

❧ *Introduction* ❧

DURING THE YEARS AROUND 1800 several publications appeared whose authors had the expressed ambition to outline a science of life or biology. Organic vitality had become a developing matter of concern throughout the latter eighteenth century, with many new organic phenomena and questions about vitality arising through a diversity of new investigations and compelling attention. The question “what is life” also received attention in the face of perceived encroachments from the physical sciences that claimed to answer that question, at least in part. Assertions of the need for a science of life emerged in the context of anxieties over the disappearance of a distinct domain for life. The articulations of that domain were accordingly also an attempt to delineate what life is not, or to demarcate a boundary between the living and the nonliving. But in explorations of the border zones of life, the space of demarcation expanded and consumed any clear boundary. Today, as the life sciences and their relationships to the physical sciences are being radically transformed through a host of new tools and techniques and areas of study, it is important to be reminded of how, from its beginnings, biology inhabited a troubled epistemic space, as attempts to posit a science of life simultaneously effaced its clear delimitation.

The expression “organic vitality” is not meant to capture an idea or term that can be tracked across texts. Rather, it is meant to indicate an associated cluster of terms, discourses, concepts, and practices, with shifting significances, in this

period. The term “organic” only appeared gradually, with living beings regarded as organized rather than organic bodies during much of the eighteenth century. The increasing use of the term “organic” marked an increasing concern with the materiality of life, with the corporeal processes necessary to the phenomena and functions of life. In the German contexts, this shift involved the study of the specific compositions or intermixtures (*Mischungen*) of organic bodies and their alterations in vital activity, alongside their form. The organic invokes the inorganic, as its relative and its other. The two terms developed together, in large part through significant advances in chemistry at the time and in the study of the similarities and differences of inorganic and organic elements and reactions. Claims for a distinct domain of vitality were not only responses to developments in chemistry, however.

“Vitality” has a longer and more varied history than the “organic.” During the eighteenth century, vital phenomena were gradually marked out as a domain distinct from both the physical or mechanical and the mental or spiritual. Although the life of human beings shares modes of organic vitality with all living beings, the focus of this study is on brute modes of organic vitality that human beings cannot make sense of through their own corporeal sensibilities. A couple of areas of inquiry were the central loci of this emerging domain. One area was the study of irritability or excitability—the receptivity to stimulus and vital response independently of conscious or unconscious volition. The borders of this domain remained blurry, with physical and chemical processes associated with organic change and mobility encroaching from the one side, and sensibility and its association with the nervous system or volition from the other. Excitability became one of the primary concepts for thinking through how living beings maintain an inner world in relationship to, but distinct from, their outer environment in the first sketches of a science of life. A second area was the study of generative activity—the reproduction and development, the nutrition and growth, and the variation or degeneration of organic kinds. Although a distinctly vital process, organic generation also involved incorporation of inorganic materials and accommodation to the contingencies of the physical environment as well as regular and apparently teleological formation. This tension between the materially necessary and the freely variable marked the distinctive character of organic generation and vitality at the turn of the nineteenth century.

In this study, I explore this complex space of change. My focus is on inquiries into organic vitality in the German language publications, debates, and settings

in the late eighteenth and early nineteenth centuries. In these contexts, anyone who argued for a science of life confronted a number of epistemic challenges. Experimental explorations of organic vitality and its boundary with the inorganic opened up questions and yet complicated their possible answers by eliciting a variety of responses from organic bodies. These experiments led to reflections on what kinds of knowledge were being produced through the implementation of a suite of new tools and techniques for the study of living beings. Even the understanding of what a science or *Wissenschaft* was or should be was developing and debated. There was no established institutional space or scholarly venue from which these questions could be addressed. These issues were given a distinctive articulation through broader critical examinations of the boundaries of and prospects for knowledge in German philosophy and Romanticism. Such critical theories offered not only influential concepts for understanding organisms but also the framework for the analysis of the forms and limits of judgments of vital processes and experimental reasoning. Through their examination of investigative practices, critical philosophers in turn experimented with new modes of thinking for making sense of organic vitality. Even as German philosophers helped naturalists and physiologists think through the epistemic challenges facing a science of life, confrontation with new studies of complex organic processes also posed challenges to philosophy, so that German idealism was fundamentally changed by its encounter with the material processes of vitality. It is this entanglement of varied senses of organic life, conceptions of boundaries, and experimental reasoning that I examine.

