

SHORT LOAN

# Acolytes of Nature

*Defining Natural Science in Germany,  
1770–1850*



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## INTRODUCTION

Science was responsible for the dramatic technological advances that transformed European society in the nineteenth century—the steamship, the railroad, the telegraph, the camera. This, at least, was what the industrialist and physicist Werner von Siemens claimed in his famous 1886 speech "The Scientific Age." Most historians of technology no longer agree with this claim, at least not when stated so baldly, but for Siemens and many of his contemporaries, this boast on science's behalf had the ring of truth.<sup>1</sup> According to Siemens, "the enlivening breath of science" had transformed almost every area of European life. Science was a force like no other in human history, and humanity, he predicted, would be happy under its harmonious rule.<sup>2</sup>

Despite the intellectual and technical gulf that separated the late nineteenth century from the late eighteenth century, there was much in Siemens's speech that would have sounded familiar to eighteenth-century natural philosophers, ignorant though they were of photographs and steamships. Siemens's conviction that knowledge about nature should be *public* knowledge was one that they would have shared. They would have applauded the industrialist's opening salvo, which celebrated natural knowledge's escape from the "closed-off circles" of the traditional learned estate and its transplantation into "public life," though their specific social referents for these terms would have been somewhat different. In fact, the Bavarian official Matthias Flurl had offered a keynote address to the Bavarian Academy of Sciences in 1799 that began on exactly this note. Just like Siemens, Flurl believed himself to be living in an age when the beneficent effects of an improved understanding of nature were everywhere visible.<sup>3</sup>

Much had changed in the study of nature in the century that separated these two speeches, but Flurl would also have been familiar with the basic forms of knowledge

that Siemens championed. Like Siemens, an eighteenth-century natural philosopher would have considered the quantitative study of physical mechanics a valuable kind of knowledge. Eighteenth-century researchers also thought it profitable “to ask Nature herself through properly carried-out experiments,” to use Siemens’s words, though their experiments would not have measured up to nineteenth-century standards of precision.<sup>4</sup> Flurl would likely have been surprised that the physicist Siemens did not have more to say in praise of natural history, but others in the late nineteenth century still shared the passion Flurl espoused for collecting and describing plants, animals, and minerals.

Alongside these congruencies lies an equally important disjuncture. Despite their familiarity with experiment, careful observation, and quantification, eighteenth-century listeners would not have known what to make of Siemens when he spoke of a world imbued with “the spirit of modern science,” and the title of the industrialist’s speech, “The Scientific Age [*Das naturwissenschaftliche Zeitalter*],” would have been a mystery to them. It would not have been their inexperience with telegraph wires and railroad tracks that would have made this phrase incomprehensible. It would have been the concept at the heart of Siemens’s speech, science.

Modern science has roots twisting into many corners of the past. The category “science” itself, however, is a relative historical novelty. In Europe’s various languages, the word took on its modern meaning only over the course of the nineteenth century.<sup>5</sup> Before 1800, there was no standard collective term for the sciences of nature taken together. Enlightenment philosophers loved inventing new classificatory schemes, but a unified science of nature rarely appeared as a landmark on their maps of knowledge. The German philosopher Christian Wolff, for example, scattered different facets of the study of nature among three more general categories. The description of specific natural objects belonged to history, and general causal explanations about nature to philosophy. Fields like mechanics that described nature quantitatively were part of mathematics.<sup>6</sup> Other eighteenth-century thinkers offered similar arrangements, dividing the study of nature among the three areas of natural philosophy, natural history, and applied mathematics, sometimes tacking on chemistry as an independent category as well.<sup>7</sup>

In this earlier period, the German word that would later mean “science,” *Naturwissenschaft*, sometimes meant “natural history,” and sometimes “natural philosophy”; it was occasionally used to refer to a loose combination of all kinds of knowledge about physical objects

and natural processes, from the study of electricity to the invention of new chimney designs. In its modest and imprecise eighteenth-century guise, *Naturwissenschaft* was not the sort of word one used to define an age; it was not even a term that necessarily got included in dictionaries. Eighteenth-century writers thought of themselves as living in an Age of Philosophy or Reason, and when they championed Newtonian physics or Linnaean taxonomy as models for other areas of knowledge, they hoped to make the rest of human knowledge similarly rational, not similarly “scientific [*naturwissenschaftlich*].”<sup>8</sup> Siemens and his contemporaries, in contrast, saw science as a powerful and coherent cultural force with a deep history; this category formed an indispensable reference point in their understanding of the world.

This book traces the emergence of this important new category within German-speaking Europe between 1770 and 1850; it follows the evolution of *Naturwissenschaft* from an eighteenth-century neologism to a nineteenth-century rallying cry. This was a development that took place over the time period that Reinhart Koselleck called the *Sattelzeit*, the watershed years that transformed the Old Regime society of the mid-eighteenth century into the nascent modernity of the mid-nineteenth. In these decades, Koselleck argued, the key political and social concepts of modern German culture first took shape. The multivolume *Geschichtliche Grundbegriffe* that he authored with a number of colleagues provides an initial road map to the conceptual developments of these years.<sup>9</sup> *Naturwissenschaft* did not receive an entry in the *Geschichtliche Grundbegriffe*, but the category belongs very much within this wider history. Science emerged as a classificatory label as the Enlightenment public was evolving into its much larger, more complex, and multilayered nineteenth-century successor, and this temporal parallel is no coincidence. Before developing this argument further, however, I would like to dwell a bit longer on the shifting historical meaning of words, in order to illustrate just how distinctive the German category *Naturwissenschaft* was in the moment of its emergence.

### Science, *Naturwissenschaft*, and Nineteenth-Century German Peculiarities

English-speaking historians of German intellectual life are used to translation problems. In contemporary scholarship, the term *Wissenschaft* is perhaps the most obvious stumbling block. This category in-

cludes all of academic knowledge, both science and scholarship combined, and present-day English has no similar word. At a loss for a suitable equivalent, historians often leave the term in German.

