Introduction

The Gestation of German Biology

Historians want to write histories of biology in the eighteenth century, but they do not realize that biology did not exist then, and that the pattern of knowledge that has been familiar to us for a hundred and fifty years is not valid for a previous period. And that, if biology was unknown, there was a very simple reason for it: that life itself did not exist. All that existed was living beings, which were viewed through the grid of knowledge constituted by *natural history*.

Foucault, *The Order of Things*[i]

This study traces the gestation of German biology from the debate about organism between Georg Ernst Stahl and Gottfried Leibniz at the beginning of the eighteenth century to the formulation of developmental morphology in the era of Carl Friedrich Kielmeyer and Friedrich Schelling at its close. Developments across the eighteenth century in Germany culminated, in the decades around 1800, in the assertion of a new research program. As Schelling famously put it in 1798, with Kielmeyer "a whole new epoch of natural history" took shape.[ii] That gestation needs to be reconstructed.

In the eighteenth century "biology" certainly did not exist as a disciplinary rubric.[iii] The very term "scientist" was not invented until the nineteenth century.[iv] Prior to that, those who pursued inquiry into the natural world went perforce by other rubrics. The set of categories through which I propose to orient my study all derive, quite unsurprisingly, from the protean term "nature." I term "naturalists" the protagonists in this study.[v] They operated in a conceptual

field with two distinct poles of orientation. "Natural philosophy" *explained* the physical world in terms of general principles.[vi] "Natural history," by contrast, *described* all the plants, animals, and minerals encountered in the material environment.[vii] By the mid-eighteenth century, natural history came to a crossroads in its self-definition and articulation vis-à-vis natural philosophy.[viii] That coincided with some fundamental crises within natural philosophy itself concerning the possibility and importance of a "nonmathematical *physique*," setting the stage for a shift in the "semantic field" of natural inquiry, a paradigm shift that has been conceptualized by historians of science as "vital materialism."[ix] My thesis is that, over the eighteenth century, naturalists undertook to reformulate some domains of natural *history* (living things) into a distinct branch of natural *philosophy* (ultimately, the science of biology).

Those who studied the domain of living things before 1800 were quite serious and systematic, but what they understood themselves to be doing may well have differed substantially from what the discipline of biology later saw as its project. Carl Linnaeus (1707–78), Georges-Louis Leclerc de Buffon (1707–88), or Albrecht von Haller (1708–77), the most eminent naturalists of the eighteenth century, might well have found themselves in a "different world," in a Kuhnian sense, by the mid-nineteenth century.[x] But that does not signify that their project did not have vital connections to what came after. Like the work of Dirk Stemerding, this study is animated by "fascination with an historical period in which those who studied plants and animals were called 'naturalists' and in which 'biology' was only just becoming a catchword, introduced by those who dreamed about a real science of 'life.'"[xi] But my interest is driven by concerns for our own philosophy of biology and naturalism more generally.[xii] Accordingly, this study is devoted to the *historicist* project of reconstructing the progress over the eighteenth century that opened the way for a "special science" in a *presentist* sense.[xiii]

The word "biology" came to be evoked by a number of theorists independently around 1800.[xiv] However, in his classic *The Growth of Biological Thought*, Ernst Mayr proclaimed that "the coining of the *word* 'biology' did not create a *science* of biology"; rather, "what existed was natural history and medical physiology. The unification of biology had to wait for the establishment of evolutionary biology and for the development of such disciplines as cytology."[xv] Dissenting from Mayr, Trevor DeJager aptly observes, "the coining of new terms indicated something significant was happening conceptually as well as culturally."[xvi] Thomas Bach makes a similar point: "The appearance of the term *Biology* is an indication of a shift in perception in the domain of the natural sciences in which the necessity of the elaboration of a new science that concerned itself exclusively with the phenomena of life became manifest."[xvii] I contend that the embrace of the new term around 1800 signaled a theoretical and methodological *convergence* of natural history with medical physiology in comparative (i.e., *zoological*) physiology that resulted in the field of developmental morphology.[xviii] The research program (*Fachgebiet*) of *Naturgeschichte*, as it made the transition toward historicization, found it increasingly necessary to move from "external" traits (taxonomic description) to "internal" organs, structures, and processes (comparative anatomy and physiology) to explain and generalize its findings.[xix] Conversely, the *Fachgebiet* of physiology found it increasingly important to create developmental and genetic accounts—not only ontogenetically (e.g., in embryology) but even phylogenetically for varieties and species.[xx] The emergent research program of morphology was, for all its equivocations, drawn toward *actual* historical development alongside "ideal" typological sequencing.[xxi] In that sense, it reached out toward the new historicizing *Naturgeschichte*. Developments in each respective *Fachgebiet* drew them, in the apt summation of Thomas Bach, to the "same result: descent explains the similarities in

organization."[xxii] Kielmeyer was the pioneer of this convergence. His "physiological theory of forces" and his "temporalized natural history" achieved the connection that offered a systematic basis for the emergent science.

Why Germany?

It makes perfect sense, of course, to maintain that the development of life science in the eighteenth century was a "transnational" affair and that a national focus can be misleading.[xxiii] Nonetheless, there are reasons for a focus on Germany. First, the Germans were operating within a distinctive cultural context, especially in religion and philosophy.[xxiv] Second, and in some measure as a result of the first, historians of biology have looked askance at the trajectory of German life science over the eighteenth century, considering it foredoomed to the metaphysical errancies they associate with *Naturphilosophie*, ostensibly anathema for any sound constitution of the life sciences.[xxv] This study aims to rebut that way of thinking.[xxvi] I propose to link the gestation of biology in Germany with that most despised phenomenon in the history and philosophy of science, Idealist *Naturphilosophie*.

As Frederick Beiser observes, "*Naturphilosophie* has been ignored or spurned for decades, by historians of philosophy and science alike. Its reputation suffered greatly under the shadow of neo-Kantianism and positivism, which had dismissed it as a form of pseudoscience. . . . For many philosophers and scientists, *Naturphilosophie* became the very model of how *not* to do science."[xxvii] His assessment is apt, and it is shared by Robert Richards.[xxviii] I take my stand with Beiser and Richards for a new revisionism.[xxix] Finally, as Daniel Steuer observes, "there seems to be a growing consensus amongst historians of science that the division between empirical science, based on experience and experiments, and speculative Romantic

Naturphilosophie, based on ideas, is an invention of the later nineteenth century."[xxx] It is well-past time to put this prejudice to rest along with all the other complacent dogmas of the positivist epoch.[xxxi] The effort to consolidate biology found positive reinforcement in German Idealist philosophy, and instead of viewing *Naturphilosophie* as a contamination, we might view it as historical evidence that something essential to the character of biology as a special science was at stake, and thus, this episode in the history of biology might reopen issues in our *own* philosophy of biology.[xxxii] That makes a specific account of German developments indispensable.

Three contexts seem pertinent in reconstructing what was distinctive about the German Enlightenment insofar as it bore upon the gestation of biology. First, in Germany the religious tenor was distinctly stronger than in western Europe.[xxxiii] More concretely, the tension between Pietism and "philosophical rationalism" (Wolffian "school philosophy") informed the trajectory of philosophy (and medicine) in the early Enlightenment.[xxxiv] Consequently, my point of departure will be the relationship between Enlightenment and Pietism in the *medical* faculty at the University of Halle. Second, ensconcement within academia was a pervasive feature of the German Enlightenment, given the relative "backwardness" of career opportunities in Germany's public sphere.[xxxv] This was true a fortiori for the emergent life sciences. My claim is that *at least in Germany* the eventual discipline of biology gestated primarily in the traditional medical school world.[xxxvi] Two university medical faculties played a decisive role: first Halle and then Göttingen. Newly formed and animated by a quite innovative temper, Halle and Göttingen were from the outset *research universities* in the sense that Wilhelm von Humboldt would later make famous at Berlin, and this was true of their medical faculties. Halle had almost half a century of preeminence before Göttingen rose to challenge it in the person of Albrecht von Haller.

A final distinctive characteristic of the German Enlightenment is the tension between the

imposition of French cultural models and the assertion of a distinctly German national culture. The nascent German culture's adversarial reaction to the hegemonic imposition of French standards has been a perennial theme, and of course, it remains important; French cultural dominance clearly provoked a reactive nationalism.[xxxvii] But not all French influence was unprofitable, even if it aroused resistance, and as regards the gestation of biology, I will argue that the French influence was both substantial and *salutary*. To grasp this creative reception of French "vital materialism" around the midcentury in Germany, we must contextualize more concretely the emergent German Aufklärung, especially in the Royal Prussian Academy of Sciences in Berlin (Berlin Academy).[xxxviii]

In tracing out the gestation of biology in Germany, our itinerary will take us through many of these key sites: the University of Halle, the University of Göttingen, the Berlin Academy, and ultimately the University of Jena. The context provided by each of these sites proved crucial to the constitution of the emergent science.