If a distinctive trajectory for inquiries into organic vitality can be traced in German contexts, German developments can only be understood within the broader European engagements with organic vitality. French chemistry and its implications for understanding vital processes were widely debated in German journals and treatises and were tested experimentally. The new chemistry was at first resisted by German chemists, who were committed to phlogiston theory; its extension into the functioning of living organisms was even more controversial. But gradually the work of Antoine-Laurent Lavoisier, Joseph Priestley, and others became important references for German investigations into organic life. Albrecht von Haller's claim that irritability is a distinct mode of vitality was questioned by French and British physicians and physiologists who argued for the centrality of sensibility to vital processes. The result was a protracted dispute between the prominent Göttingen medical professor and other medical schools.

Haller's claim for irritability was further muddled by its central place in the Scottish medical system of John Brown, who took up Haller's notion, modified it, and returned it to the German context through a series of popular works. Luigi Galvani's arguments that irritability and muscular contraction are products of a unique form of electricity—animal electricity—at once supported and complicated developing German understandings of organic vitality. It was these European debates that provided the background for the prominence of excitability as definitive of vitality in emerging sciences of life. German conceptions of generative processes also developed in the context of wider debates over the variation of organic kinds through migration, transplantation, and cultivation, or what was termed degeneration. The expansive natural histories of Georges-Louis Leclerc de Buffon, Erasmus Darwin and Jean-Baptiste Lamarck, which included theories of generation, degeneration, and hybridity as well as cosmic histories of the formation of the earth and life on earth, acted as frameworks and stimuli for German studies. Debates over the fixity or transformation of species—and over preformation, epigenetic formation, or spontaneous generation—took place on a European stage. Natural history was also entangled with human history, with the effects of imperial expansion and theories of racial difference. Thus German understandings of organic vitality occurred in the context of wider debates and of the emergence of new theoretical systems in chemistry, physiology, and natural history.

In this book I argue, however, that German understandings of organic vitality were informed more concretely and specifically through experimental inquiries than through theoretical systems. Certainly debates over theories provided the background for particular studies, and individuals worked within networks of allegiances and commitments to systems or schools. There were moments when polemics erupted into bold claims regarding vital principles or *Lebenskräfte* policing the boundaries of life. And understandings that had developed in active investigations became sedimented through the reiteration of concepts in textbooks, giving statements of vitalism reified senses. Yet it was through experiments, through engagements with organic bodies and vital processes with shifting instruments and methods, that the domain of organic vitality was first suggested and subsequently shaped. It was Haller's experiments on irritability in the 1750s, Alexander von Humboldt's galvanic trials on irritability or excitability in the 1790s, and the extension of those experiments into detailed investigations of the vital and chemical processes underlying excitability in the early 1800s

that marked it as a mode of organic vitality. Excitability was at times named as a vital power, even by those experimentally investigating its action. But it was emphasized, repeatedly, that the expression *Lebenskraft* was a synthetic concept for the complex of structures and functions being studied that characterized excitability as a vital process that was distinct from and yet acting in relationship to its physical environments. The characteristics of excitability were made manifest through particular apparatus and experimental settings.

Similarly, it was Casper Friedrich Wolff's and Johann Friedrich Blumenbach's experiments on generation in the 1760s and 1780s, Carl Friedrich Kielmeyer's and Gottfried Reinhold Treviranus's investigations of the generation of simple organisms in the 1790s and 1800s, and extended investigations into the vital, chemical, and physical processes affecting generation and degeneration of organic kinds in the early nineteenth century that made evident the processes of organic formation and its capacity for variation. Generative activity—the capacity for organic materials to organize themselves into complex structures and to propagate that organization to offspring consistently, and yet also the capacity to accommodate changed circumstances apparently freely but within limitations—was more challenging to accept and understand than excitability. The bald claim of a special power effecting such remarkable changes was widely criticized as but naming rather than explaining them. Demonstrating the formative drive and gradual formation of structures in organic materials experimentally was regarded, instead, as a mode of argument. The exploration of the extent to which organic kinds were capable of variation or degeneration through experiments with hybridity, cultivation, and interventions into the normal processes of generation made the case for transformation. Experiments on excitability and generative processes, then, not only made evident new modes of organic vitality, they also demonstrated their character. It was through enacting it experimentally that organic vitality was expounded.