For most of the nineteenth century, Anglophone translators faced a different problem. In English, "science" did not take on its narrower modern meaning until the second half of the nineteenth century, and through at least the 1870s, English dictionaries still defined "science" with the same broad boundaries that their German counterparts used for *Wissenschaft*.<sup>10</sup> As a result, H. E. Lloyd's 1836 German-English dictionary needed only one word to capture *Wissenschaft*: it meant "science." Lloyd used three terms, however, to approximate *Naturwissenschaft*: "science of nature, natural philosophy, physics."<sup>11</sup> Several decades later, when H. W. Eve wanted to render Hermann von Helmholtz's *Über das Verhältnis der Naturwissenschaften zur Gesamtheit der Wissenschaft* into English, "*Wissenschaft*" posed no problem at all. That was "science." The word that left him stumbling was "*Naturwissenschaft*." "The German word *Naturwissenschaft* has no exact equivalent in modern English, including as it does both the Physical and the Natural Sciences," Eve wrote in an explanatory footnote. By "the natural sciences," Eve meant fields like anatomy, physiology, and the natural historical disciplines (present-day British English still employs the terms "the natural sciences" and "the physical sciences" in approximately the same way). Eve went on to note that the Germans used "*Naturwissenschaft*" to cover roughly the same ground that the seventeenth-century founders of the Royal Society had intended when they talked about "natural knowledge." No phrase in modern English usage, however, seemed a perfect fit, so Eve made do with "natural science" as a literal but unsatisfying translation.<sup>12</sup> Rendering the term into French does not appear to have been any more straightforward. The French-German dictionaries of the mid-nineteenth century chose various equivalents for it. An 1868 edition of Mozin's dictionary chose "*physique*," which was decidedly too narrow to capture the standard German usage, as this term referred only to physical science. An earlier, 1862 edition of the same dictionary chose "*philosophie*." Both editions agreed, however, that "*la science*" meant "*Wissenschaft*."<sup>13</sup>

Another related German word caused similar difficulties for dictionary makers and translators. By the early nineteenth century, German speakers possessed a general label for an investigator of nature, be his field physics, chemistry, or some branch of natural history. This type of person was called a *Naturforscher*. The early nineteenth-century *Naturforscher* was not exactly the same as his later nineteenth-century de-

scendant, the fully professionalized scientist, but the outlines of this later figure were perceptible in his basic features.<sup>14</sup> For most of the nineteenth century, the British and the French struggled to find easy equivalents for this term. To say *Naturforscher* in nineteenth-century French, you had to use two words instead of one. French-German dictionaries defined a "*Naturforscher*" as both a "*physicien*" and a "*naturaliste*," and these words were not synonyms. The former was a student of *les sciences mathématiques et physiques* (the physical and mathematical sciences), while the latter studied *les sciences naturelles* (anatomy, physiology, and the natural historical disciplines).<sup>15</sup>

In English, "natural philosopher" was probably the best translation of "*Naturforscher*," but Anglophones at the time realized that this was an inexact rendering of what the Germans meant by their word. The British natural philosophers who admired Germany's national scientific association, the *Gesellschaft Deutscher Naturforscher und Ärzte* (GDNA), found it difficult to know what to call this group in their native tongue. In 1829 David Brewster called the meeting a "Congress of Philosophers."<sup>16</sup> James Johnston, in his report on the 1830 meeting of the German group, called it various things, all within one single article—"The Society of German Scientific Men," or "The Society of German Naturalists"—and finally explained in a footnote that English really did not have a word that adequately captured the German "*Naturforscher*."<sup>17</sup> A few years later, William Whewell would coin the term "scientist" in response to this dilemma, but coining the term was about all he did. Even he himself did not actually put the word into use, and it remained a controversial neologism through the end of the century.<sup>18</sup>

Of course, one should not overdraw these linguistic differences. After all, when the French talked about "*les sciences*" in the plural (as in the *Académie des sciences*), they often, though not always, meant to refer collectively to all the disciplines that studied nature. In 1831, the British founded a society in imitation of the *Gesellschaft Deutscher Naturforscher und Ärzte*, one that brought together roughly the same group of disciplines as the German group, and they managed to find a name for it. They called it the "British Association for the Advancement of Science" (BAAS). But their peers in other learned disciplines also chastised them for their atypically restrictive use of the word "science," pointing out that theology, the study of languages, and the study of history were sciences, too.<sup>19</sup> The BAAS's narrower usage took many decades to assert itself in the language as a whole. *Naturwissenschaft*, in contrast, was already a widely used term in German by the 1830s.

Historians have a long tradition of treating “*Wissenschaft*” as the primary conceptual peculiarity that marked off German-speaking intellectual life from other language traditions throughout the nineteenth century. German definitions of “*Wissenschaft*” certainly had distinctive features that set them apart from discussions of science elsewhere; both speculative philosophy and philology had a larger hand in shaping this category than in many other European language traditions.<sup>20</sup> But at least for the first two-thirds of the nineteenth century, other Europeans did not find this German concept strange enough to render its translation problematic. The category was not peculiar enough, in any case, to require apologetic translators’ footnotes, or to make the compilers of dictionaries become prolix looking for multiple equivalents. When early nineteenth-century British and French intellectuals looked at German for an equivalent of their term “science,” the words they picked was “*Wissenschaft*.” It was the vocabulary Germans used to talk about the study of nature—words like “*Naturwissenschaft*” and “*Naturforscher*”—that left translators scratching their heads.

Several recent studies have argued that the modern notion of the unity of science was a mid-nineteenth-century German invention. The linguistic evidence suggests that there is good reason to take this claim seriously. This invention, however, has so far been assigned to a fairly small number of individuals, all of whom rose to prominence within German science only after 1850. Supposedly, a new, unified ideal of science first crystallized in the neo-Newtonian programs of figures like Emil Du Bois-Reymond and Hermann von Helmholtz.<sup>21</sup> “In 1830 there could as yet be no thought of a unified natural science,” Herbert Schnädelbach claimed. “Only when a new, more ambitious program of reductive mechanism emerged as a plausible unifying framework did this concept become meaningful. With the discovery of the first law of thermodynamics and the triumph of a kinetic theory of heat, it became possible to imagine that all fields of natural knowledge might be reduced to a set of interlocking mathematical laws. With this promise on the horizon, German thinkers supposedly began to conceive of the natural sciences as a unified thing.”<sup>22</sup> The German emphasis on scientific unity, in other words, has been painted as an innovation that was the product of a few leading researchers, made possible through the growing midcentury appeal of mechanistic, physicalist explanations of natural phenomena.