Naturalists and the Medical Faculty

As Roger French made clear in his strikingly titled *Medicine before Science*, crisis had beset the traditional identity of the "learned physician" in Europe by the close of the seventeenth century. Physiology had traditionally served as "a bridge between medical theory proper and the larger domain of natural philosophy"; that is, it dressed medicine with academic learning.[xxxix] But traditional physiology (Aristotle and Galen) had come under direct attack by a rival new philosophy, the mechanization of the body, associated especially with Descartes.[xl] "By the end of the seventeenth century, . . . the attack on learned physic had succeeded almost entirely."[xli] According to Descartes and the other "mechanical philosophers" of the late seventeenth century,

a universal physics had no place for a distinct *life* science: animate and inanimate matter needed to be submitted to a single method—*mathesis universalis*—whose principle must derive from physical mechanics.[xlii] Descartes concluded that animals had to be mechanisms.[xliii] His impact is vivid in the famous opening argument from the *Leviathan* (1651) of Thomas Hobbes (1588–1679): "Life is but a motion of limbs. . . . For what is the heart, but a spring, and the nerves, but so many strings, and the joints, but so many wheels, giving motion to the whole body?"[xliv]

The *bête machine* hypothesis became the point of departure for a mechanistic medicine in the seventeenth century. Later still it evoked the eighteenth-century elaboration of vital materialism, calling Descartes's bluff with the notorious proposition that man, too, was a machine.[xlv] From the outset, Descartes's contemporaries "objected that if the *bête machine* concept were accepted, it would be very difficult in the end to prove that man himself was not a machine."[xlvi] Thus, the animal-machine hypothesis "was not primarily about what animals could do but about the implications for man."[xlvii] The wily skeptic Pierre Bayle (1647–1706) saw all the implications and laid them out in his article "Rorarius."[xlviii] Physiology was inextricably entangled with philosophy, and from this entanglement would spring the concerns that eventually spawned biology. The furious struggles across the entire eighteenth century between the defenders of "physicotheology" and their dread opponents, the Epicurean materialists, proved, in fact, the birth pains of life science.[xlix]

The Italian Giovanni Borelli (1608–79) composed *De Motu Animalium* (posthumous, 1680–81), and it went through fifteen editions from 1700 to 1723, propagating "iatromechanism."[l] This view proposed the derivation of medical diagnosis and therapy from the physics of motion, a "purely corporeal (*res extensa*) investigation of bodily functions" denying the soul any influence in physiology.[li] Concurrently, an alternative, "iatrochemical" approach

proposed to derive medical diagnosis and therapy from the analysis of "mixtures" and "ferments," drawing on the writings of Paracelsus (Philippus von Hohenheim, 1493–1541) and Jan Baptist van Helmont (1579–1644).[lii] Neither view could oust the other. Because the theoretical state of the discipline was in stark disorder, there was simply no doctrinal purity to be had.[liii]

Adding to the theoretical quandaries was a stark practical challenge. Thomas Sydenham (1624–89) confuted the learned physicians and offered an alternative, relentlessly practice-oriented medicine, invoking the hero of the learned tradition, Hippocrates himself.[liv] Sydenham became famous in Europe for contending that physicians had more to learn from natural histories of disease and from case studies of individual patients than from either the book learning of the schools or the elaborate experimental work in anatomy and chemistry that was preoccupying a number of leading physicians.[lv]

Confronted by all these challenges, academic medicine desperately sought a new orthodoxy.[lvi] The figure who achieved a measure of reintegration for learned medicine was Herman Boerhaave (1668–1738).[lvii] While he was not a major innovator, he was able to achieve a fusion of the mechanistic approach derived from Descartes with a measure of the "chymistry" of the Paracelsians, all the while enthusiastically affirming the Hippocrates-Sydenham emphasis on clinical practice.[lviii] Making it all cohere for over 1,900 medical students from all over Europe, notably Britain and Germany, at the University of Leiden from 1701 to 1738, Boerhaave emerged as the "teacher of Europe."[lix] He enjoyed an unquestioned reputation as the foremost European teacher of medicine.[lx] His personality and pedagogy exerted an enormous influence on students.[lxi] For Albrecht von Haller, Boerhaave was not only his teacher but his "great scientific and human model."[lxii] "To him I owe eternal affection and everlasting gratitude. . . . Perhaps

future centuries will produce his equal in genius and learning, but I despair of their producing his equal in character."[lxiii] Indeed, Boerhaave served as "Albrecht Haller's grand model for his [entire] life."[lxiv] Given their number and eminence, the students of the Leiden medical school—"Boerhaave's men," as they have been called—had a decisive impact on the whole medical profession in the eighteenth century. They formed a crucial medical network across Europe, in constant and fruitful communication.[lxv] Moreover, Boerhaave had a transformative impact on the organization of other medical schools. The program at Leiden became the model for the most advanced medical schools of the eighteenth century. Three great medical schools were formed after the image of Boerhaave's Leiden: Edinburgh, Vienna, and Göttingen.[lxvi] The glaring exception was France. Boerhaave had no impact on the Paris medical school, and Montpellier ultimately became a bastion of support for his great critic, Georg Ernst Stahl (1659–1734).[lxvii]

Boerhaave's physiological theories were only moderately mechanist, but he was generally taken to be the eighteenth-century standard-bearer of this approach, especially after his inaugural lecture of 1703.[lxviii] Later, Boerhaave became famous for bedside instruction of medical students. His most prominent students, however, did not report attending any clinical rounds. Notably, Haller's diary contained "no reference . . . concerning this institution," and in the exhaustive manuscripts of Gerard van Swieten (1700–1772), chronicling the whole sweep of Boerhaave's teachings, "only two clinical lectures are mentioned."[lxix] Nonetheless, on questions of practice and on questions of theory—particularly in physiology—Boerhaave assumed a towering eminence in the ensuing era.

Medicine was the only academic and professional path for a naturalist in early modern Europe, and especially in Germany. As Irmtraut Scheele puts it: "Since the career path of the botanist, the zoologist, or even of the biologist in general did not yet exist, anyone with a special

interest in one of these natural sciences was forced to undertake a course of study in medicine for the sake of earning a living later."[lxx] But within the medical faculty mutations emerged. Central to my account is the "calving" over the eighteenth century of research physiology from the larger clinical-practical structure and orientation of German academic medicine. There widened a decisive division between the clinical-practical direction that the profession of medicine clearly sought to pursue and the pure research into a variety of life-forms (their relevance often quite remote from human therapeutic ends) that a few members of the medical faculty preferred instead.[lxxi] In short, a very important trend—one that would be embodied in the key eighteenth-century Göttingen scholars Albrecht von Haller and Johann Friedrich Blumenbach (1752–1840), who will be central to my account—was the emergence of an increasingly specialized research practice within the traditional medical faculty whose agenda proved somewhat at cross-purposes with what the larger faculty and profession sought to achieve.[lxxii] The new physiology became a special research field (*Fachgebiet*) interested not at all in clinical application but rather in *zoological research* for its own sake.[lxxiii]

For this research community to carve out its own institutional space, it would need to create alliances with parallel impulses within academic medicine and beyond it. Paula Findlen writes: "Natural history would continue to be closely associated with medicine through the eighteenth century. But increasingly its leading practitioners studied nature apart from medicine."[lxxiv] Thus, neither the greatest of the late seventeenth-century British naturalists, John Ray (1627–1705), nor the "prince of naturalists" in the first half of the eighteenth century in France, René-Antoine Ferchault de Réaumur (1683–1757), was a physician.[lxxv] Key experimental naturalists of the mid-eighteenth century, especially the Genevans Abraham Trembley (1710–84) and Charles Bonnet (1720–93), would also follow that nonmedical path.[lxxvi]

Perhaps the greatest French naturalist of the whole century, Georges-Louis Leclerc de Buffon, was no physician either.[lxxvii] From outside medicine the experimental physiologists were abetted by those who shared their ambitions, both experimental and philosophical. In fact, philosophers and physicians came together as naturalists to create a curious persona—the *médecin philosophe* or *philosophischer Arzt*—through which they could articulate a *common* new research domain exploring body-mind interaction and the place of life in the order of the physical world.[lxxviii]

The term *médecin-philosophe* came to prominence in France around the middle of the eighteenth century. The maverick Julien Offray de La Mettrie (1709–51), the most notorious example, insisted that *only* philosophical physicians could penetrate the labyrinth of man.[lxxix] It became a rubric especially for the school of Montpellier. Théophile Bordeu (1722–76) was among the most explicit in identifying himself as a *médecin-philosophe*.[lxxx] The French *médecins-philosophes* adopted the "optimistic attitude that a physiological consideration of man would throw light upon obscure epistemological and moral-legal problem constellations."[lxxxi] They believed that even "the most impalpable and spiritual functions of man were to reveal themselves empirically, to exhibit sensible signs, and to permit an empirical analysis."[lxxxii] Conversely, the *médecins-philosophes* "accepted the decisive argument that physiological states affected all human behavior, including intellection, acts of will, and moral behavior."[lxxxiii] This committed them to *influxus physicus* (direct interaction between mind and body) as a *methodological* premise, even if they recognized that they could achieve no *metaphysical* solution to the conundrum of the body-mind interaction (*commercium corporis et mentis*).[lxxxiv] Accordingly, they dared intrude into spheres sacrosanct to metaphysics, to become *philosophical* physicians.[lxxxv] Crucially, this created the opportunity for *philosophers* who were *not* physicians to share this persona. Such a consolidated cadre of *médecins-philosophes*—actual physicians and

their philosophical allies—played a conspicuous role in vitalizing nature in the Enlightenment.

The French Challenge: Vital Materialism

The struggle to establish autonomy for the German language and German culture in light of the brilliance and cosmopolitan ubiquity of French culture in the aftermath of the *siècle d'or* was intense.[lxxxvi] French culture shaped Old Regime courtly-aristocratic culture across all Europe and certainly in the Germanies. Frederick II's Potsdam was a conspicuous instance.[lxxxvii] There is no question that, in the culture-transfer balance, the Germanies weighed heavily as importers. The impact of the French on fashion, manners, and thought extended well beyond court culture to the urban literate population.[lxxxviii] For Germany generally, the period around midcentury saw a massive invasion by French ideas. Montesquieu exerted a profound influence.[lxxxix] The impact of Rousseau was enormous.[xc] Voltaire proved an obstreperous presence not only in text but in person in these years.[xci] While no materialist, his sojourn in Prussia was definitely understood as part of the same inundation by the *esprits forts*.

