoil of the early eighteenth-thirties may have promised to effect a similar revolution in the values of the scientific field. Laplace and Cuvier, those stalwarts of the political and scientific status quo, died within a few years of each other, in 1827 and 1832, respectively; and the sciences now found themselves under the leadership of the scientifically adventurous, liberal-minded physicist François Arago, elected to the perpetual secretaryship of the *Académie des sciences* in 1830. The abdication of

⁶¹⁷ *Notions synthétiques*, v.

⁶¹⁸ *Ibid.*, xxviii.

Charles X in August 1830, moreover, may have contributed to the sense that an opening had been cleared for the institution of a new science, that a new political and social élite might patronize a new set of scientific values. In retrospect, the changes in the scientific field after 1830 were as modest as the political changes turned out to be. Yet the symbol of Napoleon telegraphs Geoffroy's confidence that a major transformation in the political and scientific orders might be underway.

In the *Études progressives* and the *Notions synthétiques*, Geoffroy leaves political convictions aside and only hints at the conditions of a general symbolic transformation; yet he expatiates on the transformations he saw as necessary within the scientific field. In so doing, he proposed nothing short of unseating mathematical physics as the dominant "style" of scientific endeavor, in favor of a new, more expansive physiology. In the rhetoric of exactitude, as we have seen, physical science was seen to trump physiology for the certitude of its results and the rectitude of its practitioners. This view was shared by many of the physiologists themselves; sketching out the outlines of his new experimental physiology, Magendie, after all, had explicitly recognized the superiority of the physical sciences and resolved to imitate them insofar as possible. But Geoffroy views the certitude of the exact sciences as having been purchased at an exorbitant cost, entailing the realization of ever more discrete objects and ever more specialized technical means. What Geoffroy prioritizes over certitude is the capacity to reconcile discrete findings with a general picture of Nature. As the bearer of synthetic values, physiology was now suited to take the lead over the exact physical sciences. If Geoffroy insists on the abolition of what he calls the order of "*les deux physiques*,"⁶¹⁹ the articulation of one all-encompassing new physics would entail matching the technical and theoretical resources of the physical sciences as they now stood to the grand conceptions of physiology. The subordination of physics to physiology would conduce to the achievement of a single synthetic science. Newton's *Opticks*, Geoffroy recalls, contain a series of propositions on the character of living organisms, an initial attempt to effect such a synthesis. But if this incursion was premature, as Geoffroy believes, the progress of physiology since Newton's day now put it in the position of enriching astronomy (construed as the matrix of mathematical physics). "*Que la physiologie . . . arrive à son tour sur l'astronomie*," he declares, "*pour lui apporter aussi le bénéfice de ses recherches, de ses comparaisons spéciales, et la mettre de même en voie de perfectionnement.*"⁶²⁰

If the principle protagonist of the symbolic revolution spearheaded by the partisans of exactitude had been the *physicien géomètre*, the mathematical physicist, that of the revolution Geoffroy envisions would be a sort of *physiologiste géomètre*, or a "*naturaliste* in extenso," as he expresses it, a figure who embodies the aptitude of both the physiologist and the mathematician. Under the leadership of this figure, a new style of science was to take shape, in which living things would no longer be seen as exceptions in a physics of material nature but rather as the model of "composition" on which material nature itself could be reconceived. Ill-versed in mathematics, as he confesses, Geoffroy could not do this work alone. Just as Lavoisier had recruited Laplace to lend mathematical rigor to his chemical experiments, Geoffroy envisions recruiting potential collaborators among sympathetic *physiciens*. Yet his incursions into the world

⁶¹⁹ Ibid., 103.

⁶²⁰ Ibid., 176. Emphasis his.

of the physicists are received as transgressions, he tells us. Geoffroy makes attempts both to recruit *physiciens* and to recast physics in vital materialist terms, insofar as he is able. Just as Goethe insists on the special value of coming "face to face" with Nature in an era when analytical studies predominated, Geoffroy insists that the physical world was there for anyone and everyone to study. "*Et il y aurait une classe de savans qui viendrait prescrire aux naturalistes de s'abstenir d'entrer sur un terrain qu'eux, physiciens, croiraient et diraient exclusivement leur!*" he thunders. "*Il serait mieux et plus juste, je crois, au contraire, de reconnaître que c'est un problème à devenir propre à qui en a déjà formulé la mise en équation, à qui en aurait le premier pressenti et cherché la solution.*"⁶²¹ For the zoologist, the territoriality of the physicists contravened the imperative to come face to face with Nature, to make sense of it as a whole on one's own terms. Geoffroy's accounts of his efforts to achieve recognition among the physicists often come across as poignantly comic: at a session of the *Académie des sciences*, for instance, he reads a text on the nature of light with the outlandish title "Exorde d'un ouvrage sur la lumière, où l'on discute, en cinq traités, de son essence, de son principe originel, de son analyse, de son intervention universelle, et des phénomènes de l'interférences des rayons polarisés" (1835); and he is discomfited by the reception he receives among physicists he did not personally know: "*Mais si c'est la première fois que je suis aperçu dans le vestibule des demeures des physiciens,*" he writes, "*et si c'est à juste droit, que ceux-ci, isolés dans leur spécialité ne m'aperçoivent que sous le titre d'un homme qui leur est inconnu, j'ai, pour combattre cette prétention, à faire valoir que, d'autre part, vieux zoologiste, j'ai long-temps exploré les champs d'une autre physique, à laquelle il ne manque, pour établir son légitime droit à la confraternité, qu'un nom analogue du moins et correspondant, qui rende compte de la rencontre des deux soeurs sur les mêmes routes.*"⁶²²

These measures amount to a single-handed effort to force his savant colleagues to recognize his point of view, to subordinate themselves to a new synthetic ideal. In proceeding in this way Geoffroy departs markedly from the strategies pursued by the initiators of the "exact" revolution. As I attempted to show in Chapter Two, the initiators of the symbolic revolution which instituted the ideal of exactitude succeeded in imposing their point of view thanks in large part to influxes of cultural and material capital from the State, converting some rivals to their way of seeing and displacing many others. They ultimately succeed in redefining the "constitution" of the field thanks to the concurrence of an outside authority. But Geoffroy envisions effecting a symbolic revolution through something like a process of "conversion," in which his colleagues would see the light, as it were, acquiescing in the ideal on its own strengths and in a spirit of frank disinterestedness. In every way, Geoffroy proceeds as though scientific actors in general were guided in their choices by the merit of ideas alone, setting about recruiting allies through direct confrontation, for instance, rather than through the assemblage of effective patronage networks. The persona of the "martyr-prophet" compensates for what appears in Geoffroy as the absence of a habitus suited to the dynamics of the field. The persona of the martyr-prophet corresponds to Geoffroy's refusal to recognize science *as* a field, to emit an ideal his contemporaries would one day adopt for their own and to suffer in the meantime. Geoffroy's refusal to think in

⁶²¹ Ibid.,15.

⁶²²Ibid.,102.

terms of field dynamics is reiterated at the level of the synthetic ideal, with its imperative to dissolve the existing regime of autonomizing fields in favor of a “total” cultural formation. Though we might imagine that such a formation would inevitably be regimented by the dynamics of the field in turn, Geoffroy conceives it as a zone of free collaboration insofar as it conceives it in positive terms at all. In keeping with what Bourdieu describes as the dynamics characteristic of “circuits of legitimation,” the initiators of the scientific field had leveraged the powers of legitimation inhering in a second field; yet the espousal of an ideal which prescribes the dissolution of separate fields effectively precludes this option for Geoffroy.

Aiming to “convert” the dominant scientific actors of his moment, Geoffroy perhaps predictably encounters an obstinate refusal among them to recognize his point of view. While the field functions to unite disparate positions on the background of a fundamental coherence, Geoffroy’s position remains beyond the pale of positive science. As Bourdieu observes, the field’s capacity to envelop disparate positions has its limits, the distance between “[des] couples d’oppositions spécifiques (épistémologiques, artistiques, etc.) qui sont aussi des couples d’oppositions sociales entre adversaires complices au sein du champ,” delimiting “l’espace de discussion légitime, excluant comme absurde, éclectique ou tout simplement impensable, toute tentative pour produire une position non prévue (qu’il s’agisse de l’intrusion absurde ou déplacée du “naïf”, de l’“amateur” ou de l’autodidacte, ou de la grande innovation subversive de l’hérésiarque, religieux, artistique ou même scientifique).”⁶²³ Within this scheme, Geoffroy embodies the position of both the “heretic” and the “naïf,” the prophet of a new scientific order as holy fool, interrupting the progress of the physical sciences, for instance, with his crude reflections on light and organic bodies. The opposition between “positive” and “progressive” sciences envisioned by Geoffroy is transvalued by the subjects of the positive point of view as an opposition between science as such and mad speculation. Geoffroy’s position remains too heterodox to figure among those “immédiatement reconnues comme pertinentes et sensées par ceux-là mêmes à qui elles s’opposent et qui s’opposent à elles,”⁶²⁴ and Geoffroy experiences the profound incommensurability between the positive and progressive points of view as a failure to be recognized. Of his colleagues, he complains, “Dire qu’il n’en est aucune qui se soit intéressée à la lecture de mon ouvrage, j’aurais tort: il vaut mieux raconter et mettre ce fait en question. Laquelle de ces spécialités aurait même été informée de son existence?”⁶²⁵

This failure to achieve recognition leads Geoffroy to rail against his scientific colleagues, and ultimately to stop writing for them altogether. Certain “*esprits positifs*,” he complains, had advised him to convey his ideas in accepted forms, if he could, an impossibility given what he conceives as the “novelty of my position.” “--C’était nouveau, très difficile à comprendre du premier jet,” he recounts these unnamed figures as having objected, as though he were voicing Cuvier or Laplace. “On n’y a pas regardé, et tout aussitôt a dominé dans les hauteurs scientifiques ce sentiment dédaigneux: Nous ne comprenons pas, et conséquemment nous estimons

⁶²³ *Méditations pascaliennes*, 121.

⁶²⁴ *Ibid.*, 121.

⁶²⁵ *Notions synthétiques*, 61.

que.... etc.!”⁶²⁶ Though Geoffroy abstains from making explicit just who constitutes these “*hauts scientifiques*,” he elsewhere construes “*les physiciens*” as “*une corporation nombreuse et puissante, en sorte qy’ils se trouvent, de fait, investis de l’influence et de l’action gouvernementale des sciences.*”⁶²⁷ In Geoffroy’s own sociology, the mathematical physicists of his moment monopolize the power to legitimate or marginalize the positions of other scientific agents, even those working in disciplines other than their own. Following the deaths of Laplace and Cuvier and the quasi-retirement of Biot, the exact physical sciences continue to define the identity of the sciences as a whole, the “constitution” of the field.

Though some historians have emphasized Arago’s support for Geoffroy during this period, Geoffroy’s own account testifies to his ongoing marginalization in the field. Arago has sometimes been cast as scientifically “heterodox” in comparison to Laplace or Cuvier, a claim corroborated by his occasional support for Geoffroy and his apparent interest in somnambulism and other spiritualist phenomena. John Tresch, for instance, casts Arago as a “strong public supporter” of Geoffroy, whom he characterizes as a “conduit for German *Naturphilosophie*,”⁶²⁸ yet we never learn what elements of Geoffroy’s work Arago supported, or the dimensions or degree of that support. For her part, Theresa Levitt calls attention to Arago’s interest in somnambulism during the eighteen-thirties and -forties, in particular his participation in the *Affaires Cottin* and *Pigeaire*, named after young women whose evidently occult talents galvanized public attention at the time. Geoffroy complains about his treatment by those charged with the “*action gouvernementale des sciences*” during this period, yet no one disposed of more such power than Arago. If Daston and Galison liken the appearance of new virtues to the winking into existence of new stars, not displacing previous virtues but shifting the bearings of the sky, how did the astronomer Arago position himself relative to the ideal of “synthesis,” and to his colleague Geoffroy’s synthetic notions in particular?

As Tresch points out, the secretary exhibits a personal warmth and a scientific open-mindedness absent in Laplace and many of his satellites, and maintained a more robust interest in innovations in instrumentation and the industrial application of the sciences than was generally licensed among the Laplacians. Yet I would argue that Arago never substantially departs from the mathematization of purely physical phenomena as the ideal of scientific inquiry, evincing a loyalty to the “law” of the scientific field as it had been constituted under Laplace that his interest in occult phenomena confirms rather than confuses. In 1838, Arago was persuaded to join George Sand, Théophile Gautier and a number of prominent *publicistes* to witness the blindfolded reading of Léonide Pigeaire. Arago’s very presence lent the event credibility, yet the secretary remained stubbornly mum about whether he thought Léonide could really read while blindfolded, refusing to pronounce either for or against the reality of her gifts. As Levitt writes, “Arago was adamant in his stance that claims about unknown forces should not be dismissed a priori, but

⁶²⁶ Ibid., 27-29.

⁶²⁷ Ibid., 15.

⁶²⁸ John Tresch, *The Romantic Machine: Utopian Science and Technology After Napoleon* (Chicago: University of Chicago Press, 2012), 106 and 121-22.

should be evaluated the same as any other science.”⁶²⁹ After all, in an age in which the battery and even the daguerrotype exemplified the sciences’ capacity to reveal previously inconceivable aspects of Nature, it would be presumptuous to rule out the scientific authenticity of certain phenomena, however occult they might initially seem.

Yet Arago acknowledges these seemingly occult feats only to the degree that they might eventually be realized as orthodox scientific objects. In his view, no fact was too outlandish if it promised to expand our knowledge of light and other physical phenomena. Not long before Fresnel had demonstrated that light moved in transverse waves; so who was to say that Léonide Pigeaire’s capacity to read through blindfolds and other obstacles did not betray some undiscovered property of light? “*Pour moi,*” he writes, “*je n’hésite pas à le dire, quoique, malgré les possibilités que j’ai signalées, je n’admets les réalités de lectures, ni à travers un mur, ni à travers tout autre corps opaque, ni par la seule entremise du coude ou de l’occiput, je croirais manquer à mon devoir d’académicien si je refusais d’assister à des séances où de tels phénomènes me seraient promis, pourvu qu’on m’accordât assez d’influence dans la direction des épreuves, pour que je fusse certain de ne pas devenir victime d’une jonglerie.*”⁶³⁰ The duties of an academician extended to explaining even the most astonishing effects as results of physical laws, Arago believes, even to elaborating new laws in order to explain these effects. Just as some individuals are more sensitive to certain tastes and smells, he speculates, so others might be predisposed to receiving certain light emissions unavailable to most. “*Si le système newtonien de l’émission est vrai,*” writes Arago, “*il faut irrévocablement admettre qu’un rayon cesse d’être lumière dès qu’on diminue sa vitesse d’un dix-millième. De là découlent ces conjectures naturelles et bien dignes d’un examen expérimental: les hommes ne voient pas tous par les mêmes rayons; des différences tranchées peuvent exister à cet égard chez le même individu, dans des états nerveux divers; il est possible que les rayons calorifiques, les rayons obscures de l’un, soient les rayons lumineux de l’autre et réciproquement,*” and so on.⁶³¹ In the Laplacian tradition, Arago frames inquiry into potentially new aspects of light as the experimental investigation of Newtonian premises. The idea that Arago was somehow complicit with the somnambulists is based on a fundamental misrecognition; for while the somnambulists typically presented their feats as the effects of extraordinary projections of will or thought outside the material body, or even presented will or thought as a material element that could travel in space, Arago never considered them as anything other than the potential manifestation of a previously unknown aspect of material Nature. As Levitt writes, the “unusual abilities” of the somnambulists “seemed to offer an expansion of light, all the while retaining its status as a purely physical force. As occultism veered into the realm of invisible spirits, however, Arago parted ways.”⁶³²

Even the most superficial acquaintance with Geoffroy’s vital materialist notions suggests how implausible it is that Arago might have adhered to them in any meaningful way. Arago may

⁶²⁹ *The Shadow of Enlightenment*, 108.

⁶³⁰ François Arago, “Rapport sur le magnétisme animal,” *Oeuvres complètes*, vol. 2 (Paris: Gide et Baudry, 1855), 315.

⁶³¹ *Ibid.*, 314.

⁶³² *Shadow of Enlightenment*, 116.

have acquiesced in Geoffroy's transcendental anatomy to some degree, though his "support" for the zoologist likely derived as much from his desire to counteract Cuvier's formidable powers over the administration of the sciences as from the content of Geoffroy's own research.⁶³³ Yet even this exceptionally open-minded representative of the official sciences invariably construes new phenomena in terms prompted by the previous state of the field; each new occult fact can be admitted as scientific only insofar as it reduces to an experimental and ultimately mathematizable physical phenomenon. Arago remains perfectly orthodox in this respect, steering the sciences insofar as it was in his power to do so by the star of "exactitude," maintaining a course set by Laplace and his other predecessors in the field. Our picture of Arago's "ties" to Geoffroy and the occultists of the period is conditioned by the knowledge that he did not share the same point of view on scientific inquiry as they did, did not admit phenomena like "*admirables machines*" or projections of "electric fluid" into the panoply of authentic scientific objects.

Stymied by his colleagues in the scientific field, including Arago, Geoffroy increasingly writes for the public at large. In so doing, he violates the economy of recognition constitutive of the scientific field, flouting the premise according to which the autonomy of the sciences is defined by the scientific agents' tendency to recognize their competitors alone as clients. Because Geoffroy does not occupy a sufficiently powerful position within the scientific field to change the functioning of the field as a whole, this gesture redounds to compromise his status as an authority in the sciences; from the point of view of orthodox scientific actors, the search for recognition beyond the bounds of the sciences represents the abandonment of scientificity as such. But as Geoffroy knew, he enjoyed a great deal of celebrity among a class of thinkers who represented a different scientific ideal. His debate with Cuvier in the *Académie des sciences* had transformed him into a figurehead of this ideal, and during the eighteen-thirties he performs less and less technical zoological work in order to consolidate his reputation among the public and the other intellectuals who saw an opening for the institution of "synthesis."

More than most professors or academicians, Geoffroy had been a public figure since the earliest days of his career: during the September massacres, he had helped the famous naturalist the Abbé Haüy escape from prison, and was subsequently appointed one of the twelve founding professors of the *Muséum d'histoire naturelle*.⁶³⁴ As a member of Napoleon's Egyptian expedition, moreover, he had famously saved the French natural history collections from suffering destruction or falling into British hands. Perhaps most importantly, Geoffroy joined Arago and others in opening the *Académie des sciences* up to public scrutiny, fundamentally altering its status as a public institution over the objections of Cuvier and other traditionalists. As Toby Appel writes, Geoffroy died a "popular hero," thanks to his role in transforming academic politics and sustaining a philosophical alternative to the regime of scientific positivism; nearly two thousand mourners attended his funeral, including luminaires like Hugo, David d'Angers and Edgar Quinet.⁶³⁵ To the public, Geoffroy represented a gamut of positions: "They made him a mystic, a

⁶³³ See Appel, *The Cuvier-Geoffroy Debate*, 120-21.