Only a brief survey of how and where this category first emerged in German culture suggests that the story is much larger than that. The popular Brockhaus lexicon already defined “*Naturwissenschaft*” as a uni-

fied science of nature in 1824, when Du Bois-Reymond and Helmholtz were still young boys. The first learned society in Germany to call itself a “Natural Scientific Society” was not a club of eminent professors in Berlin but a civic association of obscure provincial naturalists founded in the small town of Blankenburg in 1831. Indeed, Helmholtz and Du Bois-Reymond both advanced a definition of science that was considerably narrower than the standard usage of the term. They thought that only those fields that had been able to formulate their knowledge as mathematical laws truly belonged to science, a definition that left fields like anatomy, botany, zoology, or morphology out in the cold. In reality, the German concept of a unified science seemed distinctive to other Europeans precisely because it *combined* the physical sciences and the natural historical disciplines. That was why Eve found the concept so hard to render into English, and why the French needed two words, “*physicien*” and “*naturaliste*,” to say “*Naturforscher*.” Clearly, we need a history of this category that goes further back in time and that includes a broader range of disciplines, both the physical and the life sciences. We also need to look at its history through a wider historical lens.

If we want to understand the emergence of this distinctive new category, civic associations like Blankenburg’s Natural Scientific Society offer one promising place to start. In fact, if one searches German intellectual life for social locations in which all of the sciences of nature came together within a single forum, private learned societies offer the most widespread and numerous examples. Like the new concept “science,” many local associations joined the different branches of natural knowledge together under one roof. As a result, these societies offer an excellent place to examine the concrete communities that formed under the banner of Nature from the Enlightenment through the revolutions of 1848–49. They were one key location where a new conceptual unity, “the natural sciences,” could be related to a demarcated domain of collective social practice. They offer perhaps the best place from which to watch how this concept slowly gained salience within German public culture, and as a result they stand at the center of this book.

In fact, like the concept *Naturwissenschaft*, the general natural scientific society was in many ways a distinctly German phenomenon in the first half of the nineteenth century. At first glance, this may seem like an odd assertion, given the large body of work that exists on the scientific associational life of other countries in this period. Private societies whose activities included the study of nature were no rarity in France and Britain. But it was fairly unusual in these contexts for a society to define its *sole* purpose as the study of nature, nothing more and nothing

less. In Britain, the British Association for the Advancement of Science covered ground roughly similar to the German GDNA, on which it had been modeled. Otherwise, the British learned societies founded in this time period did not describe their intellectual goals in terms similar to a typical German natural scientific society. Natural philosophy was of central importance in the Literary and Philosophical Societies so popular in provincial centers from the 1780s forward, but as their names suggest, these groups defined their mission more broadly. They were founded to support philosophy, literature, and the arts, not just the study of nature.<sup>23</sup> Even societies devoted to the study of natural history (*all of natural history*, that is, rather than just one branch of it) were rare creatures in Britain before 1850.<sup>24</sup> A handful of such groups, such as London's Linnaean Society, had appeared in the late eighteenth century. Between 1800 and 1850, however, most provincial British learned societies with natural historical interests also studied local antiquities. Most German cities had two separate groups for these twin pursuits. Like their British counterparts, France's provincial bourgeoisie showed a strong preference for generalist societies that combined science, literature, and the useful arts. For the period between 1800 and 1850, only 3 French provincial learned societies were devoted to science in general, while many dozens of groups had either broader or narrower horizons. And France's less prestigious equivalent of the GDNA and the BAAs, the Congrès scientifiques de France, included historians and antiquarians as well as students of the natural sciences.<sup>25</sup>

In contrast, by 1850 German-speaking Europe had about 45 local societies that made the general study of nature their collective aim. As subsequent chapters will explore, there was a fair amount of variation among these different groups. Nonetheless, natural scientific societies were a clearly discernible group within German associational life by the mid-nineteenth century. When Johannes Müller composed a bibliographic guide to German-speaking Europe's scientific societies in the 1880s, he considered "natural scientific societies" a well-defined type of association. The British Council's contemporaneous publication, *Yearbook of Scientific and Learned Societies of Great Britain*, had no similar category. At first glance, the societies devoted to "science generally" would seem a good match, but on closer inspection, any apparent similarity between the German and the British taxonomies dissolves. The category of "general science" included groups as disparate as London's Society for the Encouragement of Arts, Manufactures, and Commerce; the Royal Asiatic Society; and the Balloon Society of Great Britain. In Germany, these three groups would not have belonged to-

gether under any single heading, most certainly not under the heading "*Naturwissenschaft*."<sup>26</sup>

As we know from past work in science studies, the label "science" refers to a complex set of activities that do not have any obvious or essential unity. Despite the fact that this study charts the history of a unifying category, the internal diversity of the scientific enterprise remains readily apparent at every turn. By the mid-nineteenth century, German researchers shared a collective concept of "the natural sciences" as a meaningful cultural unity; some researchers also thought these sciences shared their own unique natural scientific method. Beyond this very general accord, German *Naturforscher* continued to disagree about many things—the form that general conclusions ought to take, the role of mathematics in the study of nature, the precise kinds of observations and experiments that were most useful, the best way to characterize the scientific method, and the kinds of explanations that counted as legitimate in any given field. If asked to define science, a provincial botanist would answer differently than a university-based morphologist; the morphologist's answer, in turn, would likely differ from the answer of a chemist. A broad cultural investment in the category "science" emerged alongside continued disagreement about the specifics of its content.<sup>27</sup>

Indeed, the power of the term came in part from its continued ambiguity, the fact that it designated a loosely organized cause that many different kinds of people might join. As a result, this book is not about the development of a clearly defined philosophical category; it tracks the cruder and more general history of collective linguistic usage. It focuses on the common reference points of large groups, not the carefully delineated ideas of individual thinkers. Like other recent studies in historical epistemology, it charts the gradual process through which the fundamental collective categories used to define authoritative knowledge develop over time.<sup>28</sup>

To explain how "science" went from descriptive label to rallying cry, this study looks at the reciprocal relationships among a developing concept (the unity of the natural sciences), a word ("*Naturwissenschaft*"), and sites of collective social action. This is a different task than following the "institutionalization of science" along the lines pursued in an older historiography.<sup>29</sup> Rather than assuming we know what science is, and searching through history to find places where people are practicing it, we will need to pay attention to how people themselves described the cause that captured their allegiance. In this study, the connections between concepts and communities will not be as tight as

the one imagined by historians who wanted to trace out the emergence of “the scientific community.” Examining the emergence of “*Naturwissenschaft*” as a category is not the same thing as documenting the creation of a scientific community in the sense in which sociologists have used the term.<sup>30</sup> As *Naturwissenschaft* came into general use, it did not bring with it a set of Mertonian norms of science that governed behavior across all scientific fields.