Still, it would be misguided to infer that the Germans were passive in this situation: there can be enormous creativity in (selective) reception, and this they definitely demonstrated across the eighteenth century. Moreover, the energies of indigenous creativity were already stirring. By midcentury, not only had the Swiss German theorists Johann Jakob Bodmer (1698–1783) and Johann Jakob Breitinger (1701–76) challenged Johann Christoph Gottsched (1700–1766) and his French neoclassical gospel of taste, but the Swiss German poet Albrecht von Haller had made a European mark.[xcii] And Haller was soon joined by Friedrich Klopstock (1724–1803), whose *Messias*, the key literary work of German *Empfindsamkeit* (Sensibility), began appearing in 1748.[xciii] To be sure, from Berlin, the king of Prussia deemed German a language suitable only

for servants, and only an obscure provincial historian of Osnabrück dared publicly to differ.[xciv] But by the 1770s, a decisive new generation (the Sturm und Drang) would burst upon the scene, and "a German way and art" would prove monumental.[xcv]

At midcentury, the "German movement" was still embryonic, but a more general Enlightenment was well under way.[xcvi] The Hochaufklärung (1750–80) responded to the striking growth of large cities, especially Hamburg and Berlin but also Leipzig and Frankfurt am Main.[xcvii] With that growth came distinct changes in the cultural milieu. The periodical press took shape, for instance.[xcviii] In addition to urban newspapers, one of the most important developments was the circulation of a vast number of "moral weeklies," which offered instruction in taste and style along with—as their title suggests—a great deal of moral instruction.[xcix] With the rise of the so-called *gebildeten Stände* (educated strata) in the cities came a new "public sphere," redefining the sociocultural meaning of Aufklärung.[c] It was no longer a matter merely for *Gelehrten* (scholars). The new *Bürger* needed to achieve independence in judgment: *Selbstdenken*. To be capable of thinking for oneself was to achieve "maturity [*Mündigkeit*]."[ci]

The Berlin Enlightenment, led by the "philosophers on the Spree," as Gotthold Efraim Lessing (1729–81) and Moses Mendelssohn (1729–86) have been called, provided an indispensable incubation.[cii] Berlin was a European center; 20 percent of its population was Huguenot-French; French was an important language not only for Frederick II's court and for his academy but for the city itself. In the Berlin Aufklärung, French-language philosophical discourse had a significance that is only now coming to be sufficiently appreciated.[ciii] John Yolton's *Locke and French Materialism* has shown that this Francophone discourse turned upon the so-called "Three Hypotheses" (occasionalism, preestablished harmony, and physical influx) conceived by Leibniz.[civ] Avi Lifschitz demonstrates a similar centrality for "Epicurean

naturalism," especially regarding the link of language with mind and culture.[cv] Part of the revitalized Berlin Academy's mission under Frederick II was to introduce into German culture Western—primarily French—Enlightenment ideas, even at the expense of Pietist and Wolffian domestic traditions.[cvi] What followed was the influx of French vital materialism and its uptake by German *Freigeister* (free spirits).[cvii]

This high German Enlightenment began the moment that Lessing chose to abandon his formal university studies in Leipzig and move to Berlin to take up a career as a freelance writer (*freier Schriftsteller*).[cviii] What made his experience possible? The old-fashioned connection to the reign of Frederick II of Prussia (1740–86) retains its historical plausibility.[cix] Three particular features of his new reign are central here: first, his reinstatement of Christian Wolff (1679–1756) at the University of Halle; second, his revitalization of the Berlin Academy, especially through the recruitment of French intellectuals; and third, closely related to this, his interest in fostering "freethinking" in the sphere of religion. The third connection is tightly interwoven with the second because "freethinking," in the German mind, could not be dissociated from French materialism.

In Germany, Berlin was the unquestioned center of such freethinking, with two distinct poles: Frederick II and his court, on the one hand, and Lessing and his circle in the publishing world of Berlin, on the other.[cx] As a university student in Leipzig, Lessing had pursued freedom of thought and expression into its most problematic quarters. He was drawn to a consideration of dissenters and their fates, creating a mini-genre for himself, the *Rettung*, or "vindication," to which he devoted a good deal of writing from the late 1740s into the early 1750s.[cxi] When he moved to Berlin, he brought his commitment to tolerance with him.[cxii] Lessing believed it was essential to break loose the idea of freedom of thought from the orthodox clerical opprobrium

and popular dread it conventionally encountered. That goal animated Lessing's pioneering critical journalism in Berlin: "the penetrating and constantly repeated call to 'thinking for oneself [*Selbstdenken*],' 'judging for oneself [*Selbsturtheilen*],' is the organizing center of all the individual efforts regarding the public even in Lessing's early years."[cxiii] He set out to cultivate—indeed, to create—a new urban reading public by weaning it away from the religious confines of traditional culture, on the one hand, and from acquiescence to representations of courtly and aristocratic preeminence, on the other. As E. Schmidt puts it, "Even before exposure to the dangerous atmosphere of Berlin Lessing was . . . already enlightened enough to consider a freethinker, *esprit fort*, *Freigeist* something more than a puppet with which the moral weeklies like governesses keep their children full of fear of the Lord."[cxiv] The young Lessing relished the notion of *Freigeisterei* and it was central to his personal project.

The terminology of *Freidenker* or *Freigeister* became established only around midcentury, displacing an older reliance on imported French terms, such as *libertin* and *libertinage*. Thus, *Zedlers Universallexicon* (1736) had no entries for *Freidenker* or *Freigeist* but did address their conceptual content under the French derivation *Libertiner*.[cxv] By 1758 Johann Mehlig's *Historisches Kirchen- und Ketzer Lexikon* had no use for that French term, inserting instead an article on *Freydenker* in which Mehlig reported: "that is how those are called who would earlier generally have been termed libertines."[cxvi] Reiner Wild takes this to be a sign that the latter term was "already by the midcentury an obsolete usage."[cxvii] The next year, 1759, Johann Anton Trinius (1722–84) published his remarkable *Freydenker-Lexikon*.[cxviii] Thus, we have good grounds for believing that the question of "freethinking" was prominent in the German cultural context of midcentury, especially in Berlin.[cxix] Vernacular translation did not, however, displace cultural meaning: freethinking remained, for Germans, very "French." As

Trinius's fascinating lexicon makes clear as well, the connection to Epicureanism and Spinozism was constitutive for *Freigeisterei*. With the opening volumes of the *Encyclopédie* of Diderot and d'Alembert, the "party of the *philosophes*" achieved notoriety in Germany.[cxx] One of the casualties of the early French battles over the *Encyclopédie*, the abbé de Prades (1720–82), found refuge in Berlin. The most notorious "materialist," La Mettrie, had already taken refuge there. For the indigenous Aufklärung in Berlin, and for Germany more widely, "freethinking" and French, Epicurean-Lucretian, and Spinozist "materialism" came to be inextricably associated. All this would prove fateful for the rise of life science in Germany.

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i. Michel Foucault, *The Order of Things: An Archaeology of the Human Sciences* (New York: Vintage, 1973), 127–28. Originally published as *Les mots et les choses* (Paris: Gallimard, 1966).

ii. Friedrich Schelling, *Von der Weltseele: Eine Hypothese der höheren Physik zur Erklärung des allgemeinen Organismus* (Hamburg, 1798), 298n; Nicholas Jardine, "The Significance of Schelling's 'Epoch of a Wholly New Natural History': An Essay on the Realization of Questions," in *Metaphysics and Philosophy of Science in the Seventeenth and Eighteenth Centuries*, ed. R. S. Woodhouse (Dordrecht: Kluwer, 1988), 327–50.

iii. Foucault, *Order of Things*, 127–28 and passim; Ernst Mayr, *The Growth of Biological Thought: Diversity, Evolution, and Inheritance* (Cambridge, MA: Belknap Press, 1982), 108–9.

iv. Sydney Ross, "Scientist: The Story of a Word," *Annals of Science* 18 (1962): 65–85.

v. Ogilvie contends that "only in the middle of the sixteenth century did naturalists come to think of themselves as practitioners of a discipline that, though related to medicine and natural

philosophy, was distinct from both." Brian Ogilvie, *The Science of Describing: Natural History in Renaissance Europe* (Chicago: University of Chicago Press, 2006), 1. In the eighteenth century, Spary elaborates, "naturalists set about recruiting social and natural-historical credit by fashioning natural history as a distinct program of inquiry, appealing to a number of different audiences." Thus, "defining natural history as a scientific enterprise in its own right, independent of medicine, meant inventing a new expertise over the natural world which could be demonstrated to peers, patrons, and the wider scientific audience." E. C. Spary, *Utopia's Garden: French Natural History from Old Regime to Revolution* (Chicago: University of Chicago Press, 2000), 17.

vi. William Wallace, "Traditional Natural Philosophy," in *The Cambridge History of Renaissance Philosophy*, ed. Charles Schmitt, Quentin Skinner, and Eckhard Kessler (Cambridge: Cambridge University Press, 1988), 201–35; Ann Blair, "Natural Philosophy," in *Cambridge History of Science*, vol. 3, *Early Modern Science*, ed. Katherine Park and Lorraine Daston (Cambridge: Cambridge University Press, 2001), 365–406.

vii. According to Ogilvie, "from the 1530s through the 1630s, the task of natural history—as a discipline distinct from the mere art of gardening and the lofty science of nature—was describing nature, cataloguing its marvelous and mundane products" (*Science of Describing*, 6). See also Paula Findlen, "Natural History," in Park and Daston, *Cambridge History of Science*, 3:437–68.

viii. Phillip Sloan, "Natural History," in *Cambridge History of Eighteenth Century Philosophy*, ed. Knud Haakonssen (Cambridge: Cambridge University Press, 2006), 903–37.

ix. All these terms structure my interpretation. I have drawn them from Thierry Hoquet, Rudolf Stichweh, and Peter Hanns Reill. For the notion of "nonmathematical *physique*," see Thierry

Hoquet, "History without Time: Buffon's Natural History as a Nonmathematical Physique," *Isis* 101, no. 1 (2010): 30–61. The notion of "semantic field" refers to the language by which a discourse organizes its concepts and their relations. It has been used very effectively in the characterization of the establishment of the discipline of physics in Germany in the eighteenth century by Stichweh, and I will adopt it in my own historical account of life science in that period. See Rudolf Stichweh, *Zur Entstehung des modernen Systems wissenschaftlicher Disziplinen: Physik in Deutschland, 1740–1890* (Frankfurt am Main: Suhrkamp, 1984). For "vital materialism," my main source is Peter Hanns Reill, *Vitalizing Nature in the Enlightenment* (Berkeley: University of California Press, 2005).

x. Thomas Kuhn, *The Structure of Scientific Revolutions*, 2nd ed. (Chicago: University of Chicago Press, 1970).

xi. Dirk Stemerding, "Plants, Animals and Formulae: Natural History in the Light of Latour's *Science in Action* and Foucault's *The Order of Things*" (diss., School of Philosophy and Social Science, University of Twente, Netherlands, 1991), preface, n.p.