⁶³⁴ *The Geoffroy-Cuvier Debate*, 20-21. Geoffroy was appointed by none other than Bernardin de Saint-Pierre, during his brief tenure at the *Jardin des plantes* (the institution that subsequently became the *Muséum*).

⁶³⁵ *Ibid.*, 188.

pantheist, and an anti-Catholic,” writes Appel. “They portrayed him as an active rebel against official science and its institutions. They hailed him as a scientist of the masses. Some saw him as removed from all politics, an Archimedes concerned only with the advance of pure knowledge, while others depicted him as motivated primarily by the moral and social implications of his doctrine.”⁶³⁶ If public understanding of his doctrines remained superficial, as Appel observes, Geoffroy had nevertheless succeeded in generating a source of authority beyond the confines of the sciences themselves.

Given this advantage, Geoffroy took particular care to cultivate the “philosophers” who might be suited to collaborate with him in the institution of the synthetic ideal. Given the rejections he had suffered at the hands of his scientific colleagues, he writes, it was necessary to stimulate reflection on his ideas by other means. “*J’ai cessé d’écrire dans les formes reçues et pour les savans de profession,*” he observes in the *Notions synthétiques*. “*Je ramèmerai sur ces nouvelles idées les savans qui, aujourd’hui, les redoutent presque, comme dérangeant des combinaisons faites dans leur esprit; je les y ramènerai à la suite d’une autre classe de penseurs.*” Rather than convert the professional savants, he would lead like-minded thinkers, “*ces hommes, aux vues synthétiques,*” as he writes, figures who study the universe as “*philosophes, poètes et théologiens.*”⁶³⁷ To this end, Geoffroy held a weekly salon at his lodging at the *Jardin des plantes*, a society that included Alfred de Musset, d’Angers, Quinet, and many of Geoffroy’s contacts among the disciples of Saint-Simon, some of them initially friends of his son Isidore: Hippolyte Carnot, Pierre Leroux, Jean Reynaud, Charles Didier and Victor Considérant, among others. He arranged a meeting with George Sand, newly famous with the publication of *Indiana*, and in thrall to his ideas; and he likewise made the acquaintance of Honoré de Balzac. Geoffroy’s trajectory toward a position defined by his links with this diverse crowd of cultural agents is cemented with his references to Balzac’s *Livre mystique* in the *Notions synthétiques*. In the very work where he announces his intention to write for this new class of synthetic thinkers, he invites his friend’s works into his own, avowing his admiration for Balzac’s prophet Louis Lambert and citing Séraphita’s lament—“*La Science et une et vous l’avez partagée!!!*”, exclamation points and all.

III. The Writer’s Progress

“All painters of manners and fashions, if we will, are historians, even when they least don the uniform: Fielding, Dickens, Thackeray, George Eliot, Hawthorne among ourselves. The great difference between the great Frenchman and the eminent others is that, with an imagination of the highest power, an unequalled intensity of vision, he saw his subject in the light of science as well, in the light of the bearing of all its parts on each other, and under pressure of a passion for exactitude, an appetite, the appetite of an ogre, for *all* the kinds of facts.”

⁶³⁶ Ibid., 201.

⁶³⁷ *Notions synthétiques*, 27-29.

As Pierre Bourdieu avows in *Les Règles de l'art*, the field of cultural production is patterned on the Newtonian conception of space as a field of forces. This pedigree situates the “field” in a long tradition in French intellectual history, Bourdieu acknowledges, over the course of which the Newtonian conception of space has structured conceptions of biological and social milieux. The tradition extends from Newton, Bourdieu tell us, to Balzac, “*qui l’introduit en littérature en 1842 dans la préface de La Comédie humaine,*” through “*Taine, qui en fait un des trois principes d’explication de l’histoire,*” by way of the *Encyclopédie*, and the works of Lamarck and Comte. To describe Balzac’s and Geoffroy’s convergence in field terms, we must extend Bourdieu’s own uses of field terminology; and, as it happens, Geoffroy’s own radicalization of the Newtonian milieu as a physiological principle offers a model for understanding this convergence in ways that reflect the pedigree of the field. Like the particles in Geoffroy’s law of *attraction soi pour soi*, Geoffroy and Balzac heed an affinity for one another’s scientific principles, like converging on like. And just as Geoffroy is obliged to transgress the borders of the scientific field in order to realize this convergence, so Balzac is obliged to imagine a position beyond the space of literary possibilities available to him as an entrant in the field. Escaping the gravitational pull of these two fields came at a cost for each, however; Geoffroy forfeited the symbolic capital he possessed as a member of the scientific field (and some of the material capital as well, given that positions he expected to inherit following the death of Cuvier were instead passed on to Cuvier’s brother Frédéric), and Balzac risked the incomprehension of readers and of the critical establishment as he transformed the novel into a medium for scientific notions. Like any “prophet” of a symbolic revolution, Balzac made a long-term, high-risk bet that the investments of time and energy the articulation of the new position required would one day pay off. As the “Avant-propos” to the *Comédie humaine* and many of the author’s other prefaces and assorted articles suggest, a substantial part of Balzac’s novelistic production can be understood as investing in the chance that the outlying synthetic ideal would one day become a norm.

The links between Balzac and the sciences forms a commonplace in Balzac criticism, extending principally to considerations of how the sciences inflected Balzac’s strategies of representation, and how the naturalists Cuvier and Geoffroy Saint-Hilaire shaped his philosophical ideals. Yet this tradition has almost exclusively investigated the sciences’ “influence” on Balzac, the novelist’s integration of existing scientific knowledge into his fictional work. Erich Auerbach’s famous passages on Balzac in *Mimesis* argue that the influence of the sciences is evident in both aspects of the novelist’s fiction-writing, that the doctrine of the role of the “milieu” in defining species and individuals which Balzac “borrowed” from Geoffroy Saint-Hilaire is responsible for the style of representation characteristic of Balzacian realism. Balzac’s borrowing represents a kind of “biologism,” in Auerbach’s view, the misapplication of biological concepts to domains beyond their legitimate purview. Of the “Avant-propos” to the *Comédie humaine*, he writes that “the word milieu, which here appears for the first time in the sociological sense and which was to have such a successful career (Taine seems to have adopted it from Balzac), he

⁶³⁸ *Literary Criticism: French Writers, Other European Writers, the Prefaces to the New York Edition*, ed. Leon Edel (New York: Library of America, 1984), 93.

learned from Geoffroy Saint-Hilaire, who for his part had transferred it from physical science to biology; now it makes its way from biology to sociology.”⁶³⁹ It is this biologism which suffuses Balzac’s characteristic mode of observation and description, in Auerbach’s view: “The motif of the unity of a milieu has taken hold of him so powerfully,” he writes, “that the things and the persons composing a milieu often acquire for him a sort of second significance which, though different from that which reason can comprehend, is far more essential—a significance which can best be defined by the adjective demonic.”⁶⁴⁰ In eliciting a “demonic” element in Balzac’s style of representation, Auerbach revisits a longstanding dispute over whether Balzac can really be seen as a realist, a dispute stretching back to Baudelaire’s contention that Balzac is best understood not as a mere “observer,” as the naturalists wanted to believe, but rather as a “visionary,” whose personal vitality invariably suffuses his descriptions.⁶⁴¹ Auerbach innovates by linking the conceptual basis of Balzac’s fiction with his means of representation; yet even when critics other than Auerbach treat these elements separately or inscribe them in alternative scientific contexts, they almost universally establish a dynamic of uni-directional influence.⁶⁴²

Though Geoffroy articulates a distinctive conception of “milieu” prior to Balzac’s arrival on the scene, their espousal of scientific reform and articulation of a synthetic ideal is a coeval,

⁶³⁹ Erich Auerbach, *Mimesis: The Representation of Reality in Western Literature* (Princeton, NJ: Princeton University Press, 2003), 475.

⁶⁴⁰ *Ibid.*, 472.

⁶⁴¹ Baudelaire, Charles. "Théophile Gautier" [1859], *L'Art romantique: littérature et musique* (Paris: GF-Flammari- on, 1968), 252. As Baudelaire writes, “*J’ai mainte fois été étonné que la grande gloire de Balzac fût de passer pour un observateur ; il m’avait toujours semblé que son principal mérite était d’être visionnaire, et visionnaire passionné. Tous ses personnages sont doués de l’ardeur vitale dont il était animé lui-même. Toutes ses fictions sont aussi profondément colorées que les rêves.*”

⁶⁴² A very partial bibliography on Balzac and the sciences might also include: Madeleine Ambrière, *Balzac et “la Recherche de l’absolu”* (Paris: Hachette, 1968) and the notes and introductions Ambrière prepared for the “Avant-propos,” *La recherche de l’absolu, Ursule Mirouët* and other works in the Gallimard Pléiade edition of the *Comédie humaine*; Claire Barel-Moisan “Les sciences au risque de la fiction,” *Balzac avant Balzac*, ed. Claire Barel-Moisan and José-Luis Diaz (Saint-Cyr-sur-Loire: Piron, 2006), 153-69; Göran Blix, “The Occult Roots of Realism: Balzac, Mesmer, and Second Sight,” *Studies in Eighteenth-Century Culture* 36 (2007), 261-80; Philippe Dufour and Nicole Mozet, eds, *Balzac géographe: Territoires* (Saint-Cyr-sur-Loire: Piron, 2004); Andrea Goulet, *Optiques: The Science of the Eye and the Birth of Modern French Fiction* (Philadelphia: University of Pennsylvania Press, 2006); Boris Lyon-Caen, *Balzac et la comédie des signes: essai sur une expérience de pensée* (Saint-Denis: Presses universitaires des Vincennes, 2006); Richard Somerset, “The Naturalist in Balzac: The Relative Influence of Cuvier and Geoffroy Saint-Hilaire,” *French Forum* 27.1 (2002), 81-111.

As I suggested, these works largely presume an “influence” exercised by the sciences on Balzac. In addition, John Tresch situates Balzac among other visionary savants and philosophers of the period in his book *The Romantic Machine*; yet his language makes it impossible to establish just what kind of relationship he is establishing among them. Balzac “knew” many of the other figures examined in Tresch’s book, Tresch writes, “and mingled with them in Paris’s salons, offices, printed pages, and streets. His quest and the quest he described closely resembled and intersected with the projects described here. His protagonists, like those of this book, were seized by the passions, mystic flights, uncertainties, and obsessions of romanticism even as they sought new machines and rational sciences to let them know and act upon their environment. . . . Balzac, Sand, and their fellow travelers aimed to weave together all of reality in fabrications that were at once scientific, artistic, technological, and political.” *The Romantic Machine*, xvi-xvii. The language of resemblance, intersection or mingling here suggests that, in contrast with many other writers, Tresch is hinting at a certain originality in Balzac’s conceptions, though this claim remains implicit at best.

even collaborative endeavor. The influence operated in both directions, and for both Geoffroy and Balzac the realization of the position that corresponded to it required that each concurrently effect a symbolic revolution in the field in which he initially “came up.” Geoffroy defines a “progressive” science in opposition to a “positivist” one, as we have seen, and transgresses the boundary between scientific specialists and non-specialists in order to realize it. Balzac travels at least as far to develop an idea and a practice of literature that comprehends a similarly “progressive” notion of science. Balzac’s conception of himself as a writer emerges early in his career, as he abandons his youthful pseudonyms and begins to construct an authorial identity in his own name through a flood of articles, *contes*, and novels. As Baudelaire would do in a subsequent generation, Balzac cobbles together what Bourdieu calls an “impossible” position from the bits and pieces of existing literary positions he adopted as his own. Bourdieu describes Baudelaire’s position as impossible because it belongs fully to none of the literary positions available to him upon his entry in the field, and consequently isolates him as the sole representative of the literary values he upholds. As is also the case for Geoffroy, Balzac’s position is “impossible” in a double sense; first, because it likewise entails the invention of a outlying position, not implicit in the contemporary state of the field, and second, because the realization of the ideal to which this position corresponds supposes the advent of a genius even more consequential than the writer himself. If “synthesis” is both a progressive ideal and an ideal in progress, this doubling is reflected in Balzac’s conception of not one but two writerly personae—the authorial identity constructed by Balzac himself, and the “poet” as the avatar of the genius to come. While Balzac’s novelistic output participated in defining the ideal of synthesis, an ideal whose institution remained a work in progress, the advent of the “poet” was to herald the realization of the synthesis itself. The poet was to be “*le centre intelligent de toute chose*,” we read in the “Introduction aux *Études de moeurs*” (1835), a center at which “*les lumineuses synthèses de toutes les connaissances humaines*” would be formulated.⁶⁴³ This notion of the poet corresponds to a conception of language that remains implicit in the novels, hinted at but impossible to enact. If Geoffroy’s reconceptualization of thought, spirit or language as natural functions rather than exceptional human faculties suggests the post-human scope of his physiological thinking, Balzac’s notion of poetic language likewise presupposes a symbolic revolution that revolutionizes the symbol itself. The conceptions of language as action or materialized thought that we encounter in *Louis Lambert* and elsewhere supersede the order of “representation” to evoke a new symbolic economy.

As José-Luis Diaz’s *Devenir Balzac* proposes, Balzac’s early work as *publiciste* brims with clues about how he envisioned orienting himself in the field. The articles the young Balzac wrote for publications like *L’Artiste*, the *Revue de Paris*, or *L’Europe littéraire* give us a relatively straightforward sense of which elements of the pre-existing positions in the field he would reject, which, if any, adopt. Balzac rejects the classicists wholesale, stigmatizing Fontanes and La Harpe and depicting the members of the *Académie française* as figures “*enveloppée dans les bandelettes d’une momie restant immobile dans une sorte de statu quo metterniquois*.”⁶⁴⁴ At the same time, he denigrates women’s writing and the “feminine” genre of the sentimental novel

⁶⁴³ “Introduction aux *Études de moeurs*,” 58.

⁶⁴⁴ José-Luis Diaz, *Devenir Balzac: l’invention de l’écrivain par lui-même* (Saint-Cyr-sur-Loire: Pirot, 2007), 93.

while co-opting some of this genre's themes and plots.⁶⁴⁵ Balzac is no more convinced by the young romantics. Though Hugo and others wanted to shake off classicist convention, the synthesis of Shakespeare and Racine prescribed in the "Préface" to *Hernani* amounted to little more than another "*nature de convention*," in his view. The leaders of the *jeunesse artiste* "*ne s'attachaient qu'à certains détails d'individualité*," we read in the "Introduction aux *Études de mœurs*," "*à des spécialités de forme, à des originalités d'épiderme; en un mot c'était une exagération substitué à une autre, et toujours du système.*"⁶⁴⁶ Balzac's own aesthetic policy would develop from a sustained engagement with the novels of Sir Walter Scott, whose "faithful" descriptions of persons, places and mores and adherence to historical fact offered a point of departure for Balzacian realism. As Balzac's composition of *Les Chouans* (1829) attests, this brand of verisimilitude comported a "*projet de connaissance*" exemplified by the novelists's trip to Brittany for on-location research.⁶⁴⁷

While the literary field of the eighteen-twenties is structured by the battle between the classicists and the romantics, Balzac is increasingly obliged to position himself relative to a new set of oppositions, "*l'art social*" versus "*l'art pour l'art*." Balzac rejects these positions per se, while assimilating elements of each. Both Hugo and the followers of Saint-Simon develop a notion of the literary writer as the practitioner of one among a "*fraternité*" of the arts,⁶⁴⁸ and show the literary artist to play a principal role in the effectuation of a new political regime. But if Hugo associated romantic art with "*le libéralisme en littérature*," Balzac dissociated himself from republican values in favor of an unorthodox royalist Catholicism; likewise rejecting the socialist humanism of the Saint-Simonians and other utopians. The visionary royalist Catholicism underpinning Balzac's conception of a new human community in utopian novels like *Le médecin de campagne* (1833) and *Le curé de village* (1839) conflicts with the religion of "Humanity" espoused by the Saint-Simonians, insofar as it subordinates the figure of "man" to spiritualist imperatives. What is more, Balzac rejects the role both Hugo and the Saint-Simonians assigned the artist in society, envisioning the artist as a force for molding society rather than as an obedient servant to humanity. Far from subordinating the creative dynamism of the artist to a particular social order, Balzac views the artist as the agent of a powerful faculty of "thought," a faculty which justifies the domination of society by the artist. In the article "Des artistes," for instance, Balzac assembles a pantheon of artists whose diversity conveys a sense of the originality of his conception of the artist: Gutenberg, Colomb, Schwartz, Descartes, Raphaël, Voltaire, David, Napoléon, "*tous étaient artistes*," he writes, "*car ils créaient, ils appliquaient la pensée à une production nouvelle des forces humaines, à une combinaison neuve des éléments de la nature physique et morale.*"⁶⁴⁹

⁶⁴⁵ See Margaret Cohen, Chapter 4: "A Compromised Position: French Realism and the *Femme Auteur*" in *The Sentimental Education of the Novel* (Princeton, NJ: Princeton University Press, 1999).

⁶⁴⁶ *Devenir Balzac*, 156.

⁶⁴⁷ *Devenir Balzac*, 147. See also Marion Ayton Crawford, "Translator's Introduction," *The Chouans* (New York: Penguin, 1972).

⁶⁴⁸ *Devenir Balzac*, 104.

⁶⁴⁹ *Ibid.*

As this image of the artist as a social force suggests, Balzac similarly diverged from the position of “*l’art pour l’art*” in important ways. Like Gautier or Banville, Balzac relieves poetry of service to a fixed ideal; but unlike these partisans of “*l’art pour l’art*” he does not limit the vocation of the artist to the production of beauty, or define beauty as an autonomous ideal, useless, and epistemically and ethically indifferent. Balzac's links to the doctrine of art for art's sake are evident in his initial efforts to establish himself as a *conteur*, insofar as the ludic, self-referential world of the fantastic tale evinced the self-conscious uselessness of art as an end to itself. Following in the footsteps of Gautier, Charles Nodier, Jules Janin and others, Balzac churns out dozens of fantastic tales in the years around 1830, yet ultimately chafes against the conventions of the “*récit excentrique*” or the “*conte fantastique*,” with their metastasization of the narratorial apparatus, their emphasis on “style,” and their penchant for whimsical digression and the flaunting of arcane knowledge. Balzac's discontent with the fantastic literature of his contemporaries shines through in the “Lettre à Nodier” (1832), among other texts, where Balzac reproaches his former mentor for what he casts as an irresponsibly “eccentric” manner. In Balzac's view, Nodier errs in disavowing the “responsibility” his enormous erudition and capacity for philosophical thought imposes on him, imploring him to employ his “*sacerdoce intellectuel dans un grand but de science réelle et de consolation philosophique*.”⁶⁵⁰ The ludic, self-referential nature of the fantastic tale inevitably mooted its philosophic content, and Balzac's letter to Nodier suggests that at this stage in his career he was preoccupied with finding a way of reconciling the fantasy and the philosophy.