The story of this concept’s emergence also does not fit into older narratives that cast science as a force of secularization. In the second half of the eighteenth century, the study of nature was frequently praised as a path to piety and a way to contemplate the handiwork of the divine. This basic argument was still in wide circulation a hundred years later, though perhaps not expounded at such great length or with the same frequency.<sup>31</sup> Science’s critics sometimes claimed that it fostered a materialist worldview that threatened to destroy all higher spiritual values. The study of nature may have carried the scent of French materialism and atheism to some; this scent could seem exhilarating or noxious, depending on a person’s perspective. But before 1850, most of Nature’s acolytes were eager to distance themselves from such associations. In the decades under consideration here, the natural sciences were generally seen as working in harmony with other forms of spiritual understanding. We need to know much more about the different theological and philosophical inflections of this basic position, but it is worth recognizing the existence of a broad consensus. Indeed, its lack of specificity may be significant. The chemist and physicist J. S. C. Schweigger, originally a theology student, wrote of his relief at being able to leave behind the quarrels of theologians to contemplate God through mathematics.<sup>32</sup> In a period that had Hegelianism and Strauss’s *Life of Jesus* to chew over, the study of nature could often seem blessedly uncontroversial, theologically speaking.<sup>33</sup>

By the 1840s, the word “science” had shed its earlier status as a vague neologism and had become an indispensable intellectual reference point for educated German speakers. The cast of characters that forged science into a powerful new category was broad, and the world’s history is much more than a rarified intellectual tale. Its emergence was intertwined with the major political, social, and cultural developments of the eighteenth and nineteenth centuries. Much like other central concepts within nineteenth-century public life, terms such as “nation” and “citizen,” “science” gained its meaning against the backdrop of a socially diverse and densely populated public culture.<sup>34</sup>

### Science between the Learned and the Educated Public

Calling German science “socially diverse” strikes a strange chord, at least for the first half of the nineteenth century. Most historians of science have agreed that the interesting development in this period was the institutionalization of a new scientific elite within the state-funded universities. As David Cahan put it, German science was “a state affair.”<sup>35</sup> For the decades after 1850, this generalization no longer holds; we have a body of excellent work that looks beyond the universities to German museums, civic associations, and the activities of scientific popularizers.<sup>36</sup> But for the first half of the century, Cahan’s succinct formulation still captures the dominant view. The university has been the main site for the history of German science, the professoriat its primary actor.<sup>37</sup>

The universities, and the university educated, played an important role in the emergence of “*Naturwissenschaft*” as a public category, but sketching this word’s history requires bringing a wider intellectual world into view. To provide a first glimpse into this wider world, I would like to enlist the services of a somewhat obscure tour guide—not Goethe, Humboldt, or Helmholtz, but a minor German naturalist named Jacob Sturm. The span of Sturm’s long, happy, and productive life coincides almost exactly with the period covered in this book. He entered the world in 1771, the son of a Nuremberg engraver, and followed his father into the engraving trade when he came of age. In turn, Jacob’s own two sons would labor alongside their father in the family workshop. Sturm died, still a resident of the city of his birth, in 1849.

At Sturm’s graveside, the pastor Johann Wolfgang Hilpert described the engraver as a man “whose name resounds honorably wherever the natural sciences are practiced.” Hilbert boasted that Sturm’s name was known around the globe, and this was not simply provincial puffery. Over the course of his life, this modest Nuremberg citizen had indeed built up a network of scientific connections that reached across Europe and even across the Atlantic. As the author of the well-regarded *Deutschlands Flora in Abbildungen*, Sturm was a member of over twenty different scientific societies, groups based in foreign cities such as Moscow, Stockholm, and Philadelphia, as well as associations in German academic centers like Berlin, Jena, and Halle. Late in his life, Sturm received an honorary doctorate of philosophy from the University of Breslau.<sup>38</sup>

Sturm's life cuts an odd path through the historiographical consensus outlined above. The primary institutions in his scientific career were not universities, though the faculty of Breslau did eventually recognize his achievements with an honorary degree. They were learned societies, groups like his hometown Natural History Society or Berlin's colorfully named Society of Nature-Researching Friends. These kinds of organizations, central to the story at hand, currently occupy an ambiguous place in our picture of nineteenth-century German science.

While learned societies have been seen as central sites for the study of nature in the seventeenth and eighteenth centuries, their importance supposedly diminished rapidly (at least in the German context) after 1800, when the universities took over as the premier institutions of scientific life. After this sea change, learned societies and academies have been assigned several distinct functions. If they were devoted to a specific scientific discipline, they have been cast as the organs of the period's emerging disciplinary communities. The national GDNA (hereafter Society of German Natural Researchers and Doctors), which divided itself into separate disciplinary sections shortly after its founding, has generally also been slotted into this broader history of an emerging specialized elite. Historians have also noted the continued honorific functions of state academies like the Prussian Academy of Sciences. Such organizations gave prizes and preserved a symbolic relationship among different disciplines, but according to most assessments, the real action was elsewhere.<sup>39</sup>

For the most part, however, nineteenth-century scientific associations have been placed within quite a different history. They have been cast as the vehicles of a middle-class culture of amateur science, a pursuit that emerged in tension with, or even in reaction to, the consolidation of a university-based scientific elite. Scientific voluntary associations, in Andrew Zimmerman's words, "challenged the hegemony of official academic institutions."<sup>40</sup> For Andreas Daum, the growth of scientific associational life represented bourgeois society's appropriation of natural knowledge for the satisfaction of its own needs. Through associational life, the German middle classes sated a desire for scientific information that Germany's academic scientific establishment had left unmet.<sup>41</sup>

In making these claims, both Zimmerman and Daum were describing the second half of the nineteenth century, the period when, as Daum has convincingly shown, pursuits like "amateur science" and "popularization" first came to be clearly defined as distinguishable fields of cultural production. To talk of popularization in the modern

sense, Daum points out, requires a corresponding notion of a closed community of professional scientists, a group whose results are then communicated in altered form to a wider lay audience. This dialectic of professionalization and popularization only became fully stabilized after 1848.

But what of the period before 1848, when the dialectical pair of the professional and the popular was still half formed and inconsistently applied? In this earlier period, private learned societies did not belong to a clearly delineated secondary realm of scientific production. Though we can see a more organized "low" scientific culture emerging by the 1830s and 1840s, for most of the period under consideration here, there are significant analytical benefits to seeing all of Germany's natural researchers, nascent university professionals and small-town naturalists alike, as belonging to a single intellectual world, albeit one that had both more and less eminent members. Here again, Jacob Sturm's biography offers a useful introduction to the diverse kinds of people who participated in German scientific networks in this period. From his base in Nuremberg, Sturm corresponded with a number of men who had similar intellectual interests but varied occupational profiles. Sturm's first patron was the Erlangen professor and botanist J. C. D. Schreber; Sturm also knew Schreber's successor in Erlangen, Wilhelm Daniel Joseph Koch. He traded letters with the Regensburg apothecary David Heinrich Hoppe, and with the Bohemian aristocrat and agricultural reformer Count Kaspar von Sternberg. Ludwig Reichenbach, Saxon court councillor and the director of the Dresden Botanical Garden, was another of his correspondents.