xii. David Depew and Bruce Weber, eds., *Evolution at the Crossroads: The New Biology and the New Philosophy of Science* (Cambridge, MA: MIT Press, 1985); C. Allen, M. Bekoff, and G. Lauder, eds., *Nature's Purposes: Analyses of Function and Design in Biology* (Cambridge, MA: MIT Press, 1998); Bernard Feltz, Marc Commelinck, and Philippe Goujon, eds., *Self-Organization and Emergence in the Life Sciences* (Dordrecht: Springer, 2006); Manfred Laubichler and Jane Maienschein, eds., *Form and Function in Developmental Evolution* (Cambridge: Cambridge University Press, 2009).Cf. E. S. Russell, *Form and Function: A Contribution to the History of Animal Morphology* (London, 1916).

xiii. On the notion of a "special science," see J. Fodor, "Special Sciences and the Disunity of

Science as a Working Hypothesis," *Synthese* 28 (1974): 97–115. I juxtapose *presentism* and *historicism*, not as mutually exclusive, but as mutually dependent approaches to history of philosophy. Of course, we appropriate earlier ideas for our present purposes; but we should do so self-consciously cognizant that this is precisely appropriation, not legitimate historical ascription—at least not until we have established the latter by historical reconstruction. Historicism, by the same token, is no simple antiquarianism: it must be motivated by present problems and interests. See my review essay "Reconstructing German Idealism and Romanticism: Historicism and Presentism," review of *German Idealism: The Struggle against Subjectivism, 1781–1801*, by Frederick Beiser, and *The Romantic Conception of Life: Science and Philosophy in the Age of Goethe*, by Robert Richards, *Modern Intellectual History* 1, no. 4 (2004): 427–38.

xiv. The importance of the new and simultaneous invocation of the term "biology" around 1800 has been most pertinently articulated by Bach: "That in this context [of the simultaneous use of the term "biology" by various authors around 1800] a general trend was actually manifesting itself can be further discerned in that it was not only simultaneously but also from the most diverse vantages that the problematic of a comprehensive science of life under the rubric biology came to formulation, e.g. from the vantage of theories of life-force, from that of clinical medicine and from that of physiology." Thomas Bach, *Biologie und Philosophie bei C. F. Kielmeyer und F. W. J. Schelling* (Stuttgart: Frommann-Holzboog, 2001), 84.

xv. Mayr, *Growth of Biological Thought*, 108–9. We now know that the term "biology" was invented well before 1800, though without any systematic consequence. See Peter McLaughlin, "Naming Biology," *Journal of the History of Biology* 35 (2002): 1–4; and more

extensively, Kai Torsten Kanz, "Zur Frühgeschichte des Begriffs 'Biologie': Die botanische Biologie (1771) von Johann Jakob Planer (1743–1789)," in *Verhandlungen zur Geschichte und Theorie der Biologie*, ed. German Society for History and Theory of Biology (Berlin: Verlag für Wissenschaft und Bildung, 2000), 269–82; Kai Torsten Kanz, "Von der BIOLOGIA zur Biologie: Zur Begriffsentwicklung und Disziplingenese vom 17. bis zum 20. Jahrhundert," in *Die Entstehung biologischer Disciplinen: Beiträge zur 10. Jahrestagung der DGGTB in Berlin 2001* (Berlin: Verlag für Wissenschaft und Bildung, 2002), 9–30; Ilse Jahn, "Die Ordungswissenschaften und die Begründung biologischer Disziplinen im 18. und zu Beginn des 19. Jahrhunderts," in *Geschichte der Biologie: Theorien, Methoden, Institutionen, Kurzbiographien*, ed. Ilse Jahn, Rolf Löther, and Konrad Senglaub, 2nd ed. (Jena: Fischer, 1985), 264–323; Ilse Jahn, "Untersuchungen zum Phasenunterschied in der Herausbildung der Botanik und Zoologie zur Entstehungszeit der 'Biologie,'" *Rostocker wissenschaftshistorische Manuskripte* 2 (1978): 59–68.

xvi. Trevor DeJager, "G. R. Treviranus (1776–1837) and the Biology of a World in Transition" (PhD diss., University of Toronto, 1991), 6.

xvii. Bach, *Biologie und Philosophie bei Kielmeyer und Schelling*, 85.

xviii. "Natural history developed . . . ultimately into phylogenetic taxonomy, which reconstructs the natural order of its field via common origin [*die natürliche Ordnung ihres Gegenstandbereichs über die gemeinsame Abstammung rekonstruiert*]. Comparative anatomy, on the other hand, demonstrates that not only relative to order but also relative to the organization of organisms, there is a unity of field [*nicht nur bezüglich der Ordnung, sondern auch bezüglich der Organisation der Organismen eine Einheitlichkeit des Gegenstandbereichs vorliegt*]" (ibid., 86–87).

xix. Ziche makes a very fruitful distinction between a *Fachgebiet* as a shared field of research and a *Disziplin* in the sense of an organized and institutionalized research community. Paul Ziche, "Von der Naturgeschichte zur Naturwissenschaft: Die Naturwissenschaften als eigenes Fachgebiet an der Universität Jena," *Berichte zur Wissenschaftsgeschichte* 21 (1998): 251–63. I will adopt this distinction for my own reconstruction.

xx. Olaf Breidbach, "Transformation statt Reihung—Naturdetail und Naturganzes in Goethes Metamorphosenlehre," in *Naturwissenschaften um 1800: Wissenschaftskultur in Weimar-Jena*, ed. Olaf Breidbach and Paul Ziche (Weimar: Böhlaus, 2001), 46–64, citing 60, 64.

xxi. Engelhardt has struggled mightily to establish the idea that the German morphological turn was strictly "ideal," not "real"—a typological, not a phylogenetic theory of *Bauplan*. See Dietrich von Engelhardt, "Die Naturwissenschaft der Aufklärung und die romantisch-idealistische Naturphilosophie," in *Idealismus und Aufklärung*, ed. Christoph Jamme and Gerhard Kunz (Stuttgart: Klett-Cotta, 1988), 80–96; Dietrich von Engelhardt, "Zur Naturwissenschaft und Naturphilosophie um 1780 und 1830," in *Hegel und die Chemie: Studie zur Philosophie und Wissenschaft der Natur um 1800* (Wiesbaden: G. Pressler, 1975), 5–30; Dietrich von Engelhardt, "Historical Consciousness in the German Romantic *Naturforschung*," in *Romanticism and the Sciences*, ed. Andrew Cunningham and Nicholas Jardine (Cambridge: Cambridge University Press, 1990), 55–68; Dietrich von Engelhardt, "Natur und Geist, Evolution und Geschichte: Goethe in seiner Beziehung zur romantischen Naturforschung und metaphysischen Naturphilosophie," in *Goethe und die Verzeitlichung der Natur*, ed. Peter Matussek (Munich: Beck, 1998). But even he admits, crucially, that this distinction was not consistently maintained. See, for a similar formulation, Camilla Warnke, "Schellings Idee und Theorie des Organismus und der Paradigmawechsel der Biologie um

die Wende zum 19. Jahrhundert," *Jahrbuch für Geschichte und Theorie der Biologie* 5 (1998): 187–234, esp. 188.

xxii. Bach, *Kielmeyer und Schelling*, 86–87.

xxiii. For a more specific sense of the transnational in German-French interaction, see Michel Espagne and Michael Werner, eds., *Transfert: Les relations interculturelles dans l'espace Franco-Allemand (XVIIIe et XIXe siècle)* (Paris: Editions Recherche sur les Civilisations, 1988); Uwe Steiner, Brunhilde Wehinger, and Barbara Schmidt-Haberkamp, eds., *Europäischer Kulturtransfer im 18. Jahrhundert: Literaturen in Europa—europäische Literatur?* (Berlin: Berliner Wissenschafts-Verlag, 2003).

xxiv. The idea of a "national context," allowing for the more nuanced differentiation of such phenomena as Enlightenment or Romanticism, was the guiding historiographical principle on which my generation of intellectual historians was trained, and it is still a valuable point of departure for the more recent efforts at the integration of a "transnational" cultural history. See Roy Porter and Mikulas Teich, eds., *The Enlightenment in National Context* (Cambridge: Cambridge University Press, 1981). Less distinguished but equally representative is Roy Porter and Mikulas Teich, eds., *The Scientific Revolution in National Context* (Cambridge: Cambridge University Press, 1992).

xxv. Two works in the history of life science that I admire most share this attitude. Peter Hanns Reill's *Vitalizing Nature in the Enlightenment*, while it memorably details the formulation of a vital-materialist paradigm shift in the sciences of the mid-eighteenth century, drastically dismisses *Naturphilosophie* as an aberration in natural inquiry. Ron Amundson's *The Changing Role of the Embryo in Evolutionary Thought: Roots of Evo-Devo* (Cambridge: Cambridge University Press, 2005), while it carries out a brilliant revisionism concerning the

"modern synthesis" in the history of biology, cannot take seriously the ostensibly thick metaphysics that attached to German contributions to that history.

xxvi. See my essay "Reill's *Vitalizing Nature in the Enlightenment* and German *Naturphilosophie*," in *Life Forms in the Thinking of the Long Eighteenth Century*, ed. Jenna Gibbs and Keith Baker (Toronto: University of Toronto Press, 2016), 70–91; and my review of *Reproduction, Race, and Gender in Philosophy and the Early Life Sciences*, ed. Susanne Lettow, *Critical Philosophy of Race* 3, no. 1 (January 2015): 158–66.

xxvii. Frederick Beiser, *German Idealism: The Struggle against Subjectivism, 1781–1801* (Cambridge, MA: Harvard University Press, 2002), 507. Beiser affirms that "the legacy of positivism remains, and the old image of *Naturphilosophie* persists to this day" (507).

xxviii. According to Richards, "Historians of nineteenth-century science, the really serious historians, usually dismiss anything sounding like Romantic science as an aberration." He elaborates: "The Romantic movement, to be sure, has been dismissed as a source of genuine scientific accomplishment." Robert Richards, *The Romantic Conception of Life: Science and Philosophy in the Age of Goethe* (Chicago: University of Chicago Press, 2002), 3, 512.

xxix. See my "Reconstructing German Idealism and Romanticism."