Nodier's irresponsibility seems to frustrate Balzac precisely because of how closely the older writer anticipates the position of the synthetic thinkers. Balzac composes his “Lettre à Nodier” in response to an essay Nodier wrote for the *Revue de Paris*, entitled “De la palingénésie humaine et de la résurrection” (1832). Nodier's ingenious essay exhibits many of the attributes of synthetic thinking, setting in motion a self-reflexive relationship between knowledge and knower, for instance, and prescribing a new relationship between philosophical intuition and empirical detail in the sciences. In keeping with the genre of palingenesis, Nodier's text foretells the future development of humankind as a function of changes in organic composition. Like Geoffroy Saint-Hilaire, Nodier envisions progress as an effect of the development of transcendental “life,” rather than of improvements in the conditions of production, and this assumption removes his notions from the mainstream of utopian thinking, as he acknowledges. Though the notion of “palingenesis” might seem to establish his essay as a response to the influential *Essais de palingénésie sociales* of Pierre-Simon Ballanche (1827-29), it is really no such thing, he insists: “*Je ne m’occuperai pas dans ce chapitre excentrique, et placé hors de toutes doctrines écrites*,” he begins, “*du système des palingénésies sociales*.”⁶⁵¹ The theme of “eccentricity” becomes crucial in this essay as a means of binding Nodier's authorial persona and the visionary content of the essay together. If Nodier positions himself as “peripheral” to debates about the future of humankind and of intellectual production in general, this is because he places humankind itself at the periphery of the story of the universe. Given the anthropocentric character of nearly all intel-

⁶⁵⁰ “Lettre à Nodier, 1210.

⁶⁵¹ Charles Nodier, “De la palingénésie humaine et de la résurrection,” *Oeuvres de Charles Nodier: Romans, Contes et Nouvelles*, vol. 5 (Brussels: Meline, 1832), 297.

lectual production, he says, he has no choice but to adopt an eccentric persona. While Nodier predicts the emergence of nearly inconceivable organs and faculties in the human body over time, what makes his essay especially odd is his assertion that these improvements will remain drastically inferior to the faculties of a new super-being, the *être compréhensif*, whose advent will relegate humankind to obsolescence. The story of the universe in Nodier's fantasy essay is really the story of the emergence of this super-creature. In exiling humankind to the universe's periphery, Nodier subverts the optimistic philosophies of history typical of palingeneses and humanist utopias alike.

Nodier insists on the plausibility of this dark vision before confessing, paradoxically, that as a mere writer he lacks the authority to do so. In response, Balzac reproves him for going to such great lengths to avoid being taken seriously, protesting that neither the authorial persona adopted by Nodier nor the philosophical content of the essay demonstrate the force of conviction which Nodier's literary fame and erudition should command. "*Vous qui touchez par tant de points à la science humaine,*" he insists, "*vous dont la parole doit influencer, plus fortement que vous ne le pensez dans votre touchante modestie, sur le siècle et sur la littérature, pourquoi n'employez-vous pas l'autorité de votre talent à maintenir nos connaissances dans l'admirable voie d'analyse que leur ont fait, depuis un siècle, ces grands inventeurs de sciences, ces génies dont vous pouvez par un rare privilège, admirer les diverses portées: Newton, Charles Bonnet, Buffon, Bichat, Cuvier, Laplace, Lavoisier, Monge, Mela, Bernard Palissy, Herschell, Gall? . . .*"⁶⁵² Nodier's philosophical sophistication and familiarity with works of both an empirical and a visionary turn give him the rare opportunity to turn his thinking to account for "*le siècle et la littérature,*" Balzac enthuses, and his failure to do so marks a missed opportunity both for the progress of the age in general and the expansion of literature as a form of cultural production in particular.

Even as Balzac attacks Nodier's authorial self-presentation, he also objects to the philosophical content of the tale. The fate Nodier envisages for humankind is not only a mark of unwarranted "disenchantment," Balzac believes, but also of the elder writer's entirely too syncretic approach to philosophical speculation. In his "Letter," Balzac mocks what he construes as Nodier's "*pensée toute panthéiste, mélangée de spinosisme, trempée de christianisme, arrosée d'histoire naturelle et de phrases platoniciennes,*" a singular eclecticism with little relation to concurrent philosophic trends.⁶⁵³ This accusation may astonish given the extraordinarily speculative character of Balzac's own philosophical discourse, here and in other texts; yet Balzac's objections turn not so much on the value of metaphysical assumptions per se as on what the novelist sees as Nodier's neglect of the relationship between these assumptions and empirical fact. As Nodier himself declares in this essay, the lack of empirical verification envisaged by the disciples of Saint-Simon and other philosophers undercut the value of their doctrines: "*Le système de Saint-Simon,*" he writes, "*se composait d'inductions rationnelles qui méritoient d'être discutées, et qui pouvoient soutenir un examen approfondi. Je suis porté à croire que ses apôtres se sont maladroitement détournés de ses voies toutes matérielles et toutes positives, en substituant au calcul des hypothèses et à la critique des faits l'autorité d'un enseignement où l'on n'a*

⁶⁵² "Lettre à Nodier," 1209.

⁶⁵³ Ibid., 1206.

oublié que l'élément essentiel de l'enseignement mystique."⁶⁵⁴ Like Balzac, Nodier criticizes the followers of Saint-Simon for their excessively metaphysical or spiritualist turn, and their neglect of what he calls, in language Balzac would borrow against him, the "*voies toutes matérielles et toutes positives*" prompted by the quantification and mathematization of physical facts. What differentiates Nodier and Balzac is the balance between philosophical speculation and the "*calcul des hypothèses*" they strike in their respective works, for while Nodier's essay does little to suggest how his speculations might ultimately be confirmed, Balzac characteristically envisions a role for the analytical sciences in the development of his ideal.

Balzac's letter spells out his intentions to expand the persona inhabited by fantastic *conteurs* like Nodier, ascribing the self-effacing and excessively speculative character of Nodier's text to the reading public's misconceptions about writers in general. "*Vous avez éprouvé mieux encore que je ne l'éprouve, moi, jeune,*" he complains to Nodier, "*la pédantesque infirmité des jugements par lesquels les contemporains parquent un écrivain dans une spécialité, lui dénie les connaissances auxquelles il s'est adonné le plus amoureuxment, et, pesant sa pensée inconnue du même poids dont ils se servent pour estimer sa vie extérieure, veulent lui conformer l'âme à ses goûts apparents, à ses fantaisies d'artiste; lui refusant d'être complice de ses écrits, lui interdisant d'être de son opinion, savant de la science dont il s'occupe, occupé de la science dont il sonde plus promptement que tous les autres les obscurités mystérieuses.*"⁶⁵⁵ In this passage, Balzac calls attention to the ways writers' personae and textual production conceal the knowledge and philosophical acuity they may comport, the "*vie extérieure,*" "*goûts apparents,*" and "*fantaisies d'artiste*" of the writer blinding contemporary audiences to the value of his "*connaissances.*" If the milieu and the self-presentation of the artist differ from those of the savant, a savant nevertheless lurks within him; and if fantastic tales lack the evident gravity of scientific *mémoires*, they nevertheless pack a scientific punch. While the writer's scientific ambitions seem to Balzac to exist almost in a private realm, at odds with his "*vie extérieure,*" he insists on his right to bring them out into the open. In this "Letter" Balzac objects to the split habitus suffered by the writer with philosophic convictions, argues for the value of integrating the "speciality" of the writer with general intellectual production, and announces his intention to assume his own "*sacerdoce intellectuel*" whether it is immediately recognized as such or not.

This passage offers an important key to understanding the extraordinary claims which punctuate many of Balzac's articles, tales and longer fiction. In Balzac's articles and fantastic productions, the recto of a fantastic trope often hides the verso of a philosophical assertion; but philosophical assertions are not always correspondingly meant to be read as mere artistic "fantasies." Construing them in this way means refusing to recognize the author as the subject of his own opinion, of the science he intuits and whose development he prescribes. Balzac's advice to Nodier demonstrates his penchant for generating fantastic flights that double as weighty dictums, as well as his hopes for how Nodier's high-flying speculations might be declined in empirical forms. While Nodier's superhuman being, the *être compréhensif*, existed without respect to time or to place, embodied but never confined to any one milieu, Balzac asserts that empirical science would one day reveal that human beings themselves can transcend time and space. "*Le sommeil*

⁶⁵⁴ "De la palingénésie humaine et de la résurrection," 298.

⁶⁵⁵ "Lettre à Nodier," 1204.

démontre logiquement,” he declares, “par une chaîne de raisonnements dont quelque beau génie déduira l’ensemble, comme les Cuvier, les Laplace ont arraché des faits à un océan de pensées, que l’homme possède l’exorbitante faculté d’anéantir, par rapport à lui, l’espace qui n’existe que par rapport à lui;

De s’isoler complètement du milieu dans lequel il réside, et de franchir, en vertu d’une puissance locomotive presque infinie, les énormes distances de la nature physique;

D’étendre sa vue à travers la création sans y rencontrer les obstacles par lesquels il est arrêté dans son état normal;

*Et enfin d’obtenir une certitude mémoriale des actes dus à l’exercice de cette faculté.*⁶⁵⁶

This passage presents Balzac at his most “somnambulistic,” asserting the probability that the will could travel beyond the bounds of the human body, transporting consciousness along with it. Though it would be hard to get more speculative than Balzac shows himself to be in this passage, he casts himself as *less* speculative than Nodier insofar as he attributes this faculty to real human beings rather than to a purely notional super-human being. Moreover, he produces evidence for this faculty in the form of an experience everyone can relate to, the drift of the mind in sleep, casting the mind’s activity in general as a kind of material motion. And he expects that these phenomena will one day be integrated into the empirical sciences, taking their place among the objects the academic savants would investigate.⁶⁵⁷

This emphasis on the value of empirical science further helps to “place” Balzac in the cultural production of his time. In the letter to Nodier, he defines himself as a writer by identifying the similarities and differences between himself and the savants of the positive sciences, as well as between himself and the fantastic *conteur*. In addition to Cuvier and Laplace, the pantheon of great scientific figures he cites includes Lavoisier, Monge and other luminaries of the positive sciences, to say nothing of Newton, their patron hero. Balzac vaunts the accomplishments of exact science even as, like Geoffroy, he imagines subordinating them to a higher ideal. In the search for the truth, he tells Nodier, “*je ne vous renverrai ni à Bichat, ni à Laplace, ni à M. Savary, ni à M. Arago, parce que nous planons un peu plus haut qu’ils ne parviennent dans les*

⁶⁵⁶ Ibid., 1214.

⁶⁵⁷ This is also Balzac at his most philosophical, however, drawing as he does on a certain idea of post-Kantian philosophy. “*Ni l’espace ni le temps n’existent,*” he writes, “*en dehors de l’homme du moins; Fichte et beaucoup de grands génies les ont abstractivement, philosophiquement niés. Le temps et l’espace sont, dans l’acception que vous donnez à ces mots, une seule et même chose, qui est, par rapport à nous, un produit du mouvement, et le mouvement est comme l’espace, un abîme aussi profond que l’idée de Dieu, et où notre raison devient infirme quand nous voulons le pénétrer*” (1213). Passages like this show Balzac to conceive of time and space, then, as functions of the “living” of humankind, as Canguilhem might say, and functions which underpin the construction by humankind of its particular milieu. In this light, one might construe Balzac’s conception of an ideal of synthesis as the perception of the world beyond the milieu we spontaneously project, a milieu which here includes Kantian time and space itself. Confronted with this overwhelming task, the self-reflexivity implied by the conception of one’s own construction of one’s milieu sours into the desperate pursuit of the “abyss.” For Balzac, however, sleep represents the involuntary intimation of the world beyond milieu: “*Le sommeil montre souvent à un homme de bonne foi l’espace complètement anéanti, dans sa double forme de temps et d’espace proprement dit*” (1213).

espaces.”⁶⁵⁸ Yet Balzac admires these thinkers for providing what he sees as the requisite empirical detail. His notion that dreams might be realized as the object of Parisian exact science emblemizes this position, where the writer intuitively principles whose realization in an empirical mode would inevitably transform the empirical sciences themselves. “*Les études psychologiques,*” Balzac prophesies, “*dirigées dans une voie d’analyse, acquerront sans doute une consistance mathématique, cesseront d’être creuses et conjecturales.*” If he has little notion of how to found such a psychology himself, he does tick off the phenomena it would be bound to realize as properly scientific objects. “*Les bornes d’une simple lettre,*” he continues,

*ne me permettent pas d’embrasser autrement que par l’énumération les magnifiques irradiations de cette science nouvelle; mais les prodiges de la volonté en seront le lien commun, auquel se rattachent et les découvertes de Gall, celle du fluide nerveux, troisième circulation de notre appareil, et celle du principe constituant de l’électricité; puis les innombrables effets magnétiques, ceux du somnambulisme naturel et artificiel dont s’occupent les savants de Danemark, de Suède, de Berlin, d’Angleterre, d’Italie, et que nient ceux de notre Paris, tour à tour si stupides et si intelligents, si froids et si passionnés.*⁶⁵⁹

Nervous fluid would soon be acknowledged as an element of the human body as fundamental as blood or air, Balzac predicts. But in heralding the return of “electrical fluid” as a viable object in the investigation of nerve functioning, marginalized in the Parisian sciences since the days of Volta and Galvani, he additionally claims that this substance interacts directly with the will, that it is in some sense the manifestation of the will in substantial form. While Arago had consented to witness somnambulistic séances insofar as they might promise to reveal new aspects of light, he categorically denied the possibility that such forces might act directly upon the human will, as we have seen, or that the human will itself could be studied as a physical force.⁶⁶⁰ In contrast, Balzac positions the knowledge of electricity as an agent in the human nervous system at the center of the science of the future, along with the study of how it and other imponderables inter-related with human will.

Balzac became Balzac by fulfilling an original literary position, defining himself as a writer by assimilating some elements of “*l’art social,*” “*l’art pour l’art,*” and the positive sciences while rejecting others. Yet as his reference to the “*beau génie*” who might one day give psychological studies a mathematical substance suggests, he himself would only endeavor to project the synthetic ideal, leaving it to some future polymath to realize in full. Though Balzac likens this genius to Cuvier or to Laplace, the kinds of facts he was to pluck from an ocean of thoughts would inevitably be of a synthetic nature, pertaining to moral rather than merely physical phenomena; yet Balzac’s assumption that even these avatars of positivism intuit the notions they subsequently forge into facts characteristically places inspiration above experimentation in

⁶⁵⁸ Ibid., 1207.

⁶⁵⁹ Ibid., 1214.

⁶⁶⁰ *The Shadow of Enlightenment*, 116.

the hierarchy of scientific values. In keeping with Balzac's insistence that the most innocuous of motifs can convey weighty intentions, this reference to the "*océan de pensées*" flowing around Cuvier or Laplace evokes his frequent assertion that thought, will and other vital effects are fundamentally material in nature. This notion appears in highly variable form, sometimes pertaining to the circulation of electric fluid within the human body, sometimes to the projection of this fluid beyond the bounds of the body, sometimes to the fluid's saturation of the ambient milieu. As with Geoffroy's assertion that intelligence is a function of the milieu rather than an exceptional human faculty, Balzac's conception of thought as substance deforms the symbolic order. Though as a novelist Balzac remains bound by the order of representation, his conception of thought as a material substance corresponds to a new order of language, whose agent is the "poet" as the site of the "*lumineuses synthèses de toutes les connaissances humaines.*" If the poet is the agent who works in the medium of thought, the motif of thought as the object of thought drives Balzac to vertiginous and inevitably unsuccessful efforts to manifest it as a scientific object. As the objectification of thought itself, this transcendental language constitutes both the object of thought and the medium of its communication.

Balzac's assertions of the material nature of thought and other vital phenomena extend across a multitude of texts, whose close relationship is underlined by exchanges of citations or the mention of characters associated with this strand of Balzac's production. The epigraph of the essay-tale "La Théorie de la démarche" (1835), for instance, derives from Balzac's own *Louis Lambert*, and registers one of the characteristic ways in which Balzac would conceive of the communication of thought. If the notion of an "ocean of thoughts" construes thinking on a model of something like "contagion," where thinking saturates a milieu and exists to be seized or "caught," the epigraph from *Louis Lambert* imagines thinking as a projection of vital fluid from the human body. It calls attention to the variable ways in which Balzac "places" material thought in the physical world, and additionally reveals the ease with which he slips between the categories of will and thought. "*Enfin, à quoi, si ce n'est à une substance électrique,*" asks the epigraph, "*peut-on attribuer la magie par laquelle la Volonté s'intronise si majestueusement dans les regards pour foudroyer les obstacles aux commandements du génie, éclate dans la voix, ou filtre, malgré l'hypocrisie, au travers de l'enveloppe humaine?*"⁶⁶¹ In the novel *Louis Lambert*, the passage continues as follows: "*Le courant de ce roi des fluides qui, suivant la haute pression de la Pensée ou du Sentiment, s'épanche à flots ou s'amoindrit et s'effile, puis s'amasse pour jaillir en éclairs, est l'occulte ministre auquel sont dus soit les efforts ou funestes ou bienfaisants des arts et des passions, soit les intonations de la voix . . . ; soit tous les prestiges du toucher, d'où procèdent les transfusions mentales de tant d'artistes de qui les mains créatrices savent, après mille études passionnées, évoquer la nature; soit enfin les dégradations infinies de l'oeil, depuis son atone inertie jusqu'à ses projections de lueurs les plus effrayantes. À ce système Dieu ne perd aucun de ses droits. La Pensée matérielle m'a raconté de lui de nouvelles grandeurs!*"⁶⁶² In this passage, Balzac construes thought as a mode of volition, the discharges of Will the narrator imagines striking foreign objects soon imagined as having been ejected by the pressure of "Thought" or "Sentiment," and thought itself is soon construed in the phrase "*la Pensée*

⁶⁶¹ "Théorie de la démarche," *Comédie humaine*, vol. 12 (Paris: Gallimard, 1981), 259.

⁶⁶² Honoré de Balzac, *Louis Lambert*, *Comédie humaine*, vol. 11 (Paris: Gallimard, 1980), 633.

matérielle” not just as the prime mover of these electrical currents but also, in a sense, as identical with them. In a variant of Galvani’s physiology, Balzac imagines electric fluid to mediate sensation as well as volition; but he characteristically construes the operation of the senses in active rather than receptive terms, as “transfusions” of will expressed in various modes. Indeed, thought, like sensation, becomes a modality of the will, insofar as sensation and thought can even be distinguished as such, effectively recast as they are here as varieties of “touch.”⁶⁶³ In patterning thought, as well as sensation, on the model of “will,” Balzac offers a second model for material thought, the notion of thought as a species of action joining that of thought as a kind of contagion.

The conception of thought as a material substance upsets the order of ordinary language, and calls into question the status of the writer’s discourse itself. Whether construed as a voluntary projection or as an invisible element of milieu, the material substance of thought tends to render the economies of written and spoken language redundant, or at least to situate them as just two modalities of communicative action among others; if spoken and particularly written language can themselves be imagined as thought materialized the notion that thought itself is and could progressively be recognized as material revokes the special status of formal language. In *Louis Lambert*, the question of poetic language is developed in relation to a conception of material thought as an element of the ambient milieu. The narrator of the novel, the title character’s childhood friend, visits the increasingly mad-seeming visionary in his home, and comes away feeling that he has incidentally absorbed something of Louis’ own mindset. Louis’ environment seems to have become impregnated with the very kind of thinking which has caused him to go mad. “*La vue de Louis avait exercé sur moi je ne sais quelle influence sinistre.*,” the narrator writes.