Taken collectively, such exchange networks were part of a broader cosmopolitan community that Hilpert, Sturm's eulogizer, called the learned world, also sometimes known as the republic of letters.<sup>42</sup> Based on our current understanding of the history of nineteenth-century science, one might think that the provincial pastor Hilpert was being quaint in evoking this concept. There are differing views on when exactly the republic of letters ceased to be a meaningful reference point for European intellectuals, but there is general agreement that it was long gone, or at least transformed beyond all recognition, by 1850.<sup>43</sup> Anne Goldgar set its demise around 1750, and Anthony La Vopa posited a similar expiration date, arguing that the older, Latinate ideal of the *res publica literaria* dissolved in the second half of the eighteenth century into a broader vernacular public sphere.<sup>44</sup> For Dena Goodman, the republic of letters remained a viable category after 1750, but according to her, the republic now had its center in the fashionable



and enlightened world of the Parisian salons, and took a form quite different from its pedantic early modern predecessor. In contrast, L. W. B. Brockliss has shown that the less fashionable networks that had characterized the older republic were alive and well through the end of the century, and even expanding. The *philosophes*, he argued, were a particular camp within this broader republic, not a novel and separate formation.<sup>45</sup> Lorraine Daston also described the republic of letters as a continually evolving entity through the entirety of the eighteenth century.<sup>46</sup> For both Brockliss and Daston, however, the revolutionary and Napoleonic era marked an important moment of rupture, when the nation-state edged out the cosmopolitan republic as the primary organizing force of intellectual life.

To understand the social structure of German science through the middle of the nineteenth century, it is essential to recognize that “the learned world” remained a viable organizational idea well after 1800. This is not a hard claim to support, given that German researchers, even elite ones, continued to talk quite openly about belonging to the learned world far into the nineteenth century. In 1817, Lorenz Oken described his new review journal, the *Isis*, as an organ of “the learned world.”<sup>47</sup> About fifty years later, when Rudolf Virchow wanted to make the case that science ought to serve national interests, the first thing he knew he had to do was argue against the countervailing ideal of a cosmopolitan republic of letters.<sup>48</sup> The Nuremberg pastor Hilpert was not being old-fashioned in talking about the world of “learned men”; he was talking about intellectual life in a way that was still common among educated Germans in the middle of the nineteenth century.

Furthermore, it was not just the *concept* of the learned world that survived; many older patterns of learned sociability persisted, too. The early modern republic of letters organized itself through published exchange, but also through letter writing and learned societies. Jacob Sturm built his intellectual reputation using these same materials. He published scientific work, but he also cultivated a diverse network of correspondents. Building from this base, he acquired further intellectual connections in the form of memberships in learned societies. Recognition from a university came only late in his life, but his honorary degree from the University of Breslau suggests that a man could still build a meaningful intellectual reputation in the first half of the nineteenth century using these kinds of resources. Hilpert described Sturm as a serious researcher, and not just an amateur; he belonged to the world of science, not to the world of self-improving hobbyists, and the professors in Breslau apparently agreed.

Of course, the republic of letters had not crossed the threshold of 1800 completely unchanged, and tracing these changes will be a major task of this book. But despite many significant transformations, nineteenth-century learned sociability still had a number of features that would have been familiar to earlier generations, and these continuities are crucial to understanding the particular tensions that characterized German intellectual life in this period.

The nineteenth-century relevance of “the learned world,” as both a concept and a set of social norms and practices, has been hard to see for a number of reasons, and these stem in part from the standard explanations offered for the rise of German university science. R. Steven Turner provided one of the most influential interpretations of the changes of this period, and for him, the German research university emerged in close conjunction with the transformations that turned the early modern learned estate into the modern educated middle class. What Turner called the “Great Transition” occurred in precisely the same period covered by this book, and a key feature of this Great Transition, in Turner’s version of the story, was the demise of traditional ideals of learnedness.<sup>49</sup>

The early modern learned estate was composed of the tiny group of university-educated men who belonged to one of the traditional learned professions; these men, trained in law, medicine, or theology, enjoyed certain legal privileges, and they shared a common identity grounded in eloquence, Latinity, and a polymathic mastery of a common learned heritage. With the rise of a vernacular reading public in the second half of the eighteenth century, Turner argued, the values of the traditional learned man came to seem increasingly dated, unworldly, and impractical. By 1800, witty enlightened satirists had more or less mocked the learned man, the *Gelahrte*, out of existence. The figure that replaced him was the modern *Bildungsbürger*, the educated middle-class man. This figure, like his early modern counterpart, was a man trained at a university, and there was a fundamental social continuity between the members of these two successive groups. But the new ideal of *Bildung*, or self-cultivation, became the defining cultural property of this newer group, which was now made up of modern professional men. As *Bildung* replaced learnedness, ideals of taste and functional expertise replaced older shared values of erudition.<sup>50</sup>

Turner’s account, though it captured many important changes, mischaracterized both the status and the fate of the “learned man” in two ways. First of all, Turner conflated the learned estate and the republic of letters into one single entity; every university-educated man suppos-

edly thought of himself as a member of the republic of letters. That was clearly not true. Belonging to the early modern republic of letters required more than just a university degree. It required the active cultivation of intellectual interests and participation in networks of learned exchange. The learned world, in short, was not the same thing as the learned estate. The latter was understood as a group within the corporate social order; the former was an intellectual community whose correspondence networks might well cut across standard divisions within Old Regime society.<sup>51</sup>