xxx. Daniel Steuer, "Goethe's Natural Investigations and Scientific Culture," in *The Cambridge Companion to Goethe*, ed. Lesley Sharpe (Cambridge: Cambridge University Press, 2002), 160–78, citing 175. For the substantial revival of interest in and appreciation for *Naturphilosophie* and the science of the Romantic epoch, see Cunningham and Jardine, *Romanticism and the Sciences*; Karen Gloy and Paul Burger, eds., *Die Naturphilosophie im deutschen Idealismus* (Stuttgart: Frommann/Holzboog, 1993); Stefano Poggi and Maurizio Bossi, eds., *Romanticism in Science: Science in Europe, 1790–1840* (Dordrecht: Kluwer,

1994); Frederick Amrine, Francis Zucker, and Harvey Wheeler, eds., *Goethe and the Sciences: A Reappraisal* (Dordrecht: Reidel, 1987); Robert Cohen and Marx Wartofsky, eds., *Hegel and the Sciences* (Dordrecht: Reidel, 1984).

xxxi. See my *A Nice Derangement of Epistemes: Post-positivism in the Study of Science from Quine to Latour* (Chicago: University of Chicago Press, 2004). On naturalism, see Philip Kitcher, "The Naturalists Return," *Philosophical Review* 101 (1992): 53–114; Werner Callebaut, ed., *Taking the Naturalistic Turn; or, How Real Philosophy of Science Is Done* (Chicago: University of Chicago Press, 1993); Peter French, Theodore Uehling, and Howard Wettstein, eds., *Philosophical Naturalism*, Midwest Studies in Philosophy 19 (Notre Dame, IN: University of Notre Dame Press, 1994); Joseph Rouse, *Engaging Science: How to Understand Its Practices Philosophically* (Ithaca, NY: Cornell University Press, 1996); Joseph Rouse, *How Scientific Practices Matter: Reclaiming Philosophical Naturalism* (Chicago: University of Chicago Press, 2002); Mario de Caro and David Macarthur, eds., *Naturalism in Question* (Cambridge: Cambridge University Press, 2004).

xxxii. See "Part C: Studies in History and Philosophy of Biological and Biomedical Sciences," special issue, *Studies in History and Philosophy of Science* 43 (2012), on the question of teleology in contemporary biology and philosophy of biology. See also Nicholas Rescher, ed., *Current Issues in Teleology* (Lanham, MD: University Press of America, 1986); Mark Bedau, "Can Biological Teleology Be Naturalized?," *Journal of Philosophy* 88 (1991): 647–55; W. Christensen, "A Complex Systems Theory of Teleology," *Biology and Philosophy* 11 (1996): 301–20; Paul Griffiths and Ronald Gray, "Developmental Systems and Evolutionary Explanation," *Journal of Philosophy* 91 (1994): 277–304; Tim Lewens, "No End to Function Talk in Biology," *Studies in History and Philosophy of Biology and the Biomedical Sciences*

32 (2001): 179–90; D. M. Walsh, "Organisms as Natural Purposes: The Contemporary Evolutionary Perspective," *Studies in History and Philosophy of the Biological and Biomedical Sciences* 37 (2006): 771–91; Peter McLaughlin, *What Functions Explain: Functional Explanation and Self-Reproducing Systems* (Cambridge: Cambridge University Press, 2001).

xxxiii. "What is certain is the positive relation to Protestant religiosity," "a specific element of the German as against the west-European Enlightenment." Hans Poser, "Pietismus und Aufklärung—Glaubensgewißheit und Vernunfterkenntnis im Widerstreit," in *Aufklärung und Erneuerung: Beiträge zur Geschichte der Universität Halle im ersten Jahrhundert ihres Bestehens (1694–1806)*, ed. Günter Jerouschek and Arno Sames (Hanau/Halle: Dausien, 1994), 170–82, citing 173. See also Pangiotes Kondylis, *Die Aufklärung im Rahmen des neuzeitlichen Rationalismus* (Stuttgart: Klett-Cotta, 1981), 538.

xxxiv. See Poser, "Pietismus und Aufklärung"; Udo Stäter, "Aufklärung und Pietismus—das Beispiel Halle," in *Universitäten und Aufklärung*, ed. Notker Hammerstein (Göttingen: Wallstein, 1995), 49–61.

xxxv. In this, the German Enlightenment showed strong parallels to the Scottish Enlightenment, and for similar reasons. For some rich explorations of this parallel, see Fania Oz-Salzberger, *Translating the Enlightenment: Scottish Civic Discourse in Eighteenth-Century Germany* (Oxford: Clarendon, 1995).

xxxvi. Lester King, *The Medical World in the Eighteenth Century* (Chicago: University of Chicago Press, 1958); Andrew Cunningham and Roger French, eds., *The Medical Enlightenment of the Eighteenth Century* (Cambridge: Cambridge University Press, 1990); Richard Toellner, "Medizin in der Mitte des 18. Jahrhunderts," in *Wissenschaft im Zeitalter*

der Aufklärung, ed. Rudolf Vierhaus (Göttingen: Vandenhoeck und Ruprecht, 1985), 194–221.

xxxvii. See Jens Häseler and Albert Meier, with the collaboration of Olaf Koch, eds., *Gallophobie im 18. Jahrhundert: Akten der Fachtagung vom 2. / 3. Mai 2002 am Forschungszentrum Europäische Aufklärung* (Berlin: Berliner Wissenschafts-Verlag, 2005); Raymond Heitz, York-Gothard Mix, Jean Mondot, and Nina Birkner, eds., *Gallophilie und Gallophobie in der Literatur und den Medien in Deutschland und in Italien im 18. Jahrhundert* / *Gallophilie et gallophobie dans la littérature et les médias en Allemagne et en Italie au XVIIIe siècle* (Heidelberg: Winter, 2011). For the traditional stereotyping, see Ruth Florack, "Nationalcharakter als ästhetisches Argument," in Häseler and Meier, *Gallophobie im 18. Jahrhundert*, 33–48, a good résumé of her monograph, *Tiefsinnige Deutsche, frivole Franzosen—Nationale Stereotype in deutscher und französischer Literatur* (Stuttgart: Metzler, 2001).

xxxviii. See Avi Lifschitz, *Language and Enlightenment: The Berlin Debates of the Eighteenth Century* (Oxford: Oxford University Press, 2012).

xxxix. The "learned and rational Doctor," in French's terms, had asserted hierarchical preeminence over all other health-care practitioners by an appeal to *learning*, the mastery of a substantial body of texts, and to *discourse*, the ability to formulate persuasive arguments about the nature of human health and illness. Roger French, *Medicine before Science: The Rational and Learned Doctor from the Middle Ages to the Enlightenment* (Cambridge: Cambridge University Press, 2003), 63, 67.

xl. See Gerrit Lindeboom, *Descartes and Medicine* (Amsterdam: Rodopi, 1979); Richard B. Carter, *Descartes' Medical Philosophy: The Organic Solution to the Mind-Body Problem*

(Baltimore: Johns Hopkins University Press, 1983).

xli. Harold Cook, "Physick and Natural History in Seventeenth-Century England," in *Revolution and Continuity: Essays in the History and Philosophy of Early Modern Science*, ed. Peter Barker and Roger Ariew (Washington, DC: Catholic University of America, 1991), 63–82, citing 79. See also Harold Cook, "The New Philosophy and Medicine in Seventeenth-Century England," in *Reappraisals of the Scientific Revolution*, ed. David Lindberg and Robert Westman (Cambridge: Cambridge University Press, 1990), 397–436; Harold Cook, "Physicians and Natural History," in *Cultures of Natural History*, ed. N. Jardine, J. E. Secord, and E. C. Spary (Cambridge: Cambridge University Press, 1996), 91–105.

xlii. Descartes's appropriation, for this mechanist insurgency, of the greatest empirical discovery in seventeenth-century medicine, William Harvey's work on circulation, proved "a major factor in the loss of traditional theory" (French, *Medicine before Science*, 176). "Descartes read Harvey's book in about 1630 and decided that Harvey's doctrine of the circulation was the ideal vehicle for his own mechanism" (182). On this, see Thomas Fuchs, *The Mechanization of the Heart: Harvey and Descartes*, trans. Marjorie Grene (Rochester, NY: University of Rochester Press, 2001).

xliii. His formulations are worth citing: "I suppose the body to be nothing but a statue or machine made of earth. . . . We see clocks, artificial fountains, mills, and other such machines which, although only man-made, have the power to move of their own accord in many different ways. But I am supposing this machine to be made by the hands of God, and so I think . . . it capable of a greater variety of movements . . . and of exhibiting more artistry." René Descartes, *Treatise on Man*, in *Philosophical Writings*, 3 vols. (Cambridge: Cambridge University Press, 1984–92), 1:99. "Indeed, one may compare the nerves of the machine I am

describing with the pipes in the works of these fountains, its muscles and tendons with the various devices and springs which serve to set them in motion, its animal spirits with the water which drives them, the heart with the source of the water, and the cavities of the brain with the storage tanks. Moreover, breathing and other such activities which are normal and natural to this machine, and which depend on the flow of the spirits, are like the movements of a clock or mill" (100–101). "Think of our machine's heart and arteries, which push the animal spirits into the cavities of the brain, as being like the bellows of an organ, which push air into the wind-chests" (104). "I should like you to consider that these functions follow from the mere arrangement of the machine's organs every bit as naturally as the movements of a clock or other automaton follow from the arrangement of its counter-weights and wheels. In order to explain these functions, then, it is not necessary to conceive of this machine as having any vegetative or sensitive soul or other principle of movement and life, apart from its blood and its spirits, which are agitated by the heat of the fire burning continuously in its heart—a fire which has the same nature as all the fires that occur in inanimate bodies" (108).

xliv. Thomas Hobbes, *Leviathan* (1651; Oxford: Clarendon, 2012), 1.

xlv. The key text, of course, is Julien Offray de La Mettrie, *L'homme machine* (1747). Trans. Gertrude C. Bussey, rev. M. W. Calkins, as *Man a Machine* (LaSalle, IL: Open Court, 1912). See Julien Offray de La Mettrie, *Dedication to Haller*, in *Man a Machine and Man a Plant*, trans. Richard A. Watson and Maya Rybalka (Indianapolis: Hackett, 1994).

xlvi. Aram Vartanian, *La Mettrie's "L'homme machine": A Study in the Origins of an Idea* (Princeton, NJ: Princeton University Press, 1960), 59.

xlvii. Robert Young, "Animal Soul," in *Encyclopedia of Philosophy*, 1:122–27, citing 122.