*Je redoutai de me retrouver dans cette atmosphère enivrante où l’extase était contagieuse. Chacun aurait éprouvé comme moi l’envie de se précipiter dans l’infini, de même que les soldats se tuaient tous dans la guérite où s’était suicidé l’un d’eux au camp de Boulogne. On sait que Napoléon fut obligé de faire brûler ce bois, dépositaire d’idées arrivées à l’état de miasmes mortels. Peut-être en était-il de la chambre de Louis comme de cette guérite? Ces deux faits seraient des preuves de plus en faveur de son système sur la transmission de la Volonté. J’y ressentis des troubles extraordinaires qui surpassèrent les effets les plus fantastiques causés par le thé, le café, l’opium, par le sommeil et la fièvre, agents mystérieux dont les terribles actions embrasent si souvent nos têtes.”*⁶⁶⁴

As Auerbach points out, the theme of the synthesis of character and milieu predominates in Balzac’s novelistic discourse, and in this particular passage the agent of this synthesis is con-

⁶⁶³ In fact, Balzac’s conception of sense modes and artistic production resembles that of Jean-Luc Nancy in *Les musées*. Far from entertaining a “mimetic” conception of artistic production, passages like this one from *Louis Lambert* propose what Nancy calls a “methectic” scenario, in which each of the sensory modes is cast as a species of “touch.” Jean-Luc Nancy, *Les musées* (Paris: Galilée, 2001).

⁶⁶⁴ *Louis Lambert*, 692.

strued as a process whereby ideas attain the state of a “miasma.” In the logic of the passage, the nervous effects which the narrator associates with this miasma amount to a kind of infection by the ideas which have been troubling Louis, ideas pertaining precisely to the means by which will and thought are transmitted. This infection is imagined as a kind of susceptibility to “hosting” Louis’ thoughts as one’s own. Though the narrator feels most at risk for catching the “fever” spread by this miasma in Louis’ room, the effects of the fever, once caught, presumably travel with him wherever he goes.

This saturation with Louis’ thoughts prompts the narrator to speculate that he might have written a very different book than the novel we have before us. The narrator frames the biography he has written about his friend as an “*histoire intellectuelle*,” assembling the fragments of Louis’ written works and his own recollections of his friend’s pronouncements into a picture of Louis’ intellectual development. But beyond this “*débris de pensées*,” as he puts it, lies “*un livre complet*,” a turn of phrase which recalls the formulation according to which “*le poète, pour être complet, doit être le centre intelligent de toute chose, il doit résumer en lui les lumineuses synthèses de toutes les connaissances humaines*.” In these passages, the “completeness” of the poetry seems to designate the achievement of a transcendental language. “*Peut-être aurais-je pu transformer en un livre complet ces débris de pensées*,” the narrator reflects,

*compréhensibles seulement pour certains esprits habitués à se pencher sur le bord des abîmes, dans l’espérance d’en apercevoir le fond. La vie de cet immense cerveau, qui sans doute a craqué de toutes parts comme un empire trop vaste, y eût été développé dans le récit des visions de cet être, incomplet par trop de force ou par faiblesse; mais j’ai mieux aimé rendre compte de mes impressions que de faire une oeuvre plus ou moins poétique.*⁶⁶⁵

This “*oeuvre plus ou moins poétique*” emerges as a kind of double for the novel itself, as the whole to the fragment, or as the work of a language of becoming to that of a language of reference. If such a work is imagined to be intelligible only to those who, like Louis or the narrator, have stared into the abyss, that is because it induces a sense of the unending play of thought as the object of thought, or of the slippery choreography of word and thing, never fully aligned. Like the revolution in the symbolic order prompted by Geoffroy’s vital materialism, this notion of an abyssal language redefines signification as a problem of pacing. In this light, the superposition of abyssal language and the discourse of the novel recalls the notion of language developed by Deleuze in *La Logique du sens*. The poetic language evoked by the narrator of *Louis Lambert* supposes a duality which, like that Deleuze describes, “*n’est pas du tout celle de l’intelligible et du sensible, de l’Idée et de la matière, des Idées et des corps. C’est une dualité plus profonde, plus secrète, enfouie dans les corps sensibles et matériels eux-mêmes: dualité souterraine entre ce qui reçoit l’action de l’Idée et ce qui se dérobe à cette action*.”⁶⁶⁶ The motif of “material thought” forces an investigation into the nature of the duality hidden in material objects. This duality leads Deleuze to distinguish two orders in language, or perhaps two kinds of language,

⁶⁶⁵ Ibid.

⁶⁶⁶ Gilles Deleuze, *La logique du sens* (Paris: Éditions du minuit, 1969), 10.

the first oblivious to what Balzac characteristically calls the “abyss,” the other suited to evoking it. “*N’y aurait-il pas deux langages et deux sortes de “noms”*,” Deleuze inquires, “*les uns désignant les arrêts et des repos qui recueillent l’action de l’Idée*,” and therefore remaining securely conventional, “*mais les autres exprimant les mouvements ou les devenirs rebelles? Ou bien encore ne serait-ce pas deux dimensions distinctes intérieures au langage en général, l’une toujours recouverte par l’autre, mais continuant à “subvenir” et à subsister sous l’autre?*”⁶⁶⁷ “Poetic language” appears in Balzac as the thematization of this second language or dimension of language, the language of pure becoming which subsists beneath the conventional language of the novel’s discourse.

If Balzac himself never attempts to become the poet of this language, never abandons the writing of the novel in favor of a more elusive poetic vocation, this is because the dynamic of pure becoming remains just one motif among others in his work. In *Louis Lambert*, for instance, this motif is gnarled with a conflicting conception of Louis’ madness as a spiritual ascent, a scenario in which the plane of pure becoming evoked by the theme of poetic language is grafted on to the altogether inimical order of a hierarchy of beings. Yet the synthesis of personality and milieu which Auerbach identifies as a fundamental element of Balzac’s realism invokes this becoming even if it does not try to “enact” it in poetic language. Moreover, Balzac’s decision to inscribe Geoffroy’s law of “*attraction soi pour soi*” at the head of the “*Avant-propos*” of the *Comédie humaine* many years after the composition of these relatively early works indicates the importance and the prevalence of this problematic in his oeuvre. As we have seen, Deleuze and Guattari point out that two orders of thought inhere in Geoffroy’s work, a “transcendent” one associated with the theory of organic composition and an immanent one associated with the law of material attraction. In much the same way, Balzac’s work is riven by a transcendental order associated with the hierarchy of being and an immanent order associated with the materialization of thought and will. In both Geoffroy and Balzac, these motifs occur together, as though they were entirely compatible with one another. The convergence of Geoffroy and Balzac thus concerns not only the co-occurrence of an extraordinary vital materialism and the thinking of pure immanence which it entails, but also the perhaps incidental persistence of transcendental motifs alongside it. The “progress” of both writer and zoologist entailed the articulation of an intellectual persona corresponding to the dispositions and modes of perception available to each. For Balzac, these personal dispositions were powerfully inflected by the discovery of a theme of pure becoming beyond the apparently stable substance of everyday décors as well as beyond the evident solidity of the novel’s discourse. The integration of novelistic language and the thematic of “becoming” would be one crucial element of “becoming Balzac.”

IV. *What the Novel Knows: La peau de chagrin and the Language of Life Itself*

Balzac’s early articles and essays spell out the position the writer would seek to occupy in the field of cultural production, declaring his intention to measure himself against both the literary producers scientific producers of his day. And in the “*Lettre à Nodier*,” Balzac bears witness

⁶⁶⁷ Ibid.

to a desire to accomplish this by fusing his scientific or philosophical convictions with his “*fantaisies d’artiste*.” But how would his fictions embody this two-sided regime? Balzac’s first successful novel, *La peau de chagrin*, deformed the conventions of the fantastic tale to accommodate reflections on contemporary society and the state of literary and scientific production, adapting the tale’s repertoire of tics and tropes to the requirements of long-form fiction. The novel’s protagonist, Raphaël de Valentin, encounters the eponymous wild ass’s skin in an antiquarian shop in Paris, where he is told that the skin possesses magical powers: endowed with the ability to grant its owner’s wishes, the skin also exacts a quantity of life with each wish fulfilled. Raphaël decides to accept the skin as a gift from the antiquarian, and, discovering that it undeniably *does* shrink, spends the rest of the novel trying either to debunk it or to prevent it from doing so. While the shrinking of the skin is initially instigated by propositions in the form “I wish that. . .” it is soon shown to contract in response to desires, to mere instances of volitions, and even, finally to the bare fact of being alive. (One has the sense that with these changes, the novel undergoes a series of growing pains, negotiating various philosophical and narrative imperatives as it progresses.) Throughout, the wild ass’s skin realizes life itself as a quantifiable object, materializing life in a metaphorical register in anticipation of what Balzac and other proponents of the synthetic ideal envisioned performing in a literal one. If the advent of the positive sciences, as Foucault writes, had caused the animation of the organism to escape from the “*lois générales de l’être, tel qu’il se donne et s’analyse dans la représentation*,” the figure of the wild ass’s skin enables Balzac to manifest life itself in the order of representation.⁶⁶⁸ The life itself of the positive sciences functions like the movement of pure becoming which Balzac characterizes as “abyssal”; “*point de fuite souverain, indéfiniment éloigné mais constituant*,” it is consequently ruled out of scientific representation. But whereas the positive sciences let life flee into the “*obscur de l’organisme*” Balzac transforms it in this novel into the self-evidence of a visible object.⁶⁶⁹ In materializing life itself, the magic skin *figures* the quantifiability of life in consonance with the way Geoffroy Saint-Hilaire, Balzac and others had quite literally affirmed the mathematization of life as the goal of a new science.

In writing a fantastic novel, Balzac appealed to the contemporary vogue for the fantastic tale, but he also sought to form a reading public that did not yet exist as such. As José-Luis Diaz suggests, Balzac experiments with a variety of modes of writing at this stage of his career, his output divided between the *Physiologie du mariage* (1824-29), the *Chouans* (1828-29), the *Scènes de la vie privée* (1830) and *La peau de chagrin* (1831). “*Plusieurs Balzac s’inventent alors*,” he writes, “*dans une compétition une peu brouillonne, dont le palmarès ne se dégagera peu à peu, au gré de leur réussite auprès des lecteurs*.”⁶⁷⁰ Yet if Balzac goes on to mine the fantastic vein following the success of *La peau de chagrin*, this is not solely a response to external demand; rather, Balzac must first produce the audience capable of reading his works in the way they are meant to be read. As the avant-garde of a symbolic revolution, *La peau de chagrin* stakes out an impossible position, illegible to its initial audience as such. But the novel’s popular-

⁶⁶⁸ *Les mots et les choses*, 290-91.

⁶⁶⁹ *Ibid.*, 280, 290.

⁶⁷⁰ *Devenir Balzac*, 10.

ity presented Balzac with a peculiar challenge; for while the works corresponding to an impossible position are generally illegible to their initial audiences, Balzac was faced with the difficulty of compelling his readers to recognize his position as impossible in the first place. If with *La peau de chagrin* he offered grounds for integrating the *vie extérieur* of the writer with his capacity for thought, the “*fantaisies d’artiste*” with weighty assertions, how could he be sure that his readers were cognizant of both?

In *La peau de chagrin*, the figure of the wild ass’s skin serves both artistic and philosophic ends, its recto conveying the fantastic element that proved so popular in this period, its verso conveying a series of notions regarding life itself. While the figuration of life in the form of the ass’s skin already entails a certain number of presuppositions about the nature of life itself, most notably that it could constitute an object of scientific inquiry in the first place, the novel unfolds as an open-ended effort to imagine what discourses might be adequate to representing it. This “thinking” of life within the discourse of the novel evokes Paul Bénichou’s account of the difficulty of isolating the intellectual content of Romantic poetry. “*Ni le français ni aucune langue que je sache n’ont de mot pour désigner de façon distinctive le type de pensée qui fait l’objet de ce livre,*” he writes in *Les Mages romantiques*. “*On est conduit, dans un travail comme celui-ci, à employer tour à tour, selon la circonstance, les mots ou expression “pensée”, “philosophie”, “religion”, “credo”, “profession de foi”, “vue des choses”, “distribution de valeurs”, “figuration”, “idéologie” même, ou tout autre terme qui convienne à l’occasion, et à tenir pour sous-entendu que le poète, quoi qu’il pense, le pense en poète.*”⁶⁷¹ In *La peau de chagrin*, Balzac thinks life, if not like a poet, then like a novelist, answering the call of the literary market while inventing means to mobilize his notions in dramatic form.

A certain kind of thinking happens in the novel as it incorporates and deforms discourses which it adopts from other literary and professional settings. As Bakhtin suggests in his famous essay “Discourse in the Novel,” the novel as a genre is distinguished by the combination of “subordinated, yet still relatively autonomous, unities . . . into the higher unity of the work as a whole.”⁶⁷² If Balzac plays a particularly illustrious role in the development of the novel as a genre composed of such discursive unities, *La peau de chagrin* sets the tone for the discursive diversity that would characterize his future works and the virtuosity with which these discourses would be employed. As Bakhtin observes, the novel form is capable of absorbing a multitude of kinds of discourses, and in *La peau de chagrin*, the development of the representation of life as a primary theme in the work is furthered by assimilating what Bakhtin calls “various forms of literary but extra-artistic authorial speech (moral, philosophical or scientific statements, oratory, ethnographic descriptions, memoranda and so forth),” in particular.⁶⁷³ The assimilation takes place in a programmatic way, as Raphaël consults with a succession of scientific and medical figures, each unable to explain the mystery of the ass’s skin. The conceit of the skin gives the novel a pretext for dialogizing “scientific,” “medical” and finally “literary” discourses of Nature,

⁶⁷¹ Paul Bénichou, *Romantismes français*, vol. 2, *Les mages romantiques* (Paris: Gallimard, 2004), 991-92.

⁶⁷² Mikhail Bakhtin, “Discourse in the Novel,” *The Dialogic Imagination: Four Essays* (Austin: University of Texas Press, 1981), 262.

⁶⁷³ *Ibid.*

which successively comment upon or physically manipulate the skin. These heterogeneous discourses are clearly set off from the surrounding novelistic discourse, bounded as relatively discrete units thanks to the prevalence of “pastiche” as a dialogic mode in the novel; Raphaël’s consultations with scientific and medical experts take place in scenes patterned on similar consultations in Molière, and his efforts to find a “hygienic” cure for his waning vitality compel Balzac to pastiche the literary discourses of the “spectacle of Nature” and the “rêverie,” as well. This aspect of the novels’ heteroglossia operates in a critical mode, assigning a value to the various professional and literary discourses it incorporates from the point of the view of its central problematic—the representation of life itself. As such, one of the novel’s general ironies is that it dialogizes a diversity of discourses as a means of arguing for the necessity of a new, unitary language, a language adequate to the representation of life.

Bakhtin’s account of the “intentional possibilities of language”⁶⁷⁴ comports an analysis of the ways discursive units, including the novel as a whole, anticipate their audiences, responding to them as if in advance. The distinct marker of the novel genre is its capacity to coordinate exogenous discourses in the making of a finished artistic whole, but the special *fictional* character of the novel additionally compels us to ask how the negotiation of truth and untruth characteristic of the mode of fictionality conditions the intentional possibilities of the whole work. Balzac’s especially sophisticated handling of the interface between the novel and its readers hints at the challenges he faced in initiating a symbolic revolution, advancing an ideal which did not yet have the luxury of an understanding public. While Balzac’s dialogization of professional and literary discourses pursues a critical epistemic mode, in which each successive discourse is tested against the problem of representing life itself and found to fall short, the novel’s negotiation of the boundary between text and reader enacts a socially creative dynamic, in which Balzac’s representation of the world within the fiction induces his readers to take certain assumptions about the world outside of it to heart. The novel’s critical dialogic mode tells us that no synthetic doctrine guides the real-world medical or physical sciences contemporary with the novel, and it designates the aims and characteristics of such a doctrine while suppressing any details. In so doing it plays what Catherine Gallagher identifies as a game of referentiality characteristic of fiction, in which the generality of a fictional element in whose existence we are asked to believe leaves us more likely to believe in its existence than we would if this element were assigned a particular and discrete, real-life historical identity. We may deem a fictional character who is not meant to correspond with a real, historical individual more plausible than one who is, and the absence of the doctrine at the center of the novel follows the same logic, leaving us more inclined to believe that it could plausibly function in the extra-textual world than if it were textually cited. This element of belief is crucial, I think, to Balzac’s efforts to fashion a public sympathetic to the synthetic ideal. Through the mode of fictionality in evidence in *La peau de chagrin*, Balzac posits a real-world lack that we ourselves may feel compelled to fill, an interaction between readerly affect and the fiction’s truth claims that nudges us toward investing in the realization of the ideal.

The novel’s use of pastiche sets off the heterogeneous discourses from their textual surround, while conditioning its dialogization of these discourses. Raphaël’s consultations with scientific and medical experts echo the topos of the medical consultation in Molière, refashioning

⁶⁷⁴ Ibid., 289.

the playwright's satires of professional incompetence to skewer the state of contemporary scientific and medical knowledge. Balzac stages the "consultation" form twice, in effect, once with regard to the sciences and once with regard to medicine, showing each time that the discourses in play remain incapable of solving the mystery of the skin. In Raphaël's consultation with the savants, the problem of the skin functions to evaluate natural history and the physical sciences from the perspective of the living thing. His consultation with the zoologist M. Lavrille dramatizes the disjunction Foucault identifies between the eighteenth-century discourse of natural history and the sciences of life, showing this emblem of old-fashioned Linnaean taxonomy to be incapable of doing more than classify the skin according to the species from which it likely derived. In so doing, Lavrille proves no more capable than the Linnaeans of discerning life itself in the animal. Raphaël likewise visits the physicists Planchette and Spieghalter, and the chemist Japhet, each of whom tries and fails to manipulate the skin. In these scenes, the novel effectively inverts the hierarchy of the sciences in keeping with Geoffroy's conception, for while the positive science typically adjudged physiology according to its ability to incorporate physical and chemical techniques, as we have seen, here the physical and chemical sciences are evaluated according to their ability to solve a physiological problem. In this respect, it accomplishes in a dramatic mode what Geoffroy Saint-Hilaire had set out to show in a flatly polemical one, offering grounds for why physiology, not physics, should serve as a matrix for other sciences. Planchette's and Spieghalter's attempt to flatten the skin results in a terrifying laboratory explosion, and Japhet's attempts to slice it with a razor, submerge it in acid, and subject it to a Voltaic current all likewise end in failure. "*La science? Impuissante!*" the physicists and chemist acknowledge. "*Les acides? Eau claire! Le potasse rouge? Déshonorée! La pile voltaïque et le foudre? Deux bilboquets!*"⁶⁷⁵

If the consultation with the zoologist Lavrille dramatizes natural history's inability to recognize the problem of life itself at all, the consultation with Planchette, Spieghalter and Japhet dramatizes the inability of the exact sciences to constitute life itself as an object of scientific inquiry. Inasmuch as life itself emerges as an unanticipated byproduct of positive science in the first place, the positive sciences' inability to embrace it as a scientific object make strike us as something of a foregone conclusion. The consultation scene bears this analysis out, showing life itself in the objectified form of the skin to be intractable to the theoretical and experimental resources of the mathematical sciences. But Balzac additionally seizes the opportunity to expatiate on why and how life escapes these sciences' clutches, in terms which recall the rhetoric of the "abyss" in *Louis Lambert* and other works, as well as Geoffroy Saint-Hilaire's vitalist law of material attraction. While the sciences are increasingly adept at manipulating physical Nature, the physicist Planchette tells Raphaël, they remain as far as ever from understanding its underlying causes. "*Entre chacun des points successivement occupés par cette bille dans l'espace,*" declares Planchette, "*il se rencontre un abîme pour la raison humaine.*"⁶⁷⁶ The movement of the marble he uses to illustrate his point cannot merely be attributed to the cause of an initial shock; rather cause and effect disguise what Planchette posits as a more fundamental philosophical problem. The physicist's disquisition on the nature of movement recalls the thinking of space as pure im-

⁶⁷⁵ Honoré de Balzac, *La peau de chagrin*, *Comédie humaine*, vol. 10 (Paris: Gallimard, 1979), 251.