Second, it is misleading to link the fate of the learned man so inextricably with the decline of early modern ideals of polymathic erudition. By the late eighteenth century, the erudite and old-fashioned pedant was definitely a favorite object of parody, but Germans continued to speak in (mostly) respectful tones of “the learned public,” and the learned man had by no means disappeared as an authoritative figure. Through the middle of the nineteenth century, educated Germans often distinguished a narrower learned public from a broader educated one. This distinction, in fact, was extremely important in structuring German cultural debates from the late eighteenth century forward. Nineteenth-century ideals of education and refinement (*Bildung*) developed alongside a more narrowly defined conception of scientific expertise, and the language of learnedness remained central to how this expertise was described. In the 1880s, Werner Siemens would speak of the “love of *Wissenschaft* for its own sake” that characterized “the German learned man,” and this captures the relationship between these two terms well.<sup>52</sup> In common parlance, a man of *Wissenschaft*, or science, was also a man of learning, a *Gelahrte*. For the Nuremberg pastor Hilpert, the learned world *was* the world of *Wissenschaft*, not its long dead early modern antecedent, and here again, the provincial pastor’s usage was entirely typical.<sup>53</sup>

Once we recognize this fact, we can better account for something that has seemed paradoxical about the relationship between elite science and the public sphere in this period. Thomas Broman has argued convincingly that scientific knowledge gained cultural authority in the eighteenth century by embedding itself in the broader discourse of public opinion and the public sphere.<sup>54</sup> Scientific knowledge, like other forms of public knowledge, was seen as trustworthy because it could be subject to rational criticism and debate, and because it was made available to the eyes of all. Broman also points out, however, that science was “universally accessible in principle but recondit in practice.” Actually participating in scientific debate required a high level of ex-

pertise, and as a result, he argues, modern disciplinary communities “effectively began to withdraw large regions of scientific knowledge from the public sphere almost as soon as it formed,” but without totally abandoning the key ideological benefits the public sphere provided.<sup>55</sup>

One way to resolve this seeming paradox is to recognize that when eighteenth- and early nineteenth-century authors wrote about “the public,” they could have two rather different kinds of communities in mind. As Heinrich Bosse has shown, Germany’s seventeenth- and early eighteenth-century republic of letters possessed many of the same features that Jürgen Habermas ascribed to the public sphere. Its members also saw themselves as forming a public whose opinions were secured through reasoned debate and whose collective judgments ought to command authority.<sup>56</sup> Yet the republic of letters differed from Habermas’s version of the public sphere in significant ways, too. The public sphere, in T. C. W. Blanning’s description, was conceived of as something “anonymous and unhierarchical,” and one gained access to it “solely by the capacity to pay for the cultural commodities it consumes.”<sup>57</sup> Similarly, Anthony La Vopa described the German public sphere as consisting primarily of “solitary readers and writers,” the purchasers and producers of books and journals.<sup>58</sup>

Membership in the republic of letters required something more. An aspirant for membership in the learned world had to prove that he (and occasionally she) possessed sufficient knowledge and skill to join in the conversation. Unlike the wider public, the learned world was not anonymous or composed of solitary readers; its members were densely interconnected, and they did not talk to one another only through the medium of print. Furthermore, their social interactions were not governed solely by the rules of commodity exchange but also by a reciprocal set of obligations that often had more in common with gift economies than with the market.

In the late eighteenth century, Germans did not always draw a clear distinction between these two kinds of publics. Sometimes they wrote quite openly about the differences between the narrower learned public and a broader educated one; sometimes they conflated these potentially separate groups into a single unified category. Other authors recognized this division but rejected its legitimacy, arguing that the opinion of any rational human was as good as any other.<sup>59</sup> Indeed, throughout the entire period covered in this book, it was not an easy matter to draw a clean line between the truly learned and the merely educated public. As Jacob Sturm’s case illustrates, formal educational credentials were not all that mattered in the learned world. People

could move up from the more general public to the more expert one; purchasing a book or a natural history collection might be the first step in a process of self-education that could eventually lead to recognition from better-informed peers. The sociological boundary one crossed when one joined the learned world, however, had real weight, and if the precise location of this boundary was open to negotiation, it is not hard to see some basic differences between the relationships constituted through the period's learned networks and the relationships produced within the wider cultural marketplace of Germany's emerging consumer society.

In arguing for the existence of multiple publics, I might seem to be falling prey to a common analytical error. Harold Mah has criticized historians for their excessively spatial uses of the term "public sphere."<sup>59</sup> Too often, he argues, historians have talked about the public sphere as if it were simply a neutral stage that people could enter and leave. Since historians have thought of the public sphere as a kind of empty space, they have been quick to posit the existence of as many "public spheres" as they pleased. For Mah, this way of conceptualizing the public sphere misses a key point—the fact that the public claimed power as a unified collective subject. Against the early modern state, "public opinion" demanded a hearing because it supposedly had the right to speak with a single voice; the public was not a space but a collective entity.<sup>60</sup>

Mah's correction is a valuable one, but there are also dangers in seeing "the public" as too singular a thing. Eighteenth- and nineteenth-century writers often modified the noun "public" with different adjectives. They talked about the learned public, the educated public, the botanical public, or the patriotic public. From this perspective, there were in fact many different publics who might pass judgment on matters of general concern. Each of these various publics was conceived of as a collective unity in the way that Mah described, but each of these publics was also associated with a somewhat different social network; each had different entry requirements and different tacit expectations. These various networks overlapped and intertwined in complicated ways, but there is significant analytical value to keeping this diversity in view. Mah is right to chide historians for treating the public sphere simply as a stage on which various historical actors played their part, but there are similar problems with thinking of "the public" as a term with only a single possible referent.

As a result, we should be careful not to let the structures of the *learned* public simply dissolve into a broader marketplace of cultural goods. In his erudite and entertaining history of the German academic

persona, William Clark has shown that early modern university professors achieved their special brand of charisma in part through their reputation within a broader learned world.<sup>61</sup> The German officials who oversaw the universities liked nothing better than a professor who made noise in the republic of letters. Clark's tendency to refer to this learned world simply as "the market," however, lumps together too many disparate forms of exchange under a single homogenizing label.<sup>62</sup> It also obscures the fact that state officials were themselves often members of the learned world; when they listened to its applause, it was in part their own hands they heard clapping.

Dubbing the learned world "the market" also blunts our ability to further explore a crucial issue that troubled German researchers a great deal in this period—namely, in a world where a growing public looked to natural history and natural philosophy as a source of entertainment, and where knowledge was something that could be purchased by anyone who could afford a book or an attractive specimen, how did one keep the structures of expertise stable? What, in other words, was the relationship between the learned public, whose members were vetted, socially interconnected, and bound by mutual obligations, and the broader public, in which no such limiting relationships pertained?