According to Rosenfield, "The most unmistakable evolution undergone by the movement of animal automatism was its increasingly religious tone in France as elsewhere. After Descartes it assumed, as time went on, a growing theological motivation." Leonora Cohen Rosenfield, *From Beast-Machine to Man-Machine: Animal Soul in French Letters from Descartes to La Mettrie* (New York: Octagon, 1968), 67. The key figure was the great Oratorian interpreter of Descartes: Nicolas Malebranche. "Before Malebranche, the writers on the subject were preponderantly doctors of medicine. After him, professional churchmen were in the majority" (Rosenfield, *From Beast-Machine to Man-Machine,* 68). Indeed, Malebranche's "phrasing was followed more closely than Descartes'" (67).

xlviii. "What leads the Cartesians to say that beasts are machines is that according to them all matter is incapable of thinking. . . . According to this thesis every man can be convinced of the immortality of his soul. . . . Here is a great advantage for religion." The alternative view, he went on, was clearly pernicious: "by ascribing a soul to beasts that is capable of knowledge, all the natural proofs of our soul's immortality are destroyed." This was the aim of "impious thinkers and Epicureans." Pierre Bayle, "Rorarius," in *Historical and Critical Dictionary: Selections*, trans. Richard Popkin (Indianapolis: Hackett, 1991), 213–34, citing 216–17, 220. Scholastic opponents of Cartesian mechanism put themselves at great risk in seeking to conjecture some lesser soul for animals, for this opened them to the argument that the human soul was not different in kind, a slippery slope to Epicureanism and materialism. "We cannot think without horror of the consequences of this doctrine: 'Man's soul and that of beasts do not differ substantially. . . .' It follows from this that if their souls are material and mortal, the souls of men are so also, and if the soul of man is an immaterial and spiritual substance, the soul of beasts is so also. These are horrible consequences no matter which way

one looks at them" (224–25).

xlix. See, on physicotheology, Wolfgang Philipp, "Physicotheology in the Age of Enlightenment: Appearance and History," *Studies on Voltaire and the Eighteenth Century* 57 (1967): 1233–67; Richard Toellner, "Die Bedeutung des physico-theologischen Gottesbeweises für die nachcartesianische Physiologie im 18. Jahrhundert," *Berichte zur Wissenschaftsgeschichte* 5 (1982): 75–82; François Russo, "Théologie naturelle et sécularisation de la science au XVIII siècle," *Recherches de science religieuse* 66 (1978): 27–62; Udo Krolzik, "Das physikotheologische Naturverständnis und sein Einfluß auf das naturwissenschaftliche Denken im 18. Jahrhundert," *Medizinhistorisches Journal* 15 (1980): 90–102; Paul Michel, *Physikotheologie: Ursprünge, Leistung und Niedergang einer Denkform* (Zurich: Beer, 2008); Maria Teerea Monti, "Thélogie physique et mécanisme das la physioogie de Haller," in *Science and Relgion / Wissenschaft und Religion*, ed. A. Bäumer and M. Büttner (Bochum: Universitätsverlag N. Brockmeyer, 1989), 68–79. On Epicureanism, see Catherine Wilson, *Epicureanism at the Origins of Modernity* (Oxford: Oxford University Press, 2008); W. R. Johnson, *Lucretius and the Modern World* (London: Duckworth, 2000); Stuart Gillespie and Philip Hardie, eds., *The Cambridge Companion to Lucretius* (Cambridge: Cambridge University Press, 2007); Neven Leddy and Avi Lifschitz, eds., *Epicurus in the Enlightenment* (Oxford: Voltaire Foundation, 2009); Margaret Osler, ed., *Atoms, Pneuma, and Tranquility: Epicurean and Stoic Themes in European Thought* (Cambridge: Cambridge University Press, 1991).

l. French, *Medicine before Science*, 207.

li. Johanna Geyer-Kordesch, "Passions and the Ghost in the Machine: Or What Not to Ask about Science in Seventeenth- and Eighteenth-Century Germany," in *The Medical Revolution of the*

Seventeenth Century, ed. Roger French and Andrew Wear (Cambridge: Cambridge University Press, 1989), 145–63, citing 154. As King has aptly noted: "in reality the 17th century physicians applied the laws of mechanics and hydraulics to medicine not by experimental techniques but only by *analogy* and *armchair calculations*." Lester King, *The Background of Herman Boerhaave's Doctrine: Boerhaave Lecture Held on September 17, 1964* (Leiden: University of Leiden, 1965), 17.

lii. Allen Debus, *The Chemical Philosophy: Paracelsian Science and Medicine in the Sixteenth and Seventeenth Centuries* (New York: Science History Publications, 1977); Allen Debus, *The French Paracelsians: The Chemical Challenge to Medical and Scientific Tradition in Early Modern France* (Cambridge: Cambridge University Press, 1991); Allen Debus, *Chemistry, Alchemy and the New Philosophy, 1550–1700: Studies in the History of Science and Medicine* (London: Variorum, 1987); Allen Debus, *Chemistry and Medical Debate: Van Helmont to Boerhaave* (Canton, MA: Science History Publications, 2001).

liii. Steinke writes of "a current of non-mechanist thought running along or underneath the essentially mechanistic outlook of physiology." Hubert Steinke, *Irritating Experiments: Haller's Concept and the European Controversy on Irritability and Sensibility, 1750–90* (Amsterdam: Rodopi, 2005), 22. To "philosophize mechanistically [*mechanisch philosophieren*]" in medicine was to embrace certain paramount allegiances, within which there had to be plenty of space to accommodate other impulses—whether "iatrochemical" or Galenic or, indeed, "animist."

liv. "In distancing themselves from the new empirics, the new rationalists created a problem for themselves. . . . They could not afford to emphasize observation and experience, which looked rather empirical, at the expense of theory. Worse, the great Hippocrates, widely

revered as the Father of Medicine, was—it was generally admitted—without the arts and sciences" (French, *Medicine before Science*, 109). Thus, "the doctors were compelled to consider what they had indignantly rejected for centuries, namely that medicine was an empirical art, not a rational *scientia*" (187).

lv. Peter Anstey, "The Creation of the English Hippocrates," *Medical History* 55 (2011): 457–78. See also D. E. Wolfe, "Sydenham and Locke on the Limits of Anatomy," *Bulletin of the History of Medicine* 35 (1961): 193–200; K. Dewhurst, "Locke and Sydenham on the Teaching of Anatomy," *Medical History* 2 (1958): 1–12; Andrew Cunningham, "Thomas Sydenham: Epidemics, Experiment and the 'Good Old Cause,'" in French and Wear, *Medical Revolution of the Seventeenth Century*, 164–90.

lvi. "Both animists and mechanists often tried to find common ground in a new, confident and enlightened system of medicine," French tells us (*Medicine before Science,* 207).

lvii. Thus "Boerhaave welded theory and practice into a system which found recognition and acceptance" in an early eighteenth-century medical community eager for some coherence (King, *Background of Herman Boerhaave's Doctrine*, 19).

lviii. "It was the great service of Boerhaave to have combined the chemical and the physical, the pathological-anatomical and the microscopic with the Hippocratic conception of medicine." Paul Diepgen, "Hermann Boerhaave und die Medizin seiner Zeit mit besonderer Berücksichtigung seiner Wirkung nach Deutschland," *Hippokrates: Zeitschrift für praktische Heilkunde* 10 (1939): 298–306 and 345–51, citing 302–4. See also F. L. S. Sassen, "The Intellectual Climate in Leiden in Boerhaave's Time," in *Boerhaave and His Time,* ed. G. A. Lindeboom (Leiden: Brill, 1970), 1–16, esp. 15. Diepgen ("Hermann Boerhaave," 302) makes clear the influence of Sydenham's skeptical empiricism on Boerhaave.

lix. Haller called him *Communis Europa Praeceptor. Bibliotheca Medicinae Practicae*, 4 vols. (Bern: E. Haller, 1776), 4:142, cited in Gerrit Lindeboom, *Herman Boerhaave: The Man and His Work* (London: Methuen, 1968), 355. One-third of Leiden MDs came from German lands through 1738. Wolfram Kaiser, "Theorie und Praxis in der Boerhaave-Ära und in nachboerhaavianischen Ausbildungssystemen an deutschen Hochschulen des 18. Jahrhunderts," *Clio Medica: Acta Academia Internalialis Historiae Medicinae* 21 (1987): 71–94, citing 72.

lx. Some now hold this to be undeserved. Cook, drawing on a study by W. Frithoff, claims that "the period of Boerhaave's professorship shows a decline both in the absolute number of foreigners who took their medical degrees at Leiden and in the percentage of foreigners who studied at Leiden rather than at other Dutch universities," and he supports Frithoff's conclusion that "Boerhaave's considerable reputation may have owed more to the changes in Dutch academic medicine advanced in the seventeenth century than to his personal genius." Harold Cook, "Boerhaave and the Flight from Reason in Medicine," *Bulletin of the History of Medicine* 74 (2000): 221–40, citing 224. To be sure, of the 1,919 students who matriculated at Leiden during Boerhaave's tenure, only 178 completed a dissertation under him (Lindeboom, *Herman Boerhaave*, 356–57). But that does not translate into a lack of influence. See Edgar Ashworth, *Boerhaave's Men at Leyden and After* (Edinburgh: Edinburgh University Press, 1977), for a more nuanced consideration of the behavior of British students at Leiden.

lxi. In his biography of Haller, Zimmermann goes on for many pages, on the basis of Haller's own attestations, concerning the personality of Boerhaave as the foundation of his pedagogical grandeur. Johann Georg Zimmermann, *Das Leben des Hrn Albrecht von Hallers*

(Zurich: n.p., 1755).

lxii. Urs Boschung et al., eds., *Repertorium zu Albrecht von Hallers Korrespondenz, 1724–1777*, 2 vols. (Basel: Schwabe, 2002), 1:112.