⁶⁷⁶ *Ibid.*, 244.

manence in Deleuze or Geoffroy Saint-Hilaire, a place where the transpositions of the object become a succession of “events,” separated by the abyss, or the infinity supposed by the eternal return of the same, as the case may be. The problem of movement in physical objects attaches to the understanding of vital objects, as well, Planchette observes. “*Tout est mouvement,*” he affirms. “*La pensée est un mouvement La mort est un mouvement dont les fins nous sont peu connues.*” In construing both thought and the transition between life and death as a function “*du repos, de la vitesse et de la lenteur,*” Planchette evokes the plane of pure immanence where Deleuze and Guattari place Geoffroy’s vitalist law of attraction, the thinking of thought as movement introducing the element of self-reflexivity characteristic of this vein of synthetic philosophy and the thinking of death as movement likewise transposing living from the regime of “life” to that of a mere effect of material dispositions. Though these notions are voiced through a character, their prevalence in other Balzac texts suggest that Planchette’s speech can be understood not as a stretch of dialogized discourse but rather as “direct authorial literary-artistic narration” by other means.⁶⁷⁷

The novel’s dialogization of medical discourse takes place in a second “consultation” scene, once again set off from the surrounding novelistic discourse as a pastiche of Molière. In this scene, the mysterious skin serve as the criterion against which these medical discourses are measured, as in the review of scientific discourses that came before them; but it no longer serves as the sole gauge of their efficacy. Though the evidence that Raphaël’s personal vitality is diminishing continues to take the form of the skin’s contraction, the evidence soon appears in Raphaël’s body, as well, in the form of ill-health. “*Pour mourir,*” muses Raphaël, “*il faut que mon organisation, ce mécanisme de chair et d’os animé par ma volonté, et qui fait de moi un individu homme, présente une lésion sensible.*”⁶⁷⁸ This shift in the way the skin functions in the novel corresponds to a new thinking of the relationship between life itself and physiological functioning, construing health as a function of the quantity of life one has left. In drawing a parallel between the size of the skin and Raphaël’s health, moreover, the novel moves closer to literalizing life itself as an element in bodies.

The nearest model for this doctor’s consultation in Molière is a scene from the *comédie-ballet L’Amour médecin* (1665), in which a succession of quack doctors fail to diagnose a lovesick girl. Where Molière satirizes the doctors for their greed, incompetence and sinister corporatism, Balzac gives his pastiche a philosophic dimension, identifying three of the four doctors with a specific medical doctrine. “*Pour arracher à la science humaine son dernier mot,*” we read, “*Valentin avait-il convoqué les oracles de la médecine moderne. Grâce à sa fortune et à son nom, les trois systèmes entre lesquels flottent les connaissances humaines étaient là devant lui.*”⁶⁷⁹ Balzac himself invents the notion that the medical sciences of the day were divided into three competing systems, a schematization of the medical field that constitutes the novel’s second step in dialogizing medical discourse, following its play on Molière. The three famous doctors “*portaient avec eux,*” we are told, “*toute la philosophie médicale, en représentant le combat*

⁶⁷⁷ “Discourse in the Novel,” 262.

⁶⁷⁸ *La peau du chagrin*, 253-54.

⁶⁷⁹ *Ibid.*, 256.

que se livrent la Spiritualité, l'Analyse et je ne sais quel Éclectisme railleur."⁶⁸⁰ With the character Caméristus standing for the doctor Joseph Récamier, identified in Balzac's schema with a royalist "Spiritualité," the fictional Brisset standing in for François-Joseph-Victor Broussais, identified with a republican materialist "Analyse," and, finally "Maugredie" standing in for François Magendie, identified with a politically autonomous, skeptical "Eclecticism," Balzac not only schematizes the medical field according to his own philosophic notions but also associates particular historical protagonists with each of these positions. (In this, Balzac might have been aided by works like Jean-Louis-Hippolyte Peisse's *Les Médecins français contemporains*, an encyclopedia of medical celebrities with a polemical bent, forged in the pitched political battles of the medical field of the day.⁶⁸¹) While these three doctors are caricatures *à clef*, designating real medical personalities, the fourth doctor, Horace Bianchon, is a character of Balzac's invention. Presented in this passage as the savior-to-be of French medicine, the young Bianchon is associated with the "synthesis" of his colleagues' three positions. Yet this synthesis is never manifested in the novel, even when Bianchon is charged with forging his colleagues' opinions into a single diagnosis and prescription. In practice, Bianchon merely adopts elements of the others' prescriptions without synthesizing them into something new, mirroring in the order of the novel Balzac's own efforts to project a new position in the field without himself realizing the ideal the position represented.

In the logic of the passage, Caméristus and Brisset designate the extreme political and intellectual poles of contemporary medicine, enforcing a rather rough translation of the positions of Récamier and Broussais, respectively. The character Caméristus compresses a variety of specific traditions in the science of man into a single figure representing "Spirituality," just as Brisset represents materialism in medicine in general. While Caméristus is characterized as an "*homme d'exaltation et de croyance . . . chef des vitalistes, poétique défenseur des doctrines abstraites de Van Helmont,*" who sees in "*la vie humaine . . . un phénomène inexplicable qui se joue des bistouris, trompe la chirurgie, échappe aux médicaments de la pharmaceutique, aux x de l'algèbre, aux démonstrations de l'anatomie,*" Brisset is characterized in a diametrically opposed manner as "*chef des organistes, le successeur des Cabanis et des Bichats, le médecin des esprits positifs et matérialistes, qui voit en l'homme un être fini, uniquement sujet aux lois de sa propre organisation, et dont l'état normal ou les anomalies délétères s'expliquent par des causes évidentes.*" In naming one doctor a spiritualist, the other a materialist, Balzac reduces these doctors' medical positions into idiomatically philosophical language. Brisset's "materialism" arises from Broussais' aggressive liberal politics and his embrace of the notion of "irritation" as a pathological term. As for Récamier, his transformation into the spiritualist, monarchist Caméristus may have more to do with his career success under the Restoration than with any particular ideological qualities. Récamier, in fact, published little and was known as a capricious speaker whose flights of improvisation made it impossible, contemporaries complained, to associate him

⁶⁸⁰ Ibid.

⁶⁸¹ Jean-Louis-Hippolyte Peisse, *Les Médecins français contemporains* (Paris: Gabon, 1827).

with a particular doctrine.⁶⁸² But in defining the doctor as “*un être inspiré*” with the God-given power to “read” into vitality, Caméristus quite clearly designates what Elizabeth Williams sums up as the spiritualization of Montpellier vitalism under the Restoration. As Williams observes, figures like the doctor and medical theorist Jean-Louis-Marc Alibert (1768-1837) assimilated the “vital principle” of the sometimes materialist Montpellier doctors to the “soul” of Catholic doctrine, and drew on a discourse of the passions to describe the rapports between the individual and its environment.⁶⁸³ Caméristus epitomizes figures like Alibert, for whom works by Bernardin de Saint-Pierre, Chateaubriand, and Alexander von Humboldt offered potentially valuable medical insights into the relationship between place and the passions. Favoring “a hygienic regime” in the mountain air, Caméristus represents the position of Alibert and others who attempted to fuse medical discourse with the spectacular tradition examined in Chapter One.

In striving to articulate a third, “skeptical” position that would halve the spiritualism of Caméristus and the materialism of Brisset, the novel quite boldly casts François Magendie as the representative of a medical, rather than a scientific position. Magendie is disguised here as “Maugredie,” described rather dashingly as “*Panurge de l’école,*” (that is of the *École de Paris*, the tradition of medicine associated with Paris, rather than Montpellier or abroad), “*roi de l’observation, ce grand explorateur, ce grand railleur, l’homme des tentatives désespérées,*” an “*esprit distingué, mais pyr rhonien et moqueur, qui ne croyait qu’au scalpel.*” Maugredie’s eclecticism is apparent in his ability to “find the good in every theory, without adopting any one”; he claims, we read, “*que le meilleur système médical était de n’en point avoir, et de s’en tenir aux faits.*” In this emphasis on facts, in the reference to the scalpel, in the way Maugredie’s skepticism of particular medical doctrines sublimates Magendie’s lack of medical affiliation, the novel attempts to incorporate elements of the real historical Magendie’s biography.⁶⁸⁴ A scientific celebrity, Magendie was likely all the more present to the public imagination given his prominence in attempting to put an end to the cholera epidemic that swept Paris the year before the

⁶⁸² See Jacyna, “Medical Science and Moral Science,” 136. Récamier also published little. In determining that Récamier used his chair at the Collège de France to attack materialist medical philosophy and promote a “spiritualist” medicine, Jacyna refers to such polemical texts as E. F. Dubois, “Récamier” in *Éloges lus dans les séances publiques de l’Académie de Médecine (1845-1863)*, vol. 2 (Paris, 1864), 1-52; and J. L. H. Peisse, “M. Récamier,” in *Les médecins français contemporains*. Also, see P. Triaire, *Récamier et ses contemporains 1774-1832* (Paris, 1899), ch. 11; and F.-A. Isambert, *De la charbonnerie au saint-simonisme: Étude sur la jeunesse de Buchez* (Paris, 1966).

⁶⁸³ As Williams points out, Alibert’s *Physiologie des passions* (1825) attempts to illustrate the influence of milieu on the individual’s passions in parables like the story of a Guyanese girl who, though educated in France, fails to flourish there, and pines for her “natural” home.

⁶⁸⁴ Though Magendie defended a medical thesis at the Faculté de Médecine in 1808, he resigned his post as *aide* and *prosecteur* (in charge of preparing dissections) in 1813 due to conflicts with a superior, then tried and failed in 1818 to secure a chair in anatomy and physiology at the Faculté de médecine. By the time the novel was written, Magendie had quite brilliantly effected a transition from medical to scientific life, as we have seen, through the invention of the new science of experimental physiology and the, in which animal vivisection made it possible to study living bodies without the burden to cure brought to bear by medicine. Having already begun pursuing the patronage of Laplace, Geoffroy Saint-Hilaire and others, however, he was admitted to the Académie des sciences in 1821 and eventually joined the committee of the prestigious Montyon prize, giving him official sway over physiological questions in French scientific life. See Williams, *The Physical and the Moral*, 132. On Magendie see also, John Lesch, *Science and medicine in France: the emergence of experimental physiology, 1790-1855* (Cambridge, MA: Harvard University Press, 1984).

novel's publication. Yet as in the cases of Récamier and Broussais, Magendie's biography is substantially distorted in order to conform medical discourse to the novel's philosophical program.

The fourth doctor, Bianchon, plays a crucial role in the intellectual economy of the novel, representing the novel's medical point of view and setting the stage for the key moments of heteroglossia that follow. Bianchon is a wholly fictional character rather than a character *à clef*, like the other doctors; and while the other doctors represent Balzac's notion of medical science as it then existed, Bianchon represents the possibility of achieving a new medical synthesis. As such, the character helps to dialogize the medical discourses invited into the novel, as well as to smooth the transition from the discursive unity of the pastiche to the novel's subsequent episodes of dialogization. The novel tells us that Bianchon is one of the young doctors who are working to achieve a synthesis of current medical philosophies, an expression of the synthetic ideal in medical form. "*Homme plein d'avenir et de science,*" as the novel describes him, "*le plus distingué peut-être des nouveaux médecins,*" Bianchon is also a "*sage et modeste député de la studieuses jeunesse qui s'apprête à recueillir l'héritage des trésors amassés depuis cinquante ans par l'École de Paris, et qui bâtitra peut-être le monument pour lequel les siècles précédents ont apporté tant de matériaux divers.*"⁶⁸⁵ Within the novel itself, Bianchon's prescription inevitably falls short of fulfilling this program, inasmuch as it achieves a mere consensus among the three other doctors, and nothing more. "*Ces messieurs ont unanimement reconnu la nécessité d'une application immédiate de sangsues à l'estomac,*" Bianchon tells Raphaël, "*et l'urgence d'un traitement à la fois physique et moral.*"⁶⁸⁶ Acting in an "eclectic" manner that presumably satisfies Maugredie, Bianchon additionally recommends "*un régime diététique*" to satisfy Brisset and "*un régime hygiénique*" to satisfy Caméristus. Within the narrative economy of the novel, this prescription prompts a visit to the baths of Aix en Savoie and of Mont-Dore in Auvergne, an excursion that doubles as an excursus, a deferral of the novel's end. For if the general narrative momentum of the novel suggests that Raphaël is doomed to die, these travels delay the inevitable to no other end, it seems, than to provide the novel an opportunity to dialogize additional discourses. Once again, Balzac resorts to pastiche as a means of incorporating heterogeneous forms; this time, however, no particular character embodies them, and the rhetoric of the discourses itself forms the object of the pastiche.

These patches of pastiche hide in plain sight within the novel, camouflaged all the better in dialogizing authorial speech of a distinctly literary nature. In particular, the novel appropriates two discursive forms which flourished broadly in the literary culture of the eighteenth and nineteenth centuries, the "spectacle of Nature" and "rêverie." In spite of the general currency of these discourses, the novel links them to Rousseau in particular, the figure who perhaps more than any other established the conditions for the emergence of discourse on Nature in the letters of the period. Though Rousseau himself goes unmentioned in the novel, a complex set of allusions to *Julie, ou la Nouvelle Héloïse* (1761) and the *Rêveries du promeneur solitaire* (1776-78) in particular help establish the citational character of the novel's moments of spectacle and rêverie,

⁶⁸⁵ *La peau du chagrin*, 257.

⁶⁸⁶ *Ibid.*, 262.

while provoking questions about the novel's own relation to literary tradition.⁶⁸⁷ Here, the practice of pastiche lends itself to a more open-ended inquiry into the conceptual potentials of the discursive strands it appropriates than did the consultation scenes. In this respect, Balzac's technique resembles the "maximal interpretation" that Deleuze famously exercised on certain philosophers of the past, extending their conceptual categories to meet his own set of philosophic concerns.⁶⁸⁸ By juxtaposing the rhetorical forms of the spectacle and of *rêverie* with the novel's central philosophical problem, Balzac effectively asks whether the discourses of moral hygiene to which they are attached in Rousseau's oeuvre might bear any relation to the understanding of life itself. Balzac does so by asking what relationship the constructions of space supposed by the rhetorics of "spectacle" and of "rêverie" might bear to the question of milieu as an element in the thinking of living form. The novel dialogizes the discourses of "spectacle" and "rêverie" by showing that at different moments Raphaël experiences his environments through the schemes of perception they suppose, while experimenting with the effects different milieux exert on his moral and physical well-being. If Geoffroy casts humankind as receiving the "*principaux motifs d'intelligence du concours de son monde ambiant*," and Balzac alludes to the synthesis of ideas and milieux through the motif of the "*miasme*," Raphaël attempts to live in such a way that the influence of the milieu might penetrate to the sources of his vitality or that his personal existence might be dispersed in the activity of the milieu.

As I argued in Chapter One, the "spectacle of Nature" is one of the most prevalent and powerful rhetorical forms in eighteenth-century discourse, shaping the perception of Nature in natural philosophy, fiction, experimentation and beyond. In *La peau de chagrin*, the spectacle form shapes Raphaël's perception of the Nature at Aix, conveying a sense of the ordered multiplicity of Nature and the providential commensurability of the human and the natural orders. The description of the landscape at Aix is set off as a distinct discursive unit thanks to a network of references linking the passage to literary standards like Lamartine's "Le Lac" as well as to Saint-Preux's famous description of the Valais in *La Nouvelle Héloïse* (Lettre XXIII à Julie).⁶⁸⁹ The singularly late 18th-century variety of wonder that the synopses of Nature and Culture, far and near, light and dark, great and small, spring, summer, autumn and winter convey in Saint-Preux's letter to Julie finds a precise corollary in Balzac's description of a mountain landscape in which, we read, "*ces harmonies et discordances composent un spectacle où tout est grand, tout est petit.*"⁶⁹⁰

Saint-Preux's description of the Valais exemplifies how the quirks of optics and a providential orientation to Nature coalesce in the "spectacle" form:

⁶⁸⁷ The exogenous character of these stretches of discourse is also linked to the novel's composition history. The description of the lac du Bourget, where the thematics of the spectacle is established, is first introduced in the edition of 1833. Honoré de Balzac, *La peau de chagrin*, ed. Pierre Citron (Paris: Gallimard, 1979), 10: 269d.

⁶⁸⁸ See, for example, Deleuze, *Expressionism in Philosophy: Spinoza*, trans. Martin Joughin (NY: Zone Books, 1990).

⁶⁸⁹ *La peau de chagrin*, 267-69.

⁶⁹⁰ *Ibid.*, 269.