"Science" emerged as a category because it was useful for answering precisely these kinds of questions. And these questions were particularly thorny ones in the period under examination here for several reasons. In the decades after 1770, a large number of new aspirants came knocking at the door of the learned world. These new men, and a much smaller number of women, appeared on the scene as a result of several broader developments within German political, cultural, and economic life. Germany's reading revolution, which shifted most of learned discussion into the vernacular, greatly expanded the audience for natural philosophy and natural history.<sup>63</sup> Growing circles of readers also meant more opportunities (though often not terribly lucrative ones) for authors, engravers, and artists. Already in the seventeenth century, connections to the book trade had introduced people like Maria Sibylla Merian to natural history; the engraver Jacob Sturm followed a similar route to participation in the learned world. As print culture expanded, figures like Sturm also multiplied.<sup>64</sup> By the early nineteenth century, one can even find people making a modest living catering to the public's enthusiasm for natural history collecting.

The schooling revolution that began in the late eighteenth century also created a new stratum of people at the lower edge of what the late eighteenth century called "the educated estates." New techni-

cal schools, normal schools, and agricultural academies produced new kinds of educated men of ambiguous social status. Such men joined scientific associations in large numbers in the 1830s and 1840s. Forestry and mining officials, the men who staffed the technical branches of the German states' expanding bureaucracies, did the same, as did other men from the lower ranks of state service.<sup>65</sup> Within manufacturing and certain fields of craft production, one can also find a growing number of aspirants for inclusion in the learned world, men like the famous instrument maker and natural philosopher Joseph Fraunhofer.<sup>66</sup> Natural history and natural philosophy attracted attention among the upper strata of the social order, too; German noble landlords, many of whom were interested in agricultural improvement, often also became enthusiastic collectors of *naturalia*. These improving landlords, and the increasingly commercialized agriculture they practiced, set up the conditions for the emergence of yet another new group of men, estate managers and practical agricultural experts whose knowledge of farming might or might not be based on formal training.<sup>67</sup>

In the passage above, I described this group of new men as "large," and that statement requires clarification. In comparison to the scale of most social history, the number of people involved in the changes outlined above was in fact not really all that high. When placed against the institutions of later periods, the new normal schools and academies of the *Sattelzeit* look quite modest. Most of them taught dozens of students in a given year, not thousands.<sup>68</sup> Even the largest scientific societies of this period did not have more than a few hundred local members. Within the learned world, however, the pressures that this expansion created were significant, and the resulting aftershocks reverberated through public culture as a whole.<sup>69</sup> Indeed, the developments outlined above put significant strain on Germans' basic categories of social classification, and in this period of intense flux, men of varied backgrounds had good reason to take advantage of the status that could be gained through participation in the republic of letters.

Just as it makes sense to keep the distinctive features of the learned public in view, it is also important not to let the distinctive practices that characterized learned societies fade too seamlessly into a broader history of civil society and associational life. When viewed in this way, scientific societies become much less interesting, just one lesser example of familiar processes that can be better examined elsewhere. Historians of German political and social history who have studied associational life in this period have generally deemed their subject important for several reasons. Clubs and societies forged new kinds of so-

cial linkages, *Erziehung* set up a new middle-class culture out of the more localized and fragmented world of the Old Regime. They created forums of debate that were free of state oversight, facilitating the growth of a new political public. They have also been seen as central to the history of modern nationalism.<sup>70</sup> In very general terms, learned societies certainly contributed to each of these developments, as previous historians have noted.<sup>71</sup> When placed within these broader trajectories, however, learned societies do not cut a particularly impressive figure. They were much smaller and less numerous than the period's ubiquitous Freemason lodges; they were less effective as crypopolitical vehicles than the choral or gymnastic associations, and less promising as nascent economic interest groups than were early agricultural, industrial, or workers' organizations.<sup>72</sup>

The distinctive appeal of learned societies lay in their ties to the old and still prestigious traditions of the republic of letters. Through the early nineteenth century, most German intellectuals proudly listed their various society memberships on the title pages of their books. The lure of learned status best explains the proliferation of these groups, not just a need for information nor a yen to claim a generalized bourgeois identity.<sup>73</sup>

Indeed, in this transitional period, we need to be careful about how we use terms like "the *Bildungsbürgertum*," or the educated middle class. Many of the developments outlined in the following chapters were certainly part of the history of this social category, and as a loose descriptive term, "the educated middle classes" has a certain value.<sup>74</sup> But no one in the first half of the nineteenth century called himself a *Bildungsbürger*.<sup>75</sup> This particular social label came into general use only in the twentieth century, and transposing it back into the early nineteenth century, as Turner and others have done, preemptively answers questions that were still very much open, especially before 1850. Through the middle of the nineteenth century, the term that people *did* use, "the educated estates [*die gebildeten Stände*]," stretched beyond the *Bildungsbürgertum* in several ways. This group included well-read and cultivated noblemen and women; it included prosperous merchants and their wives. It also might include a well-read artisan or entrepreneur.

This heterogeneous group "the educated estates" made up the broader public from which the learned wanted to distinguish themselves; this was also the broader public the learned wanted to court. To make things more complicated still, learned natural researchers also wanted to bring *new* groups into the ranks of the educated. They wanted to educate farmers and craftsmen, the diverse members of "civil

society [*bürgerliche Gesellschaft*]” in the broader meaning often given that term in this period.<sup>76</sup> In such a dynamic and socially heterogeneous landscape, defining the boundaries of the learned world was a tricky task. Educated Germans worked out their answers to this conundrum through the varying trajectories of their individual lives, the evolving networks of local learned sociability, and the back-and-forth of published debate. Under the cumulative pressure of these negotiations, early modern habits of classifying knowledge (and knowledge makers) strained to a breaking point, and new categories like science appeared in their stead.

Eighteenth- and nineteenth-century German intellectuals participated in a variety of sophisticated, complicated debates about the nature of natural knowledge. To interpret their complex reflections on this topic merely as the product of social anxieties or collective enthusiasms would be facile. What this book attempts to understand, however, is why intellectually sophisticated and highly individualized people aligned themselves with certain broad, general habits of linguistic usage. In explaining *that* kind of behavior, shared status anxieties, along with shared passions and ambitions, offer a good starting place for analysis.

### The Germans in Comparative Context

There are many aspects of the developments I have just outlined above that are *not* particular to Germany. The tensions I have described bear a strong family resemblance, in fact, to the conflicts that other historians have examined within French and British science in the same period. In those places as well, the expansion of the public sphere, along with the accompanying specter of natural knowledge as spectacle, amateur dalliance, or utilitarian slave, raised troubling questions about how to stabilize expertise. Here, too, an emerging scientific elite competed with a “low” scientific culture for the right to define what counted as legitimate knowledge.<sup>77</sup> Furthermore, intellectual traffic across language barriers remained intense in the nineteenth century. Cosmopolitan exchange was an integral feature of scientific life in all parts of Europe.<sup>78</sup> In the following chapters, I have tried to indicate at specific moments the reasons that the Germans’ classificatory schemes diverged from those used in other places. At the outset, however, it is possible to make a few generalizations about why developments within German-speaking Europe looked different from developments elsewhere.