lxiii. Albrecht von Haller, *Bibliotheca Anatomica*, vol. 1 (1774; repr., Hildesheim: G. Olms, 1969), 757, cited in Shirley Roe, "*Anatomia Animata*: The Newtonian Physiology of Albrecht von Haller," in *Transformations and Tradition in the Sciences*, ed. Everett Mendelsohn (Cambridge: Cambridge University Press, 1984), 273–300, citing 287.

lxiv. Adolf Haller, *Albrecht von Hallers Leben* (Basel: Reinhardt, 1954), 24.

lxv. Ashworth, *Boerhaave's Men*. For the wider context, see Simon Schaffer, "The Glorious Revolution and Medicine in Britain and the Netherlands," *Notes and Records of the Royal Society* 42 (1989): 167–90.

lxvi. See Kaiser, "Theorie und Praxis in der Boerhaave-Ära"; Diepgen, "Hermann Boerhaave und die Medizin seiner Zeit"; Guenther Risse, "Clinical Instruction in Hospitals: The Boerhaavian Tradition in Leyden, Edinburgh, Vienna and Pavia," *Clio Medica* 21 (1987/88): 1–19; Andrew Cunningham, "Medicine to Calm the Mind: Boerhaave's Medical System, and Why It Was Adopted in Edinburgh," in Cunningham and French, *Medical Enlightenment of the Eighteenth Century*, 40–66; and G. E. Lindeboom, *Boerhaave and Great Britain* (Leiden: Brill, 1974).

lxvii. On the Montpellier medical school, see Elizabeth Willliams, *The Physical and the Moral: Anthropology, Physiology, and Philosophical Medicine in France, 1750–1850* (Cambridge: Cambridge University Press, 1994); Elizabeth Williams, *A Cultural History of Medical Vitalism in Enlightenment Montpellier* (Aldershot, UK: Ashgate, 2003).

lxviii. Herman Boerhaave, "Oration on the Usefulness of the Mechanical Method in Medicine,"

in *Boerhaave's Orations*, trans. E. Kegel-Brinkgreve and A. M. Luyendijk-Elshout (Leiden: Brill, 1983), 85–120.

lxix. Harm Beukers, "Boerhaavianism in the Netherlands," *Journal of the Japan-Netherlands Institute* 1 (1989): 116–29, citing 117. Beukers points out that Boerhaave himself "indicated that he became less active in medical practice after 1723" and "that he did not spend much time visiting patients." Harm Beukers, "Clinical Teaching in Leiden from Its Beginning until the End of the Eighteenth Century," *Clio Medica* 21 (1987/88): 139–52, citing 147.

lxx. Irmtraut Scheele, "Grundzüge der institutionellen Entwicklung der biologischen Disziplinen an den deutschen Hochschulel seit dem 18. Jahrhundert," in *"Einsamkeit und Freiheit" neu besichtigt: Universitätsreformen und Disziplinenbildung in Preußen als Modell für Wissenschaftspolitik im Europa des 19. Jahrhunderts* (Stuttgart: F. Steiner, 1991), 144–54, citing 150.

lxxi. The *Fachgebiet* began "to evolve in a direction separate from other branches of medicine." Within the university culture of the eighteenth century, a few "non-clinical members of medical faculties enjoyed the freedom to pursue their interests in a setting largely unencumbered by considerations of how their research might inform or threaten practical doctrines." Thomas Broman, *The Transformation of German Academic Medicine* (Cambridge: Cambridge University Press, 1996), 74, 159.

lxxii. Already in the seventeenth century, William Harvey did poorly as a practicing "learned physician" while pursuing his innovative physiological research. Jan Swammerdam (1637–80), perhaps his most eminent Dutch research peer, had sufficient wealth never to need to practice medicine. Marcello Malpighi (1628–94), the most important Italian research-oriented physician of the seventeenth century, found himself constantly upbraided in the

Italian medical community because his inquiries were not "really medical."

lxxiii. The relation of *anatomy*, with its strongly interventionist (experimental, not simply observational) orientation, to the "theoretical" enterprise of *physiology* proved very complex. Cunningham has elaborated on this issue, contrasting "the pen and the sword." 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* 33 (2002): 631–65; Andrew Cunningham, "The Pen and the Sword: Recovering the Disciplinary Identity of Physiology and Anatomy before 1800, Part II, Old Anatomy: The Sword," *Studies in History and Philosophy of Science* 34 (2003): 51–76. On anatomy in the period, see Andrew Cunningham, *The Anatomist Anatomis'd* (Farham, Surry, UK: Ashgate, 2010); Matthew Landers and Brian Muñoz, eds., *Anatomy and the Organization of Knowledge, 1500–1850* (London: Pickering and Chatto, 2012); Rüdiger Schultka, Josef Neumann, and Susanne Weidemann, eds., *Anatomie und anatomische Sammlungen im 18. Jahrhundert* (Berlin: LIT Verlag Dr. W. Hopf, 2007).

lxxiv. Findlen, "Natural History," 462–63.

lxxv. C. E. Raven, *English Naturalists from Neckham to Ray: A Study in the Making of the Modern World* (Cambridge: Cambridge University Press, 1947), 235. See also Neil Gillespie, "Natural History, Natural Theology, and Social Order: John Ray and the 'Newtonian Ideology,'" *Journal of the History of Biology* 20 (1987): 1–49; Phillip Sloan, "John Locke, John Ray, and the Problem of the Natural System," *Journal of the History of Biology* 5 (1972): 1–53. For Réaumur, Dawson puts it clearly: "Réaumur was the unquestioned European authority in natural history prior to 1749 when Georges-Louis Leclerc de Buffon published the first volumes of his more encyclopedic, if less precise, works of natural history." Virginia Dawson, "Regeneration,

Parthenogenesis, and the Immutable Order of Nature," *Archives of Natural History* 18 (1991): 309–21, citing 310.

lxxvi. Virginia Dawson, *Nature's Enigma: The Problem of the Polyp in the Letters of Bonnet, Trembley, and Réaumur* (Philadelphia: American Philosophical Society, 1987); P. Speziali, "Réaumur et les savants genevois," *Revue d'histoire des sciences* 11 (1958): 68–80.

lxxvii. Jacques Roger, *Buffon: A Life in Natural History* (Ithaca, NY: Cornell University Press, 1997).

lxxviii. For the specific persona of the *médecin philosophe*, see my essay "*Médecin-Philosophe*: Persona for Radical Enlightenment," *Intellectual History Review* 18, no. 3 (November 2008): 427–40.

lxxix. Julien Offray de La Mettrie, *Machine Man and Other Writings* (Cambridge: Cambridge University Press, 1996), 5.

lxxx. Théophile Bordeu, *Traité de médecine théorique & pratique* (Paris: Ruault, 1774). See Williams, *The Physical and the Moral*; Elizabeth Haigh, "Vitalism, the Soul, and Sensibility: The Physiology of Théophile Bordeu," *Journal of the History of Medicine* 31 (1976): 30–41.

lxxxi. G. Hartung, "Über den Selbstmord: Eine Grenzbestimmung des anthropologischen Diskurses im 18. Jahrhundert," in *Der ganze Mensch*, ed. H.-J. Schings (Stuttgart: Metzler, 1994), 33–51, citing 41.

lxxxii. Ibid. As Hatfield puts it, "Ontological questions were bracketed in order to concentrate on the study of mental faculties through their empirical manifestations in mental phenomena and external behavior." Gary Hatfield, "Remaking the Science of Mind: Psychology as Natural Science," in *Inventing Human Science*, ed. C. Fox, R. Porter, and R. Wokler (Berkeley: University of California Press, 1995), 184–231, citing 188.

lxxxiii. Kathleen Wellman, *La Mettrie: Medicine, Philosophy, and Enlightenment* (Durham, NC: Duke University Press, 1992), 130.

lxxxiv. John Yolton, *Locke and French Materialism* (Oxford: Clarendon, 1991); Eric Watkins, "Development of Physical Influx in Early Eighteenth-Century Germany: Gottsched, Knutzen, and Crusius," *Review of Metaphysics* 49 (1995): 295–339.

lxxxv. H.-J. Schings, "Der philosophische Arzt," in *Melancholie und Aufklärung* (Stuttgart: Metzler, 1977), 11–40; W. Riedel, "Influxus physicus und Seelenstärke," in *Anthropologie und Literatur um 1800*, ed. J. Barkoff and E. Sagarra (Munich: Iudicium, 1992), 24–52.

lxxxvi. The two greatest names of the German Frühaufklärung, Leibniz and Thomasius, both wrestled energetically with this challenge. See esp. Albert Heinekamp, "Leibniz als Vermittler zwischen Frankreich und Deutschland," in *Aufklärung als Mission / La mission des Lumières*, ed. Werner Schneiders, Das achtzehnte Jahrhundert, Supplementa 1 (Marburg: Hitzeroth, 1993), 93–102; Catherine Julliard, "Christian Thomasius (1655–1728) et son *Discours de l'imitation des Français* (1687): Un plaidoyer gallophile dans un context gallophobe," in Heitz et al., *Gallophilie und Gallophobie*, 1–24. For later developments, see Eric Blackall, *The Emergence of German as a Literary Language, 1700–1775* (Ithaca, NY: Cornell University Press, 1978).

lxxxvii. Friedrich II, *De la littérature allemande* (1780).

lxxxviii. See Wolfgang Förster, ed., *Aufklärung in Berlin* (Berlin: Akademie Verlag, 1989); Olav Krämer, "'Welche Gestalt man denen Frantzosen . . . nachahmen solle': Stationen einer Jahrhundertdebatte (Thomasius, Prémontval, Herder, Friedrich II., Möser)," in Häseler and Meier, *Gallophobie im 18. Jahrhundert*, 61–88.

lxxxix. Rudolf Vierhaus, "Montesquieu in Deutschland: Zur Gesichte seiner Wirkung als

politischer Schriftsteller im 18. Jahrhundert," in *Deutschland im 18. Jahrhundert* (Göttingen: Vandenhoeck und Ruprecht, 1987), 9–32.

xc. Herbert Jaumann, "Rousseau in Deutschland: Forschungsgeschichte und Perspektiven," in *Rousseau in Deutschland: Neue Beiträge zur Erforschung seiner Rezeption* (Berlin: De Gruyter, 1995), 1–22; and see the extensive bibliography in that volume, 291–309.