Ce n'était pas seulement le travail des hommes qui rendait ces pays étranges si bizarrement contrastés: la nature semblait encore prendre plaisir à s'y mettre en opposition avec elle-même, tant on la trouvait différente en un même lieu sous divers aspects! Au levant les fleurs du printemps, au midi les fruits de l'automne, au nord les glaces de l'hiver: elle réunissait toutes les saisons dans le même instant, tous les climats dans le même lieu, des terrains contraires sur le même sol, et formait l'accord inconnu partout ailleurs des productions des plaines et de celles des Alpes. Ajoutez à tout cela les illusions de l'optique, les pointes des monts différemment éclairées, le clair-obscur du soleil et des ombres, et tous les accidents de lumière qui en résultaient le matin et le soir; vous aurez quelque idée des scènes continuelles qui ne cessèrent d'attirer mon admiration, et qui semblaient m'être offertes en un vrai théâtre; car la perspective des monts, étant verticale, frappe les yeux tout à la fois et bien plus puissamment que celle des plaines, qui ne se voit qu'obliquement, en fuyant, et dont chaque objet vous en cache un autre.⁶⁹¹

Rousseau's famous text epitomizes a tradition in which the optics of the spectacle elicit "admiration" for or gratitude to God. Balzac's rewriting of this passage makes a similar connection:

Être [dans le lac] dans une barque au milieu de cette nappe par un beau ciel, n'entendre que le bruit des rames, ne voir à l'horizon que des montagnes nuageuses, admirer les neiges étincelantes de la Maurienne française, passer tour à tour des blocs de granit vêtus de velours par des fougères ou par des arbustes nains, à de riantes collines; d'un côté le désert, de l'autre une riche nature; un pauvre assistant au dîner d'un riche; ces harmonies et ces discordances composent un spectacle où tout est grand, où tout est petit. L'aspect des montagnes change les conditions de l'optique et de la perspective: un sapin de cent pieds vous semble un roseau, de larges vallées vous apparaissent étroites autant que des sentiers. Ce lac est le seul où l'on puisse faire une confiance de coeur à coeur. On y pense et on y aime. En aucun endroit vous ne rencontreriez une plus belle entente entre l'eau, le ciel les montagnes et la terre. Il s'y trouve des baumes pour toutes les crises de la vie. Ce lieu garde le secret des douleurs, il les console, les amoindrit, et jette dans l'amour je ne sais quoi de grave, de recueilli, qui rend la passion plus profonde, plus pure. Un baiser s'y agrandit. Mais c'est surtout le lac des souvenirs; il les favorise en leur donnant la teinte de ses ondes, miroir où tout vient se réfléchir. Raphaël ne supportait son fardeau qu'au milieu de ce beau paysage; il y pouvait rester indolent, songeur et sans désirs.⁶⁹²

In these passages, the spectacle's capacity to distort proportion, to make large things seem small and small things seem large, acts in both the physical and the moral orders: in Saint-Preux's and Raphaël's experience, large objects recede from view and small ones expand; for Saint-Preux, moreover, the spectacle diminishes undesirable passions, while for Raphaël it magnifies the memory of a kiss. This extraordinary phenomenon accords with the larger tradition of the specta-

⁶⁹¹ Jean-Jacques Rousseau, *Julie, ou la Nouvelle Héloïse*, Letter xxiii.

⁶⁹²*La peau du chagrin*, 269.

cle, in particular with the aesthetics of “absorption” which Michael Fried has famously identified as a common feature of eighteenth-century French painting and art criticism. In Fried’s account, Diderot’s dictum that “*la morale et la perspective*” are the artist’s two essential qualities serves to emphasize how the spectacle’s peculiar optics designate an ethically prescriptive standpoint for the spectator.⁶⁹³ This standpoint accords with the spectacle’s status as what I earlier suggested can be called a “synopticon:” its power as a style of representation derives from the breadth, both spatial and temporal, of the objects it is capable of condensing--*each* of the seasons, the entire *range* of terrestrial topographies, the chiaroscuro of light and dark--as well as from the way this representational power is understood to convey an ethically supreme position. The visual logic of the spectacle, its multiplicity in unity, its tendency to convey the impression, as Fried puts it, that the viewer’s fixed position is “[dissolving] as it were beneath his feet,” is associated throughout its history with the power to generate extreme delight in its beholders, an affect intimately bound up with its ethical power.⁶⁹⁴ There is, says Saint-Preux, something supernatural about the spectacle; in the swimming of objects before one’s eyes, without one’s willing, he says, one forgets everything, most of all oneself and where one is. The spectacle, Diderot echoes in the Salon of 1767, makes one forget oneself yet also causes one to recognize oneself for as virtuous as one really is. For both, the experience of recognizing a virtuousness that is essentially one’s own while also, seemingly, other, coincides with the curbing of desire and an impression of self-sufficiency. “If there is a God,” Diderot concludes, “this is how he is, he takes pleasure in himself.”⁶⁹⁵

The evocation of an experience that leaves the spectator “without desires” bears a clear thematic pertinence to Raphaël’s predicament. Given the link the novel establishes between desire and volition, Raphaël comes to view the task of conserving vitality as encompassing the suppression of desire. The conceptual cluster linking desire, milieu and health already exists in the tradition of the spectacle, a framework clearly conveyed in Saint-Preux’s letter to Julie. The view from the mountain, Saint-Preux reflects, inspires a state that is “*grave sans mélancolie, paisible sans indolence,*” where one is “*content d’être et de penser,*” and where “*tous les désirs trop vifs s’émoussent.*” So powerfully do milieux mediate passions, Saint-Preux asserts, that “*Un heureux climat fait servir à la félicité de l’homme,*” as he puts it, “*les passions qui font ailleurs son tourment.*” Yet the optical effects which he experiences as particularly therapeutic are confined to the mountain landscape. The sight of thunderstorms forming below one’s vantage point, he adds, is an “*image trop vaine de l’âme du sage, dont l’exemple n’exista jamais, ou n’existe qu’aux mêmes lieux d’où l’on en a tiré l’emblème.*” This image is “vain” because the wise soul it symbolizes cannot exist anywhere other than on the very sort of mountain top where Saint-Preux himself experiences it. While the spectacle Saint-Preux witnesses becomes a moral paradigm for relating to self and space in general, the mountaintop milieu is so singular in con-

⁶⁹³ Denis Diderot, *Pensées détachées*, qtd. in Michael Fried, *Absorption and Theatricality: Painting and Beholder in the Age of Diderot* (Berkeley: University of California Press, 1980), 93.

⁶⁹⁴ Michael Fried, *Absorption and Theatricality: Painting and Beholder in the Age of Diderot* (Berkeley: University of California Press, 1980), 134.

⁶⁹⁵ Denis Diderot, *Salon de 1767*, qtd. in Fried 126-26.

struction that the wisdom conferred by spectacular vision can only really be acquired when one is there.

By proposing milieu as a medium through which individuals might allay their moral ills, Rousseau designates place as an element in a literary technology of the passions. This technology is capable of modifying both physical and moral being, as Saint-Preux suggests in imagining that the mountain milieu might one day serve as a therapeutic retreat. “*Je doute,*” he remarks, “*qu’aucune agitation violente, aucune maladie de vapeurs pût tenir contre un pareil séjour prolongé, et je suis surpris que des bains de l’air salubre et bienfaisant des montagnes ne soient pas un des grands remèdes de la médecine et de la morale.*”⁶⁹⁶ In this formulation, Rousseau forges a conceptual cluster linking the notions of health, milieu and the passions. Yet even if the suppression of desire associated with the experience of the mountaintop spectacle might be imagined to answer Raphaël’s therapeutic needs, the fact that narrative events compel him to depart the sanctuary at Aix implies that the conceptual cluster organized by the “spectacle” does not fully satisfy the novel’s philosophical imperative. The novel’s focus on the state of Raphaël’s body suggests that it locates the authentic medical expression of the synthetic ideal in a physiological register, and while the discourse of moral and physical hygiene associated here with the spectacle of Nature offers a way of understanding how Raphaël might experience a therapeutic effect, it does not offer a means of understanding the role played by the body in the achievement of this effect. By reconstructing the moral and visual logic of the spectacle in the midst of a sequence that stresses the physical logic of the ailing body, Balzac asks, in effect, how and whether the spectacle can be made to function as a physiological discourse. Established entirely through circumstantial, rather than expository or allegorical means, Balzac’s mode of inquiry here relies on the performative efficacy of juxtaposing a stretch of exogenous discourse with the novel’s central problem of vitality.

Though the skin is curiously absent from this passage, the novel’s narrative economy offers means of gauging its perspective on the spectacle as a possible language of life itself. Initially happy at Aix, Raphaël is increasingly persecuted by the other inmates of the baths, though the novel’s passages of immersion in his point of view make it impossible at times to tell whether this is really an effect of paranoia. As Raphaël is obliged to flee the baths, the novel’s restless appropriation and repudiation of exogenous discourses implies its dissatisfaction with each. Having evoked the paranoia and the persecution of the Rousseau of the *Rêveries du promeneur solitaire*, the novel now launches a pastiche of “rêverie” as a mode of perception. But as with “spectacle” and the other discourses it has co-opted, the novel extends Rousseau’s writing of rêverie by asking how the relationship between the self and the milieu it supposes might orient a thinking of life itself. While “spectacle” had animated a kind of exultant heteroaffection, Balzac appropriates “rêverie” as the experience of an utter confusion between self and world, as a shrinking of the scope of consciousness, and eventually as a form of perception without ideation. Following Bianchon’s prescription, Raphaël flees to the Auvergne, lodging with a peasant family and spending his days alone in the surrounding wilderness. As in Rousseau, rêverie is associated here with a particular experience of Nature, in which mind is dispersed in the surrounding envi-

⁶⁹⁶ Rousseau, *La Nouvelle Héloïse*, 1:Lettre 23.

ronment and the environment is drafted into an experience of self. While Raphaël imagines that the mode of “natural” living corresponding to his experience of rêverie is replenishing his vitality, the narration departs from his perspective for the first time in the novel to expose it as a delusion, a manifestation of his pathology. These almost hallucinatory pages compress many motifs that would become prevalent in the life-writing of later Balzac novels, consigning them here to a sort of cadenza performed on literary-natural philosophical themes.⁶⁹⁷ Chief among them are allusion to events, places and language found in Rousseau’s *Rêveries*, motifs through which the novel dialogizes Rousseau’s particular brand of rêverie with respect to its own work on life.⁶⁹⁸

The novel’s use of rêverie evokes the dynamic of self-reflexivity characteristic of the synthetic ideal. Self-reflexivity is already a feature of rêverie in Rousseau, for whom it induces a sense of confusion about the limits of self and world. Contemplating the waters of the *lac de Biemme*, for instance, Rousseau begins to perceive the outside world in a way that rebounds to alter his experience of self. “*Le flux et reflux de cette eau,*” Rousseau writes in the famous “Septième Promenade,” “*son bruit continu mais renflé par intervalles, frappant sans relâche mon oreille et mes yeux, suppléaient aux mouvements internes que la rêverie éteignait en moi et suffisaient pour me faire sentir avec plaisir mon existence sans prendre la peine de penser.*”⁶⁹⁹ The sounds of the water “supplement” Rousseau’s internal movements, generating a slippery superposition of internal and external action. As he goes on to affirm, moreover, the pleasurable sense of his own existence induced by this threshold-state corresponds to a falling off of thought and a contraction of the scope of his awareness. “*Mes idées ne sont presque plus que des sensations,*” he observes, “*la sphère de mon entendement ne passe pas les objets dont je suis immédiatement entouré.*”⁷⁰⁰ For Raphaël, the self-reflexivity of rêverie is likewise associated with the contraction of consciousness; but where Raphaël himself construes this experience of narrow existence as a means of conserving life, the novel diagnoses the shrinking of his awareness as an effect of his infirmity. The ambivalent status conferred on rêverie is apparent in a passage in which Raphaël resolves to live out the rest of his days in the Auvergne: “*Devenir une des huîtres de ce rocher, sauver son écaille pour quelques jours de plus en engourdissant la mort, fut pour lui,*” we read, “*l’archétype de la morale individuelle,*

la véritable formule de l’existence humaine, le beau idéal de la vie, la seule vie, la vraie vie. Il lui vint au coeur une profonde pensée d’égoïsme où s’engloutit l’univers. À

⁶⁹⁷ Balzac completed the end of the novel in extreme haste in July 1831. “Dernière interruption, trahissant peut-être des difficultés de rédaction, juste avant la consultation des quatre médecins: les chapitres XLVII à LIII et la conclusions ne sont composés que les 29 et 30 juillet.” Pierre Citron, “Histoire du texte,” *La peau de chagrin*, 1224-25.

⁶⁹⁸ The covert yet programmatic spirit of this bricolage is suggested by a sentence constructed around the title of Rousseau’s work, in the manner of a rebus or enigma: “*Étonné de rencontrer des promeneurs dans cette partie du lac ordinairement solitaire,*” we read, “*le marquis examina, sans sortir de sa rêverie, les personnes assises dans la barque.*” *La peau de chagrin*, 270.

⁶⁹⁹ *Rêveries*, 1045.

⁷⁰⁰ *Rêveries du promeneur solitaire* (Paris: Gallimard, 1959), 1066.

*ses yeux, il n'y eut plus d'univers, l'univers passa tout en lui. Pour les malades, le monde commence au chevet et finit au pied de leur lit. Ce paysage fut le lit de Raphaël.*⁷⁰¹

As this passage suggests, Raphaël imagines rêverie in terms similar to those adopted by Rousseau, experiencing it as a state in which the burden of thinking or willing is lifted and a delicious sense of one's own existence surfaces in its place. But the novel entirely revalorizes the discourse of rêverie in conjunction with a thinking of life itself, construing this confusion of self and world as a symptom of diminishing vitality. The narration insists on the pathos of Raphaël's fall from the life of ambition and vision he led in former times to the abject life he leads now, an oyster on a rock. Elsewhere, the narration regrets that "*cet homme d'imagination si puissamment active,*" as we read, "*s'abaissa jusqu'à la hauteur de ces animaux paresseux qui croupissent au sein de forêts, sous la forme d'une dépouille végétale, sans faire un pas pour saisir une proie facile.*"⁷⁰² These motifs of base life—the oyster or this other nameless predator—express the egoism of Raphaël's resolution to live as though the only thing at stake in life was the conservation of life itself.

Even as the novel distances itself from Raphaël's point of view, it pauses to cast the "*rêveries matérielles*" he experiences as a state its readers may themselves have known. "*Qui n'a pas, une fois dans sa vie, espionné les pas et démarches d'une fourmi,*" the novel asks, "*glissé des pailles dans l'unique orifice par lequel respire une limace blonde, étudié les fantaisies d'une demoiselle fluette, admiré les mille veines, colorées comme une rose de cathédrale gothique, qui se détachent sur le fond rougeâtre des feuilles d'un jeune chêne?*"

*Qui n'a délicieusement regardé pendant longtemps l'effet de la pluie et du soleil sur un toit de tuiles brunes, ou contemplé les gouttes de la rosée, les pétales des fleurs, les découpures variées de leurs calices? Qui ne s'est plongé dans ces rêveries matérielles, indolentes et occupées, sans but et conduisant néanmoins à quelque pensée? Qui n'a pas enfin mené la vie de l'enfance, la vie paresseuse, la vie du sauvage, moins ses travaux? Ainsi vécut Raphaël pendant plusieurs jours, sans soins, sans désirs, éprouvant un mieux sensible, un bien-être extraordinaire, qui calma ses inquiétudes, apaisa ses souffrances.*⁷⁰³

In this passage, the novel perpetuates its understanding of the egoism of rêverie by placing Raphaël—and by extension its readers—on a level with a population of marvelous but nevertheless base forms of life: an ant, a slug, a dragonfly. And it highlights the universality of rêverie by presenting it as an expression of the mentality of childhood, not least in the odd detail whereby the suffocation of a slug is cast as an innocent prank. The oddly magnified, technicolor matter of Raphaël's consciousness in this passage echoes the reduced scope of mind which Rousseau vaunts in his depiction of rêverie. And in its evocation of "*rêveries matérielles*" the passage also echoes the confusion of mind and matter implied in Rousseau, casting the nature of which Raphaël remains aware as a kind of material realization of thought. The novel effectively re-

⁷⁰¹ *La peau du chagrin*, 281.

⁷⁰² *Ibid.*, 289.

⁷⁰³ *Ibid.*, 282.

writes *rêverie* as a statement of the notion of the “*pensée matérielle*” which preoccupies Balzac in *Louis Lambert* and elsewhere, portraying Raphaël as wishing to dissolve himself in materialized thought, much like the miasma of ideas which clings to the grove where one of Napoleon’s soldiers has committed suicide. Prior to Balzac’s invention of a mode of realist description in which, as Auerbach points out, the dominant motif is the synthesis of character and milieu, this appropriation of *rêverie* enables the novelist to achieve an initial statement of such a synthesis.

This notion of “*rêverie*” as material thought is linked to the novel’s central conceit through a discourse of will, which the *Rêveries* already incorporate in an incipient form. At the lake, Rousseau is delighted to achieve a novel sense of existence without really trying, contrasting the tedious application of “*réflexion*” or “*méditation*” to the benefits that accrue from *rêverie*, which occur “*sans prendre la peine de penser*.”⁷⁰⁴ If Rousseau understands *rêverie* to arise with the suspension of active willing, the novel links this notion of willessness to Raphaël’s attempts to prevent discharges of volition as a means of conserving his life. His “*rêveries matérielles*” are cast as a kind of willess willing, “*indolentes et occupées, sans but et conduisant néanmoins à quelque pensée*.” As such they suggest a dynamic in which Raphaël might maintain a mode of consciousness without exhausting his vital resources. As in the pastiche of spectacle, the skin is absent from this episode as a gauge of Raphaël’s vitality, and the novel foregrounds his body as such a gauge instead. Though Raphaël exults in what he experiences as “*une seconde enfance*,”⁷⁰⁵ he is rudely confronted with the reality of his wasting body when he overhears the peasant woman with whom he lodges speaking to a visitor: “*Pauvre jeune homme*,” she laments, “*il est sûr qu’il ne peut guère ben finir. C’te fièvre, voyez-vous, ça vous le mine, ça le creuse, ça le ruine! Il ne s’en doute point. Il ne le sait point, monsieur. Il ne s’aperçoit de rien*.”⁷⁰⁶ The reappearance of Raphaël’s body as a gauge of his vitality reinforces the link the novel has drawn between medical discourse and the synthetic ideal, as represented by the skin, and posits *rêverie*’s capacity to exert a physiological effect as the ultimate test of its viability. Having discovered that he continues to waste away in the Auvergne, Raphaël returns to Paris, where he asks Bianchon to sedate him, and succeeds in surviving in a vegetative state until he happens to be awoken and swiftly dies. In this pastiche or discursive “*maximization*,” Balzac has rewritten *rêverie* to determine the degree to which it could function as a language of life itself, linking it to the problem of material thought and the relationship between will and vitality. The novel’s perspective on the degree to which *rêverie* might function to that end remains implicit, conveyed only by means of its narrative economy. The disappearance of the skin and Raphaël’s death not only reaffirm the status of the skin as a figure for material life but also suggest that none of the exogenous discourses has in any way succeeded in representing or manipulating life itself.

The novels’ dialogization of these scientific, medical and literary discourses has primarily performed a critical function, demonstrating the degree to which they each fail to represent or

⁷⁰⁴ As Starobinski and others have shown, *rêverie* figures in Rousseau as a kind of askesis, a self-reflexive practice oriented toward achieving a state in which self-reflexivity is impossible or unnecessary. Jean Starobinski, “*Rêverie et transmutation*,” *Jean-Jacques Rousseau: la transparence et l’obstacle* (Paris: Gallimard, 1971), 415-29.

⁷⁰⁵ *La peau du chagrin*, 282.

⁷⁰⁶ *Ibid.*, 283.

manipulate life itself, acting upon it as such or transforming it into a feasible object of representation or technique. Perhaps the novel has never really presumed that these exogenous discourses would effectively do so; yet the novel's treatment of these discourses takes on an experimental feel at times, as though it were thinking through the degree to which they might be deformed by the problem of "life." Even in its critical mode, the novel perhaps undertakes the kind of "thinking" of the sort cited by Bénichou, enacting a "*pensée*," "*vue de choses*," "*figuration*" or "*distribution de valeurs*," as it were, according to its means. Whatever the novel thinks of life itself, it thinks it as a novel.