In Germany, the social networks of natural knowledge cut across the boundaries of a particularly strong learned tradition that had its central base in the universities.<sup>79</sup> “The learned,” as a social and educational group, had particular strength and coherence in German-speaking Europe, but in the case of natural knowledge, the republic of letters extended well beyond the boundaries of the learned estate, much further than was the case in other scholarly fields. *Naturforscher* were a much more socially heterogeneous group than philologists or historians. The people who participated in published discussion, who had collections and did experiments, were not all “learned” in the narrower sense, and, as discussed above, these other kinds of researchers were growing more numerous with each passing decade. Champions of science, particularly if they were men with liberal political sentiments, sometimes considered this social diversity a positive thing, but this heterogeneity also created perennial status problems. Adding to this problem was the fact that German rulers and their officials were often quite interested in the knowledge of practical knowledge possessed by men from outside the university-educated elite.<sup>80</sup>

These crosscutting tensions marked out the peculiar features of the German concept of “*Naturwissenschaft*.” They set the natural sciences in stronger contradistinction to other scholarly fields like history, and also differentiated them more clearly from emerging practical fields of discussion. This particular combination of tensions helps to explain, in other words, why in Britain in the 1880s a society devoted to ballooning, Eastern antiquities, or manufacturing could still be classified as part of a broader project called “science,” while an educated German would have described the situation very differently.

Finally, Germany was not a unified nation but a polycentric cultural space. Historians of France and Britain have often emphasized the importance of the relationship between province and metropolis in shaping the scientific cultures of those nations.<sup>81</sup> Germany, in contrast, had many competing cultural centers, and many smaller, “provincial” places that were still loath to think of themselves as such.<sup>82</sup> Given Germany’s political decentralization, one might be tempted to read Germans’ interest in the unity of science simply as a projection of nationalist longings.<sup>83</sup> Science and nation building were indeed sometimes linked, but the former category was not the projection of the latter. The ways in which the following story is a “national” one are more complicated than that, and they have to do with a shared set of conditions that pertained within German-speaking Central Europe, not a conscious common effort to forge a unified nation through the

creation of a unified science. It was the complex interplay among cosmopolitan, national, and other regional loyalties that gave the German context its particular cast. Regional, civic, and dynastic allegiances played an important role in shaping the German scientific landscape, and in focusing just on the nation, we would be missing key elements of the story.<sup>84</sup>

Because of the absence of a clear cultural center, some historians have argued that German intellectuals were more exclusively oriented toward printed exchange than their colleagues in France and Britain, where people could gather in the capital and talk face-to-face.<sup>85</sup> There is certainly something to this argument; in terms of raw numbers of specialized journals, German-speaking Europe eclipsed Britain and France.<sup>86</sup> This thriving print culture did not lessen educated Germans' desire for local intellectual sociability, however; if anything, it heightened it. For if specialized scientific accomplishments were to mean anything in a man's daily life, they needed to be visible in a local setting. Jacob Sturm's eulogizer described how difficult it could be to get cosmopolitan learned fame to register in a local context: "Hardly anyone in his native city noticed him," Hilpert wrote. "And yet, while in Nuremberg hardly anyone even knew of the existence of a Jacob Sturm, he stood in friendly contact with the greatest *Naturforscher* of all the nations of the civilized world."<sup>87</sup> For both Germany's academic elite and more modest figures, local scientific societies provided an answer to this dilemma. They allowed learned men to advertise the collective scientific resources of their city within a landscape full of competing centers; at the same time, they made each member's scientific accomplishments more visible within local cultural life. In nineteenth-century Germany, intellectual reputations were secured first and foremost through publication, but the business of building a name for oneself was not just a matter for the printed page. Learned reputation had important local components as well. It was grounded in the urban social worlds where most German *Naturforscher* spent their daily lives.<sup>88</sup>

This study draws on material from across German-speaking Europe, but in order to examine the complex position of the natural sciences in local urban settings, there is one city to which I return throughout the book more than any other, and that is Dresden. Nineteenth-century Dresden is an interesting place to observe scientific life for several reasons. As the capital of Saxony, it was at the heart of a densely urban and precociously industrial state, a place where the early tensions of the emerging industrial world were felt particularly keenly.<sup>89</sup> Though less commercially powerful than its neighbor Leipzig, the Saxon capital was

also home to a number of thriving economic enterprises. Widely recognized as an important artistic center, the Saxon court city had an active literary and philosophical life, one that included both polite salons run by aristocratic women and less well-heeled circles of radicalizing young liberal men. From the early nineteenth century forward, Dresden also had a well-regarded medical academy and technical school. It did not have a university; rather, it offers us a chance to look at other kinds of professors, ones who were also part of the elite learned world of this period. Most important, the city had an unusually rich scientific associator-1 life. Dresden had more general natural scientific societies than any other German city in this period.

For a book about a German particularity, it is not a book about a German *Sonderweg* (special path). Germans did not have a different concept of science because they were more "inward looking," less practical, or less empirical than the French or the British. They did not have a different concept of science because the state and the nobility were too strong, and civil society too weak. They did not have a different concept of science because intellectual activity seduced the middle classes away from the political realm. "*Naturwissenschaft*" was another sort of German peculiarity, one that fits quite well with our revised understandings of nineteenth-century German history.<sup>90</sup>

#### A Note on Terms and Translation

Writing the history of a German word in English comes with inherent difficulties. To avoid making the preceding introduction too cumbersome, I have up until now followed familiar English usage and used "science" for "*Naturwissenschaft*." For the rest of the book, I have translated this term as "natural science." When I use the adjective "scientific" from here on, the German equivalent would be "*wissenschaftlich*." When the source says "*naturwissenschaftlich*," I have translated this as "natural scientific." Historians of science generally make it a point to avoid the term "scientist" before the late nineteenth century, when this professional persona appeared in its mature form (the Germans, too, often used a new label, "*Naturwissenschaftler*"). As a result, I have often used the word that Germans employed in this period, "*Naturforscher*," without translating it, or have rendered it literally into English as the somewhat awkward "natural researcher."