xci. Raymond Heitz, "Gallophile et gallophobe Diskurse in der Voltaire-Rezeption der deutschen Publizistik des 18. Jahrhunderts: Identitätssuche und Kampf gegen Entfremdung," in Heitz et al., *Gallophilie und Gallophobie*, 225–47. And see Martin Fontius, *Voltaire in Berlin* (Berlin: Rütten und Loening, 1966).

xcii. The classic account of the Bodmer/Breitinger challenge to Gottsched is Ernst Cassirer, *Philosophy of the Enlightenment* (Princeton, NJ: Princeton University Press, 1951). For a nuanced view, see Albert Meier, "Plus ultra! Johann Christoph Gottscheds gallophobe Gallophilie," in Heitz et al., *Gallophilie und Gallophobie*, 195–206.

xciii. See Gerhard Sauder, *Empfindsamkeit*, vol 1, *Voraussetzungen und Elemente* (Stuttgart: Metzler, 1974).

xciv. See the classic Erich Kästner, *Friedrich der Große und die deutsche Literatur: Die Erwiderungen auf seine Schrift "De la littérature allemande"* (1925; Stuttgart: Kohlhammer, 1972). Frederick's foil was Justus Möser, *Über deutsche Sprache und Literatur: Schreiben an einen Freund nebst einer Nachschrift, die National-Erziehung der alten Deutschen betreffend* (1781). See Winfried Woesler, "'. . . ob unsere Art der Kultur der fremden vorzuziehen sei?': Justus Möser antwortet Friedrich II," *Möser-Forum* 1 (1989): 192–207. Already Möser figured as a forefather in the great manifesto of the "German movement," *Von deutscher Art und Kunst* (1773), edited by Herder and Goethe and launching the Sturm

und Drang.

xcv. Roy Pascal, *The German Sturm und Drang* (Manchester: Manchester University Press, 1953); David Hill, ed., *Literature of the Sturm und Drang* (Rochester: Camden House, 2003); esp. Gerhard Sauder, "The Sturm und Drang and the Periodization of the Eighteenth Century," in Hill, *Literature of the Sturm und Drang*, 309–32.

xcvi. Wilhelm Dilthey, "Die dichterische und philosophische Bewegung in Deutschland 1770–1800," in *Gesammelte Schriften*, vol. 5 (Stuttgart: Vandenhoeck und Ruprecht, 1957), 11–27.

xcvii. Rolf Grimminger, "Aufklärung, Absolutismus und bürgerlichen Individuen: Über den notwendigen Zsusammenhang von Literatur, Gesellschaft und Staat in der Geschichte des 18. Jahrhunderts," in *Hanser Sozialgeschichte der deutschen Literatur vom 16. Jahrhunder bis zur Gegenwart*, vol. 3, *Deutsche Aufklärung bis zur Französischen Revolution*, ed. Rolf Grimminger (Munich: Hanser, 1980), 15–99, esp. 48ff. In the same volume, see also Reiner Wild, "Städtekultur, Bildungswesen und Aufklärungsgesellschaften," 103–32. Helen Liebel has given us a vivid image of Hamburg in this era; Horst Möller has done the same for Berlin. Helen Liebel, "Laissez-faire vs. Mercantilism: The Rise of Hamburg and the Hamburg Bourgeoisie vs. Frederick the Great in the Crisis of 1763," *Vierteljahrsschrift für Sozial und Wirtschaftsgeschichte* 52 (1965): 207–38; Horst Möller, *Aufklärung in Preußen: Der Verleger, Publizist und Geschichtsschreiber Friedrich Nicolai*, Einzelveröffentlichungen der Historischen Kommission zu Berlin, vol. 15 (Berlin: Colloquium, 1974). See also Helga Schultz, *Berlin, 1650–1800: Sozialgeschichte einer Residenz* (Berlin: Akademie, 1987), 163–320.

xcviii. Paul Raabe, "Die Zeitschriften als Medium der Aufklärung," *Wolfenbütteler Studien zur Aufklärung* 1 (1974): 99ff.

xcix. Wolfgang Martens, *Botschaft der Tugend: Die Aufklärung im Spiegel der deutschen moralischen Wochenschriften* (Stuttgart: Metzler, 1968).

c. Benjamin Redekop, *Enlightenment and Community: Lessing, Abbt, Herder and the Quest for a German Public* (Montreal, QC: McGill-Queens University Press, 2000); James Van Horn Melton, *The Rise of the Public Sphere in Enlightenment Europe* (Cambridge: Cambridge University Press, 2001); Thomas Broman, "The Habermasian Public Sphere and 'Science *in* the Enlightenment,'" *History of Science* 36 (1998): 123–49; John H. Zammito, "The Second Life of the 'Public Sphere': On Charisma and Routinization in the History of a Concept," in *Changing Perceptions of the Public Sphere*, ed. Christian Emden and David Midgley (New York: Berghahn Books, 2012), 90–119.

ci. It is no coincidence that these are Kantian categories. See Norbert Hinske, ed., *Eklektik, Selbstdenken, Mündigkeit* (Hamburg: Meiner, 1986).

cii. Lewis White Beck, *Early German Philosophy: Kant and His Predecessors* (1969; repr., Bristol: Thoemmes, 1996), 324ff.

ciii. See Förster, *Aufklärung in Berlin*; and esp. Lifschitz, *Language and Enlightenment*.

civ. Yolton, *Locke and French Materialism.*

cv. Lifschitz, *Language and Enlightenment*.

cvi. See Conrad Grau, *Die Preußische Akademie der Wissenschaften zu Berlin: Eine deutsche Gelehrtengesellschaft in drei Jahrhunderten* (Heidelberg: Spektrum, 1993), 87–114; Dominique Bourel, "Philosophes et politiques français à Berlin au XVIIIe siècle," in Schneiders, *Aufklärung als Mission*, 195–205.

cvii. Edgar Mass, "Französische Materialisten und deutsche 'Freigeisterei' (1746–1753)," in Schneiders, *Aufklärung als Mission*, 129–56. See also Martin Fontius, "Littérature

clandestine et pensée allemande," in *Le matérialisme du XVIIIe siècle et la littérature clandestine,* ed. Olivier Bloch (Paris: Vrin, 1982), 251–62; Arseni Gulyga, *Der deutsche Materialismus am Ausgang des 18. Jahrhunderts* (Berlin: Akademie, 1966); Ann Thomson, *Materialism and Society in the Mid-eighteenth Century: La Mettrie's "Discours préliminaire"* (Geneva: Droz, 1981).

cviii. "His fondest wish [*Wunschvorstellung*] conformed to the concept of a freelance writer who was forced to make concessions on no sides. He believed this plan could be realized best in a big city in which an urbane air circulated. . . . Thus, he renounced abruptly all his grants and the support of his parents and gave himself over to the daredevil adventure of living as a freelance writer in Berlin." Gustav Stichelschmidt, *Lessing: Der Mann und sein Werk* (Dusseldorf: Droste, 1989), 56. On the notion of the *freier Schriftsteller*, see Hans J. Haferkorn, "Zur Entstehung der bürgerlich-literarischen Intelligenz und des Schriftstellers in Deutschland zwischen 1750 und 1800," in *Deutsches Bürgertum und literarische Intelligenz, 1750–1800*, ed. Bernd Lutz (Stuttgart: Metzler, 1974), 113–276.

cix. See Wilhelm Dilthey, "Friedrich der Große und die deutsche Aufklärung," *Gesammelte Schriften,* vol. 3 (Leipzig: Teubner, 1927), 83–209. And see, more recently, Martin Fontius, *Friedrich II. und die europaische Aufklarung* (Berlin: Duncker und Humblot, 1999).

cx. Möller, *Aufklärung in Preußen*.

cxi. See, e.g., Lessing, "Gedanken über die Herrnhuter" (1750), in *Sämtliche Schriften,* ed. Karl Lachmann and Franz Muncker (Stuttgart: Göschen, 1886–1924), 14:154–63.

cxii. Franklin Kopitzsch, "Gotthold Ephraim Lessing und seine Zeitgenossen im Spannungsfeld von Toleranz und Intoleranz," in *Deutsche Aufklärung und Judenemanzipation,* ed. Walter Grab, Jahrbuch des Instituts für deutsche Geschichte, Beiheft 3 (Tel Aviv: Nateev-Print,

1980), 29–85.

cxiii. Wilfried Barner, “Lessing und sein Publikum in der frühen kritischen Schriften,” in *Lessing in heutiger Sicht* (Bremen: Jacobi, 1976), 331. As Martens puts it, “The drive toward truth, seeking, thinking for oneself [*das Selbstdenken*] that can actualize itself in the form of criticism, that is Lessing’s thing.” Wolgang Martens, “Lessing als Aufklärer: Zu Lessings Kritik an den Moralischen Wochenschriften,” in *Lessing in heutiger Sicht*, 244.

cxiv. E. Schmidt, *Lessing: Geschichte seines Lebens und seiner Schriften* (Berlin: Weidmann, 1909), 1:143.

cxv. Mass, “Französische Materialisten und deutsche ‘Freygeisterei’ (1746–1753).”

cxvi. Reiner Wild, “Freidenker in Deutschland,” *Zeitschrift für historische Forschung* 6 (1979): 253–85, citing 258.

cxvii. Ibid.

cxviii. Johann Anton Trinius, *Freydenker-Lexikon, oder Einleitung in die Geschichte der neuern Freygeister: Ihre Schriften, und deren Widerlegungen* (Leipzig, 1759).

cxix. Mass, “Französische Materialisten und deutsche ‘Freygeisterei’ (1746–1753).”

cxx. See Roland Mortier, *Diderot en l’Allemagne* (Paris: Presses Universitaires de France, 1954); Anne Saada, *Inventer Diderot: Les constructions d’un auteur dans l’Allemagne des Lumières* (Paris: CNRS, 2003), esp. 91–133. On the specific reception of the *Encyclopédie*, see, in addition to these, esp. Jürgen Voss, “Verbreitung, Rezeption und Nachwirkung der Encyclopédie in Deutschland,” in *Aufklärungen: Frankreich und Deutschland im 18. Jahrhundert* (Heidelberg: Winter, 1985), 183–91.