Though *La peau de chagrin* omits to put forth a positive conception of what a language of life might look like, this lack may represent its most creative measure in the advancement of a synthetic ideal. Fiction in general works its magic in inducing us to believe in characters whom we know to be inventions, and indeed, often to believe in them precisely to the degree that we understand them not to be meant to represent real historical persons. A fictional entity's lack of real-life coordinates lends it the freedom to evolve as a plausible element of the fiction: "The founding claim of the form," writes Catherine Gallagher of the modern novel, "was a nonreferentiality that could be seen as a greater referentiality." The very fact that the character was known not to refer to a specific extra-textual person enabled it to pertain to a class of persons, and the non-referentiality of the character concomitantly gave readers the obligation and the opportunity to realize the character themselves, as a function of their reading. In affective terms, writes Gallagher, "the fictional framework established a protective affective enclosure that encouraged risk-free emotional investment."⁷⁰⁷

This curious logic turns out to pertain as much to the "language" Balzac's novel imagines for life itself as for a given character. If the novel's critical mode allows it to articulate what is missing in the scientific, medical and literary discourses it dialogizes, this strategic lack allows the doctrine to grow as an element in the fiction, in much the same way a character might. For if some doctrine consistent with the novel's point of view were textually cited in the novel, readers would have only to determine whether they agree with it or not; whereas, presented within the fiction as a system whose parameters are in some sense "undefined," the doctrine associated with the novel's own point of view develops with the progression of the novel as an artistic whole, fictionally "alive."

The novel posits the strategic absence in question through the critical dialogization of heterogeneous discourses, present in the gap between the conceptual resources of the discourses

⁷⁰⁷ Catherine Gallagher, "The Rise of Fictionality," *The Novel*, vol. 1, ed. Franco Moretti (Princeton, NJ: Princeton University Press), 351.

in question and the problem of life itself figured by the skin.⁷⁰⁸ This gap is foregrounded by the character Bianchon, the fourth doctor in the consultation scene. As the novel tells us, Bianchon belongs to the generation of medical philosophers most likely to realize the medical science of the future, and he is himself one of this generation's leading lights. If the progress of Bianchon's career is identified with that of the doctrine in question, Bianchon's status as a recurring character within the *Comédie humaine* expands the fictional space open to the development of the doctrine beyond the bounds of *La peau de chagrin*. Balzac's system of recurrences complicates the rhetoric of fiction that characterizes individual novels in the nineteenth century, in ways that inflect the evocation of the doctrine. And this manipulation of the rhetoric of fictionality works to induce readers, I would argue, to believe in the necessity of such a doctrine, positioning them as potential participants in the realization of the synthetic ideal.

The psychological dynamic through which Gallagher understands readers to have learned to identify with characters who referred to no particular extra-textual being resembles that which can be understood to lead readers to invest in the future of a doctrine that the fiction neither cites textually within itself nor asserts exists as such in real life. Like the characters in Gallagher's account, the doctrine is at once "utterly finished," given the ends which have been assigned to it in the particular fiction (we know, for example, that it will be a monument in which centuries of medicine will culminate), and "necessarily incomplete," given the impossibility for anyone to fulfill it, to "know" it as such.⁷⁰⁹ The very venture of fiction, Gallagher proposes, required readers to "take the reality of the story itself as a kind of suppositional speculation," one which, assented to, would give out onto an experience of reading narrative in which readers were to "anticipate problems, make suppositional predictions, and see possible outcomes and alternative interpretations."⁷¹⁰ In positing a contentless philosophic doctrine, Balzac draws on the logic of fiction itself to frame a work of judgment and speculation with regard, this time, to the fate of a philosophic problem rather than to that of a particular character. The suspension of disbelief that well-contrived fictions achieve encourages this work of speculation, in which the reader might rush into the vacuum left by the doctrine's incompleteness.

If the dialogization of medical discourse states the realization of a language of life itself in medical terms, the novel associates the realization of this medical language with Bianchon in particular. As I have suggested, Bianchon has very little to do in the consultation scene, beyond cobbling together elements of the other three doctors' opinions and delivering a single eclectic prescription to Raphaël. But the novel confers an outsized importance on him nonetheless. As you will remember, the novel tells us that Bianchon is an "*homme plein d'avenir et de science, le*

⁷⁰⁸ And it posits this absence in other ways as well. Raphaël himself has written a treatise on the will, we learn, which plumbs the abyssal nature of willing and addresses the link between will and life; yet this treatise is only briefly mentioned in the text: "*Toi seul,*" Raphaël tells a friend, "*as calmé la plaie profonde que d'autres firent à mon coeur! Toi seul admiras ma Théorie de la volonté, ce long ouvrage pour lequel j'avais appris les langues orientales, l'anatomie, la physiologie, auquel j'avais consacré la plus grande partie de mon temps. Cette oeuvre, si je ne me trompe, complètera les travaux de Mesmer, de Lavater, de Gall, de Bichat, en ouvrant une nouvelle route à la science humaine.*" *La peau du chagrin*, 138.

⁷⁰⁹ *Ibid.*, 358.

⁷¹⁰ *Ibid.*, 346.

plus distingué peut-être des nouveaux médecins, sage et modeste député de la studieuse jeunesse qui s'apprête à recueillir l'héritage des trésors amassés depuis cinquante ans par l'École de Paris, et qui bâtira peut-être le monument pour lequel les siècles précédents ont apporté tant de matériaux divers."⁷¹¹ Though the novel has little to say about the content of a new medical science, this passage suggests that its composition would occur as the assembly of a variety of already existing intellectual and, presumably, institutional materials. The dual historiographies Balzac designates for this science-to-be, the first one centuries long, the second extending back only fifty years, to the days of Cabanis and Bichat, suggest just how vague an idea of the doctrine the novel may have. All the passage really conveys about the doctrine is that it exists, though it has yet to be realized; that it will be an assemblage of pre-existing materials, conceived more in terms of continuity than rupture; that it will be a totalizing "human science," rather than a work of specialization; and that it will arise from the work of a particular generation, the generation of 1820.

In associating the realization of the synthetic doctrine in its medical form with Bianchon, the novel thus hitches its future to the kind of realization available to a character as a credible but non-referential fiction; yet the character also functions, in this case, as little more than the bearer of the doctrine. In its use of Bianchon, the novel avoids the direct exposition of doctrine, or even the implicit exposition that Bianchon's ability to articulate an original prescription for Raphaël would entail, while also abandoning the exclusively critical mode pursued in the pastiche of Molière. Instead, it forges Bianchon as a kind of empty signifier, a passage point through which the traditions of medicine must pass as they are reconfigured into the medicine of the future. And while the doctors *à clef* refer to specific real-life persons, the character Bianchon is non-referential in precisely the way that gives fictional characters a greater potential capacity for referentiality. We know just enough about Bianchon to situate him socially, and this sociological dimension of his plausibility is largely promoted by a discourse of "generation." While the novel's first edition (1831) identifies the character who would become Bianchon (originally named Prosper) as "*le plus distingué peut-être des élèves internes de l'Hôtel-Dieu*" the change in subsequent editions to "*le plus distingué peut-être des nouveaux médecins*" swaps a particular institutional

⁷¹¹ *La peau de chagrin*, 257. The "École de Paris" designates the scene of official French clinical and research medicine in general during this period, or attempts to do so. On the one hand, the term designates the specificity of the Parisian institutions with regard to the medical school of Montpellier, one of the few provincial institutions of any kind to challenge the Parisian institutions for supremacy. Montpellier medicine defended its prestige until well after the Revolution but by 1830 its reputation was in eclipse. On the other hand, it tends to designate French medicine of the period in contrast to that of other national traditions. See Williams, *The Physical and the Moral*; and *L'avènement de la médecine clinique moderne en Europe, 1750-1815: politiques, institutions et savoirs* (Montréal: Presses de l'Université de Montréal, 2001).

role for membership in something tantamount to a movement.⁷¹² Indeed, Bianchon's place within the cadre Balzac designates as "the new doctors" draws on a discourse of "generation" that was itself heavily thematized at the time. Contemporaries perceived Bianchon's factual coevals in medicine as sharing a particularly coherent group identity in view of the conflicts that pitted medical students against the often reactionary medical administration of the Restoration.⁷¹³ Given the politicization of medical students under the Restoration, Balzac's allusion to the "new doctors" crystallizes the sociological profile of the future medicine, the "place" where it might be born.

The novel's play with the rhetoric of temporality conspires to convey the "inviting openness" which Gallagher construes as typical of the ontology of novelistic characters, but which also distinguishes the fictional presentation of the doctrine. "Characters' peculiar affective force," Gallagher suggests, "is generated by the implication of their unreal knowability and their apparent depth, the link between their real nonexistence and the reader's experience of them as deeply and impossibly familiar."⁷¹⁴ The condition of fictionality lifts the "epistemological constraints on our knowledge," as she puts it, which otherwise pertain to acquaintance with a person or the decipherment of a text. In the case of Bianchon, the sense of familiarity is generated by the work of sociological identification the novel has undertaken, and this work transfers to our understanding of the doctrine; but the sense of familiarity we may bring to the doctrine also arises from the work of dialogization the novel has undertaken with regard to scientific, medical and literary discourses, a process which has imparted the goals the doctrine would have to meet and the difficulties it would encounter in doing so. In particular, the novel's use of future tense orients the ontological openness of both character and doctrine with respect to time. Bianchon, we have learned, is a leader of "*la studieuse jeunesse . . . qui bâtitra peut-être le monument*" of a total human science. This future tense evokes a life for both character and doctrine beyond the bounds of the novel itself. For Gallagher, the "inviting openness" of fictional characters corresponds to the subliminal awareness that "we are, as readers, its actualizers, its conditions of being, the only minds who undergo these experiences."⁷¹⁵ In *La peau de chagrin*, the mode of prolepsis reinforces this sense that character and doctrine are entities subject to realization, entities which not only require our readerly assistance to achieve realization as elements of the novel but which even remain unrealized within the order of the novel itself.

⁷¹² Within the scheme of the *Comédie humaine* Bianchon is born in 1797, making him a "contemporary" of Balzac himself and the generation succeeding those which came of age during the Revolution and the Empire, respectively. See Spitzer *The French Generation of 1820*; and Pierre Barbéris, *Balzac et le mal du siècle: contribution à une physiologie du monde moderne* (Paris: Gallimard, 1970) for accounts of the generational dynamics at work. The obstacles that practitioners of previous generations posed to doctors of Bianchon's generation heighten the generational dynamics at stake. The generation of doctors educated after the fall of the Empire faced overcrowding and "murderous competition": "Young doctors complained of the dead weight of aged practitioners, the competition of the *officiers de santé*, and of their own low economic and social status compared to the other professions." Young doctors, moreover, were in large part anti-Bourbon and participated in large numbers in the revolution of 1830 (Spitzer 246-48).

⁷¹³ Spitzer, *French Generation*.

⁷¹⁴ "Rise of Fictionality," 356.

⁷¹⁵ *Ibid.*, 357.

The novel's rhetoric of temporality coordinates both the events of the narrative and the novel's relationship to its readers. *Bâtira* functions as a temporal shifter which references the time of the reader, as well as some moment in the narrative's own temporal scheme (although this moment lies beyond the bounds of the narrative itself). The future referenced by "*bâtira*" shifts with the moment of reading, a different future now, we might imagine, for instance, than that evoked for a reader at the time of the novel's publication. A reader of 1831 might well feel personally though indirectly implicated in the secondary narrative whose inception and ultimate goal the future tense of "*bâtira*" blazes, namely the series of events involved in the realization of the doctrine. Since we know that the future in question does not lie within the bounds of the novel itself, we are implicitly asked to posit an auxiliary space in which the doctrine might be realized. Insofar as the narratorial voice which articulates the "*bâtira*" has positioned itself all along as an authority on contemporary Paris, the reader of 1831 is asked to believe, as it were, that that space might be the contemporary Paris of the narration's understanding. Since the novel is set in contemporary Paris, that reader belongs to some degree to the novel's own sociocultural milieu, and is as such invited to situate the realization of the doctrine in the Paris of his or her own day. To the degree that the narration provokes uncertainty about the temporal scheme to which the shifter "*bâtira*" refers, it invites the impression that that scheme might be the one inhabited by its own readers.

The "reality-effect" Balzac generates by means of the rhetoric of temporality becomes even more complex with the novel's insertion into the *Comédie humaine*. The fourth doctor in the consultation scene was initially named "Prosper," a name construct that highlights the character's promise (and invites associations with Shakespeare's sorcerer). Only with the 1838 edition does Balzac rename the character "Bianchon," a decision that occurs in tandem with the composition of *Illusions perdues*, which also features Bianchon in a cameo role. If *La peau de chagrin* gives Bianchon a future, *Illusions perdues* gives him a "past." In the later novel this past is precisely the present the character occupies in *La peau de chagrin*, such that as readers we have the impression that Bianchon's career has proceeded apace with the earlier novel's predictions about his future. In *Illusions perdues*, we learn that Bianchon has joined the "Cénacle," a group of extraordinary artists and intellectuals; and Bianchon's membership in this group thus serves to bear out the earlier prediction that he would accomplish great things. "*Parmi ceux qui vivent encore,*" the later novel tells us of the Cénacle membership, "*était Horace Bianchon, alors interne à l'Hôtel-Dieu, devenu depuis l'un des flambeaux de l'École de Paris, et trop connu maintenant pour qu'il soit nécessaire de peindre sa personne ou d'expliquer son caractère et la nature de son esprit.*"⁷¹⁶ Balzac's use of the rhetoric of temporality in this passage tells us, in effect, that Bianchon's early promise has *already* been fulfilled. Once again, it does this by conflating the temporal schemes of the novel and of the reader, the referent of "*maintenant*" shifting according to whether we construe it as indicating the present of the novel or that of the reader. The past evoked by the passage thus orients itself around this ambiguous "now." Just as the "*bâtira*" of *La peau de chagrin* evoked a future beyond the novel's end, the "*était,*" "*alors,*" and "*devenu depuis*" of the passage from *Illusions perdues* evokes a past prior to the novel's beginning. To the degree that the ambiguous "now" confuses the temporal orders to which it refers, we

⁷¹⁶ Honoré de Balzac, *Illusions perdues, Comédie humaine*, vol. 5. (Paris: Gallimard, 1977), 315.

are asked as readers to imagine that Bianchon's past might have taken place within the temporal scheme which we ourselves occupy. The reality of the character is heightened inasmuch as we are asked to “realize” him as an ambiguously extra-novelistic entity. In *Illusions perdues* as in *La peau de chagrin*, moreover, Bianchon remains a sort of empty signifier whose realization as a character occurs in step with that of the doctrine associated with him.

In these novels' participation in the *Comédie humaine*, the logic of character they vehicle begins to depart from that which Gallagher associate with modern fiction. Balzac mobilizes the logic of character in designating the doctrine, I would propose, because he wants us to become attached to it in the way we as readers become attached to characters, inviting us into a conditioned openness that it is up to us to realize. But he also wants us to conceive of such a doctrine as an entity that exists in the extra-novelistic world more particularly; and to that end he projects the strategic lack that constitutes the doctrine beyond the bounds of the novel. This creates a paradox in which Balzac deploys the logic of character typical of modern fiction but also contravenes it at times; for if, as Gallagher writes, typical modern fiction writers stress the plausibility of their characters as fictional entities by suppressing any reference to specific real-life persons, Balzac wants to convince us that his characters lead plausible lives within the novels and beyond them, in the greater openness of the *Comédie humaine* and perhaps even of the extra-fictional world. At the level of the *Comédie* (as opposed to that of the individual novel), Balzac stops trying to establish the particularity of this character by denying its referentiality, and starts trying to establish its referentiality by suppressing its particularity. That is, he switches from the logic underwriting most modern fictional characters to that underwriting the depiction of real-historical protagonists. Ultimately, Balzac imbues the doctrine with a supplemental reality by means of devices which Gallagher argues typify historical and counterfactual fiction. These means of presenting real historical figures (Napoleon, for instance) assume the “reader's prior knowledge of his corporal traits” and avoids the kind of detailed personal descriptions and effortful specification of characters' social status typical of fictional characterizations, invoking instead “an individual extradiegetic body, familiar from countless pictures and descriptions.”⁷¹⁷ The last part of the passage from *Illusions perdues* seems crucial to this scenario: Bianchon is currently too well known, we read, “pour qu'il soit nécessaire de peindre sa personne ou d'expliquer son caractère et la nature de son esprit.” And in fact, Balzac omits all reference to the character's personality or physical existence. In so doing, he risks lapsing into a counterfactual mode, asserting the reality of something or someone which we may easily affirm does not really exist in the extra-textual world. He asks us to transpose the openness available to readers in the order of the fiction to another order, encompassing our own spatial and temporal coordinates. He does so at the risk of provoking a sense of the counterfactual, but with the potential advantage of imbuing the doctrine with a supplemental reality-effect.

Extraordinary as this manner of proceeding may be, there is, it seems, an intrinsic link between the synthetic ideal in general and Balzac's rhetoric of fiction. For if the logic underwriting the creation of fictional characters lifts the “epistemological constraints” which limit our ac-

⁷¹⁷ “What Would Napoleon Do?: Historical, Fictional, and Counterfactual Characters,” *New Literary History* 42.2 (2011): 315-36.

cess to real-life people, as Gallagher points out, framing the synthetic ideal in characterological terms allows us to invest in realizing it regardless of the epistemological constraints inhering in the representation of life itself. The virtue of synthesis, as I suggested earlier, is both a progressive ideal and an ideal “in progress.” It imagines that knowledge transforms the knower and also casts itself as a process advancing toward a distant end, rather than as a program, a paradigm or a set of results. In experimenting with the epistemological constraints of fiction, Balzac imagines, I would claim, that he can engineer a scheme in which reading transforms the reader, the invitation to realize a doctrine of life itself re-orienting this reader’s imaginative investments. And in keeping with the virtue’s conception of an ideal in progress, it does so in order to lead the reader actually to participate in its real-life realization, as a member of a like-minded public.

The special tact Balzac deploys in managing the relationship between fiction and reader in *La peau de chagrin* reflects, I think, his position as a cultural agent working beyond the intellectual norms of his moment. As Bourdieu suggests, the position of the initiator of a symbolic revolution is “impossible” until it becomes legible as such to a critical mass of other readers and producers. If the symbolic revolution succeeds, it ends by redefining the criteria for admission to the field and by reorienting the agents of the field around the formerly impossible position. Insofar as the symbolic revolution envisaged by Balzac entails dissolving the literary field as it existed at the time of its writing, the picture of intellectual production which he projects in his novels can be imagined as functioning to leverage the weight of the public in the re-orientation of cultural production in general. In the absence of any appeal on Balzac’s part to a “vertical” authority like the State or a patron class, the strategies he pursues in his fictions posit readers themselves as a force for effecting a low degree of “horizontal” autonomy. In the era of industrial fiction, the press played a powerful role in shaping the options open to literary producers, but in *La peau de chagrin* and other novels, perhaps we can distinguish ways in which Balzac, as a literary producer, uses mass media as a means to advance his own intellectual ends. If the effectuation of a symbolic revolution meant the production of an audience for whom one’s position was legible, Balzac’s fictions incorporate the means to mold that audience.

V. *The Pre-History of Pure Literature*

“Wir scheinen uns nicht zu verstehen, mein Allerbestester, erwiderte Goethe. Ich rede gar nicht von jenen Leuten; es handelt sich bei mir um ganz andere Dinge! Ich rede von dem in der Akademie zum öffentlichen Ausbruch gekommenen für die Wissenschaft so höchst bedeutenden Streit zwischen Cuvier und Geoffroy de Saint-Hilaire!”

In Bourdieu's historical sociology, literature becomes fully autonomous when it ceases to cater to the values of dominant classes and to identify itself with such neighboring forms of cultural production as philosophy, science or social activism. With the advent of Baudelaire and Flaubert, literature disavows any social "function" while maintaining a prerogative to critique the social, disengaging itself from co-optation by elites and from the definition of literature touted by the proponents of "*l'art social*" but also defining itself as the bearer of certain universal values. In this light, literature is both a "*contre-discours*" in that it pursues its own aesthetic and linguistic ends, indifferent to any notion of utility or knowledge-production,⁷¹⁹ and a "*contre-pouvoir*" insofar as it diffuses a set of universal values according to means consistent with the limited forms of cultural production it encompasses, particularly fictional and poetic genres.⁷²⁰ Balzac forms part of the pre-history of pure literature insofar as he departs from this regime: neither subordinated to a social elite himself nor favoring the subordination of literary art to particular social means, he nevertheless sustains literature's imbrication with a diversity of other forms of cultural production—philosophy, psychology and the study of the social, for example—and even favors reversing the processes that had led to the secession of the sciences from "letters." If pure literature is defined by high degrees of both "vertical" and "horizontal" autonomy, Balzac departs most dramatically from the regime of pure literature insofar as his work exhibits a low degree of horizontal autonomy. As a proponent of the virtue of synthesis, as I have tried to show, he espouses the heteronomization of all fields of intellectual production, envisioning a "total" regime of cultural production organized around the pursuit of a single ideal. If at an epistemic level the virtue of synthesis implied the application of material means to immaterial objects, at a sociological level it implied the trans-field collaboration of artists, writers, men of science, and philosophers.

Though Bourdieu himself has little to say about the pre-history of literary autonomy, scholars working in his wake have tried to describe the state of the literary production through the Restoration and July Monarchy in terms of field dynamics. In *La Responsabilité de l'écrivain*, Gisèle Sapiro conveys the multi-dimensional nature of the process whereby literature progressed toward autonomy. During the Restoration, she argues, the attenuation of censorship and

⁷¹⁸ *Gespräche mit Goethe in der letzten Jahre seines Lebens* (Wiesbaden: Brockhaus, 1959), 567. The whole conversation goes like this: "The news of the Revolution of July, which had already commenced, reached Weimar today, and set everyone in a commotion. I went in the course of the afternoon to Goethe's. "Now," he exclaims as I entered, "what do you think of this great event? The volcano has come to an eruption; everything is in flames, and we no longer have a transaction behind closed doors!"

"A frightful story," I replied. "But what else could be expected under such notorious circumstances and with such a ministry, than that matters would end with the expulsion of the royal family?"

"We do not appear to understand each other, my good friend," replied Goethe. I am not speaking of those people at all, but of something entirely different. I am speaking of the contest, of the highest importance for science, between Cuvier and Geoffroy Saint-Hilaire, which has come to an open rupture in the Academy."

This expression of Goethe's was so unexpected that I did not know what to say, and for some minutes felt my thoughts completely at a standstill." Johann Peter Eckermann, *Conversations with Goethe*, trans. Toby Appel, quoted in Appel, *The Cuvier-Geoffroy Debate*, 1.

⁷¹⁹ *Les mots et les choses*, 59.

⁷²⁰ *Les règles de l'art*, 545.

of patronage conduce to freeing literary production from what I have been calling “vertical” pressures, at the same time as processes of discipline formation disengage literature from formerly associated forms of cultural production: the Restoration witnesses processes of “*autonomisation*,” she writes, “*par rapport à d’autres activités intellectuelles, qui entraîne une restriction de l’acception même du terme “littérature.” Dès le début du XIXe siècle, une différenciation, sinon une séparation complète, commence en effet à s’instaurer entre philosophie, science, politique et littérature.*”⁷²¹ While the professionalization of philosophy and the sciences under the Empire effectively differentiate them from literary pursuits, she argues, the process is not so complete as to institute a “pure” literary art just yet.

This notion of autonomization as a linear process likewise typifies José-Luis Diaz’s explorations of literary culture during the period. Diaz tracks the vertical autonomization of literature through changes in the forms of literary sociability, particularly the transition from a scenario dominated by aristocratic salons to one characterized by the “*soirée d’artiste*.” As Diaz puts it, a “*Tout-Paris artiste*” arises to rival the “*Tout-Paris aristocratique*,” staking out a modicum of independence for the artistic life in so doing. The nature of this split is expressed in a formula belonging to Balzac himself, to the effect that “*la Célébrité va[ut] la Noblesse.*”⁷²² And while with the rise of such a celebrity class literature frees itself in large measure from subordination to an aristocratic élite, the notion of celebrity itself hints at the mediatization of this new form of sociability, Diaz points out, sponsored and publicized by the new industrial press. This process coincides with another process in which disputes among literary producers take on a decisive role in defining the “identity” of the field, initiating a process whereby the constitution of the field, as Bourdieu puts it, is made and remade through the actions of the agents who belong to it. The notion of the literary “*querelle*,” claims Diaz, cedes to that of the “*bataille*,” a modification that expresses a transition between an order of “*polémiques individuelles ou en clans restreints, des haines invétérées à deux ou trois*” to one in which literary conflicts took on symbolic significance, “*centrale, décisive, structurante.*”⁷²³ With the advent of an age of “battles,” the literary field becomes structured by the conflict between classicism and romanticism that raged until approximately 1830, between “*l’art social*” and “*l’art pour l’art*” that set in just after, and between bohemians, creators of industrial literature and others against “*l’école du bon sens*” around 1843.⁷²⁴ These controversies tended to reveal what Bourdieu conceives as the “specificity” of the field, Diaz effectively argues, a process which corresponds to the emergence of the figure of the “poet” as the representative of a pure literature, distinct from both philosophy and literature as “*savoir, rhétorique, métier.*”⁷²⁵

⁷²¹ Gisèle Sapiro, *La responsabilité de l’écrivain: littérature, droite et morale, XIX-XXIe siècle* (Paris: Seuil, 2011), 43.

⁷²² José-Luis Diaz, “Les sociabilités littéraires autour de 1830: le rôle de la presse et de la littérature panoramique,” *Revue d’histoire littéraire de la France* 110 (2010), 535.

⁷²³ José-Luis Diaz, “Le champ littéraire comme champ de bataille (1820-1850),” *Contextes* 10 (2012), paragraph 1. <https://contextes.revues.org/4943>.

⁷²⁴ *Ibid.*, paragraph 22.

⁷²⁵ José-Luis Diaz, “L’autonomisation de la littérature (1760-1860),” *Littérature* 124 (2001), 15.

Though these historians touch on many crucial elements of literary production during the period, they err, I would argue, in casting autonomization as a single, uni-directional “process.” The autonomization of literature in particular during this period can better be conveyed as the interaction among a number of processes, some of which conduced to producing a more or less autonomous literary field, others of which counteracted that trend. Among the processes that conduced to literature's autonomization, the disciplinization of philosophy or science were contested among actors excluded from these disciplines, such that the disciplinization of these fields does not by itself remove them from the study of the *res literaria*. Under these circumstances, accepting the disciplinization of philosophy and the sciences as a fact of cultural history means writing a victory's history, reproducing the point of view belonging to those who won out. Bourdieu's sociology of “points of view,” on the other hand, offers the conceptual resources to shake us from the attitude of the passive *lector*, the reader who unwittingly accepts the cultural categories of history's victors. Thus, Sapiro rightly acknowledges that, “à la différence des sciences et de la philosophie qui connaissent alors un processus de spécialisation, l'écriture de l'histoire, la peinture de la société, les études de moeurs, l'analyse psychologique ne sont pas encore une spécialité et peuvent emprunter les formes romanesques, comme en témoigne l'oeuvre de Balzac.”⁷²⁶ But Balzac's production is a prime instance of the importance of undertaking a sociology of points of view, one which distinguishes that the process of specialization undertaken in the sciences and philosophy was to be disregarded, in his view. While Balzac engaged in “l'écriture de l'histoire, la peinture de la société, les études de moeurs, [and] l'analyse psychologique,” he also sustained a right to write natural philosophy, a venture that becomes difficult so much as to discern when we acquiesce in the point of view of the sciences or of autonomous literature, according to which science and literature constitute distinct domains of production. As this study has endeavored to show, the recognition of points of view like that of Balzac and the synthetic philosophers constitutes an important element in the writing of cultural history, not for reasons of fastidiousness or sympathy, but for reasons having to do with the ways such points of view shape the cultural productions of the agents who espouse them and therefore set the conditions for their legibility.⁷²⁷

The force or authority of this perspective is difficult to estimate as an element in cultural production in Post-Enlightenment France. Though the concept of the “field” derives from physical science, as Bourdieu tell us, the quantification of the social remains no more realizable as an element in the science of cultural works than it is in the various mathematical sociologies of the synthetic thinkers. Bourdieu's notion of the “point of view” enables us to cast cultural production as a conflict among rival ideals, where necessary, but, naturally, it does not enable us to quantify the authority of a given point of view relative to another. We know that the proponents of synthesis lost out to the proponents of positive science, but we cannot say by “how much.” Even so, the range and importance of the figures who espoused some sort of synthetic ideal compels us to

⁷²⁶ *La responsabilité de l'écrivain*, 106.

⁷²⁷ While the horizontal dimension of literature is in some sense peripheral to Sapiro's basic problematic, it nevertheless does inflect conceptions of the writer's “responsibility,” as Balzac's conception of a “*sacerdoce intellectuel*” suggests. In reproving Nodier for not assuming his “*sacerdoce*” after all, Balzac takes him to task not just for neglecting his prerogatives as a writer but also for shirking his duties as one.

recognize it as a cultural force. The epigraph from Eckermann's *Gespräche mit Goethe* suggests that the conflict between Geoffroy Saint-Hilaire and Cuvier was seen not just as an academic debate but as an opening for symbolic revolution. If general revolutions often prove propitious to symbolic ones, as Bourdieu observes, Goethe's play on the simultaneity of the July Revolution and the Geoffroy-Cuvier debates evokes the serendipity and perhaps the opportunism of those who believed a new science might supplant that of the status quo. For Goethe, the symbolic revolution in question takes on proportions so colossal that it overshadows even the fall of the Restoration. "I am not speaking of those people at all," he responds to Eckermann, in reference to the political disputants, "but of something entirely different. I am speaking of the contest, of the highest importance for science, between Cuvier and Geoffroy Saint-Hilaire, which has come to an open rupture in the Academy."⁷²⁸ For Goethe, Cuvier's positive science and Geoffroy's progressive science represented two images of the future, two modernities we might say, whose differences were more extreme than those separating the house of Bourbon from the house of Orléans. Though the debate in the *Académie des sciences* centered on nothing more momentous than mollusk anatomy, it marked the explicit confrontation of a "positive" and a "progressive" future before the *Académie* and the European press.

Given the support the progressive ideal enjoyed, why did the associated revolution fade away, we might ask? Though we may imagine its failure to have been inevitable, there are nevertheless a multitude of ways of explaining why it did not succeed. As I suggested at the beginning of this chapter, the ideal of synthesis supposed a doubly "impossible" position, entailing, first, the transgression of the existing scientific and literary fields, and second, the representation or experimental realization of "truths" that were resistant to expression in this form. Yet symbolic revolutions *do* sometimes succeed; and the plausibility or feasibility of a given virtue as judged by those who do not feel the magic of its *illusio* has little to do with its eligibility to serve as a scientific ideal. The virtue of admiration reigned for centuries, after all, in spite of binding Nature to a providential hermeneutic regime; and the virtue of exactitude often erred in exaggerating the importance of precision and construing properly chemical or physiological problems as physical ones instead. Each nevertheless produced certain kinds of viable and even enduring knowledge, realizing certain scientific objects while remaining incapable of imagining others, maximizing certain aspects of the objects it realized while minimizing others. If the language and the ideals of the virtue of synthesis seem hopelessly visionary in some ways, we might also think of certain of its advantages—its conception of a self-reflexive science, for instance, or its affirmation of the living body as a privileged scientific object. Given that synthesis remained a virtue "in progress" in Paris, never instituted as such, assigning a value to the cultural forms and kinds of knowledge that might have been realized within its scope remains a counterfactual exercise. Millennial in its scope, moreover, the synthetic ideal eludes the temporal categories of modernity, provoking reflexion on our own assumptions about the relationship between time and knowledge. After all, from the point of view of synthesis, we may still be living in progressive time, witnessing and even experiencing the unfolding of life in the species.

If the effectuation of a successful symbolic revolution was a charge under these circumstances, a few further contingencies suggest themselves as explanations for why the synthetic

⁷²⁸ Quoted in Appel, *Cuvier-Geoffroy Debate*, 1.

virtue did not prosper. Geoffroy became the figurehead of a “progressive” movement in France, watched by foreigners like Goethe, by the disciples of Saint-Simon and by many others who opposed the élitist turn of the official sciences in Paris. But he was not an ideal leader, prone to spells of depression, with a volatile personality and a talent for alienating friends.⁷²⁹ As the dense and repetitive writing of the *Études progressives* and the *Notions synthétiques* suggests, moreover, he was not a particularly effective communicator, a shortcoming that led him to reach out at times to writers like Sand and Balzac to diffuse his ideas better than he knew he could himself. While the master rhetorician Cuvier mocked Geoffroy’s “*style de cuisinière*,”⁷³⁰ it took a reader as sympathetic and imaginative as George Sand to perceive “*des pensées vastes comme le monde, des cris de l’âme mystérieux et grandioses*” through a “*style dur, étrange, heurté, obscur*.”⁷³¹ The proponents of synthesis conceived of themselves as prophets of a coming age, moreover, a self-image that was not conducive, one imagines, to the realization of a positive program. Given the nature of the ideal, the omission of a concrete program was perhaps not wholly incidental: the language of the prophet often shades into that of the “martyr,” suggesting the degree to which the synthetic thinkers themselves expected to suffer from their ideal rather than to triumph on the strength of it. Even so, the synthetic philosophers’ use of the press suggests that their fatalism was not comprehensive. As a new power in eighteen-thirties France, the press promised to confer a certain legitimacy on the movement that the patronage of élites alone might have been able to do in the past. In Geoffroy’s publication of books and articles directed at a general audience, Balzac’s use of the industrial press to disseminate scientific fictions, and the Saint-Simonians ownership of the newspaper *Le Globe*, we can see the elements of a strategy for legitimating synthesis in the eyes of the reading public.

Of all the visionary elements of synthesis, perhaps the most confounding is the ambition to manifest “life itself” as representation or experimental object. As I have tried to show, however, the theme of the representation of life itself supposes the transformation of both representation and life, altering the potentialities of the symbolic order and dispersing that discrete, obscure entity into the multiple, self-evident form of vital matter. If synthesis emerges as a reaction to the order of the positive sciences, the category of “life itself” which it inherits from the positive sciences does not withstand its scrutiny intact, as the multiple transfigurations of life in the works of Balzac and Geoffroy attest. In this respect, the proponents of synthesis have proven to anticipate some of the critical dilemmas posed by life in the present day and age, the dispersal of life itself into a host of assumptions about what animation is, means or can do. As the anthropologist Stefan Helmreich observes, the only consensus about “life” presently available is that it is no longer what it used to be. “Proliferating reproductive technologies, along with genomic reshufflings of biomatter in such practices as cloning have unwound the facts of life,” he notes. Biotechnology, biodiversity, bioprospecting, biosecurity, biotransfer, and molecularized biopolitics draw novel lines of property and protection around organisms and their elements. From cultural theorists and

⁷²⁹ Franck Bourdier’s article “Le prophète Geoffroy Saint-Hilaire, George Sand, et les saint-simoniens,” recounts the series of truly strange gaucheries which contributed to undermining Sand’s friendship for Geoffroy.

⁷³⁰ “Le prophète Geoffroy Saint-Hilaire,” 48.

⁷³¹ George Sand, *Lélia* (Paris, Gallimard: 1985), 548.

historians of science we learn that life itself, consolidated as the object of biology around 1800, has morphed as material components of living things—cells and genes—that are rearranged and dispersed, and frozen, amplified, and exchanged within and across laboratories. Writers in philosophy, rhetoric, and cultural studies, meanwhile, claim that, as life has become the target of digital simulation and bioinformatic representation, it has become virtual, mediated, and multiple.⁷³² To the extent that these various biotechnologies have fractured “life itself,” the study of living things has been subject to what Bourdieu would call a process of heteronomization, the hybridization of specifically scientific problems with imperatives of another, often (in this case) profit-driven nature. Work at the intersection of biology and industry has proven conceptually prolific, as the work of many science studies scholars attests, even as it tends to maximize those elements of research on living things that can ultimately be commodified. In the hybridization of industry and science, the transfiguration of life itself that “synthesis” envisioned in philosophical terms has been achieved in the interest of bare interest.

Though synthetic science and today’s various bio-technologies each transfigure life itself, synthetic science alone does so in the interest of pure knowledge. Despite this distinction, the two orders are by no means mutually exclusive. As Canguilhem writes in the essay “Thought and the Living,” the thinking of life as a creative, dynamic force is wholly compatible with positivist biology. “The determination and measurement of the effect of such and such a mineral on the growth of an organism,” he proposes, “the establishment of a measure of energy expenditure, the pursuit of the chemical synthesis of a suprarenal hormone, the search for laws for the conduction of nervous influx or the conditioning of reflex—who could seriously think of holding all this in contempt? Yet, on its own, all this hardly amounts to biological knowledge, so long as an awareness of the meaning of the corresponding functions is lacking.”⁷³³ The synthetic thinkers, too, admired the positive life sciences, even as they insisted that their physico-chemical discoveries be subordinated to the problem of their “meaning” for the animal as a whole, and to a conception of the living thing’s place in the greater picture of Nature. Were the synthetic thinkers to confront the array of biotechnologies today, they might react in a similar fashion. Who could seriously think of holding gene therapies, reproductive technologies and so on in contempt? (Presuming of course that they do not transgress ethical boundaries in animal experimentation and exploitation). Impressive and useful as they may be, the synthetic thinkers would also likely remark that such technologies lack a language for life per se, a conception of the living unit’s “meaning.” As Canguilhem might say, what they know of life “hardly amounts to biological knowledge.” For them as for Canguilhem, the knowledge of life is as familiar and as abyssal as the image of one’s face in the mirror.

⁷³² Stefan Helmreich, “What was Life? Answers from Three Limit Biologies,” *Critical Inquiry* 37.4 (2011), 671.

⁷³³ “Thought and the Living,” xx.

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