It is important to have a sense of how remarkable these experiments must have been to investigators. A severed frog leg jerked on the application of a small electrical shock or an extracted heart contracted with the prod of a needle. Flesh or organs that appeared dead responded anew to stimulus with the application of acids. Infusions of dead organic materials were found to soon be teeming with new rudimentary forms of life or infusoria. Simple organisms such as polyps and algae showed an extraordinary capacity to regenerate after the introduction of injuries, or to transform their mode of reproduction under changed conditions.

The undifferentiated organic material of eggs or germs appeared to organize into complex forms almost before one's eyes when opened and dissected sequentially. Plants and animals could gradually be coaxed or forced into all manner of formations through interbreeding or changes to their external environments. Some of these experiments were not new at the turn of the nineteenth century; it was their amassing, differential repetition and extension that drew attention to organic vitality. Many of these experiments were brutal. Haller cut open not only living, but conscious and sensitive animals, prodding their exposed parts to test for irritability or sensibility. Other experiments involved decapitating animals and detaching limbs or isolating organs surgically. Innumerable dogs, rabbits, frogs, and chicks were sacrificed, as fresh specimens were provided for each new trial. Many participants found such procedures disturbing, as their experimental subjects writhed in pain or quivered in fear, and some refused to pursue experiments on living beings. Experiments on simple organisms were less fraught but also had an affective quality. Organic matter, whether brute flesh or rudimentary forms of life, had a vitality that could be provoked into action experimentally. What seemed dead could sometimes be revitalized, and what seemed formed could be transformed. In describing their experiments, investigators often described results that were unexpected or even startling. Organic matter came to life through instruments and in experimental settings in new and striking ways.

Demonstrations of organic vitality were not informed by a simple empiricism, however, but involved relatively sophisticated modes of experimental reasoning as well as practice. In opening up a new domain of organic vitality experimentally, investigators also reflected on the developing methods and technologies of inquiry and their validity. Many worried that the phenomena manifested were artifacts of the experiments rather than of natural processes. They argued that the pathological conditions produced by the preparation of specimens and experimental interventions precluded the possibility of gathering reliable information regarding the normal responses of organic bodies. The violence and destruction, the coercion, and intrusion inflicted on living beings was regarded as disrupting the integrity of the whole organism and its integrated functioning. Others argued that it was difficult to separate the phenomena manifested by organic materials from the instruments of their investigation. Instruments were not just means for reading signs of vitality but seemed also to inscribe those signs

into the materials themselves. Certainly particular experimental arrangements were means of articulating developing understandings of organic vitality and of rendering vital processes cognitively meaningful. Each new experiment carried traces of past conceptions and inquiries, both implicitly and explicitly, which affected readings of their results. But many investigators also remarked how living bodies are unruly, difficult to pin down, dissect, and control; organic matter was often found recalcitrant to the theoretical coherence they tried to impose. Of course, there were tremendous differences in the sophistication with which individuals reflected on such epistemic issues. But as experimental investigations of organic vitality developed in scope and complexity, so too reflections on experimental reasoning developed. Instruments became regarded as playing a mediating role between the agent and the matter of experiments that was reciprocal and interactive. Not only was subjective apprehension conditioned by tools, but the object of inquiry was folded into the apparatus of experiments. This relationship was also recursive, with experimental arrangements and instruments designed according to theoretical commitments, but with subjective conceptions, practices, and purposes also informed through past experiments, and then these in turn were incorporated into the reading of phenomena in future trials. Amassing, repeating, extending, differentiating—experimental practices and reasoning provided medial constitutions of organic vitality in the dialectic between theory and phenomena, and in the reflections on those medial operations.

That such sophisticated epistemic reflections on the means through which knowledge of organic phenomena was produced in the late eighteenth and early nineteenth centuries is perhaps surprising. Debates over the results of trials prompted investigators to defend and analyze their methods. In German contexts, however, these critical reflections on the epistemology of experiment also developed in reciprocal relationship with the development of critical philosophy and Romantic theory. Immanuel Kant provided the terms and analytic structure for reflections on experience of the natural world for his age. Importantly, he did not offer simply a duality of sensory intuition and a priori concepts. His analysis of the activity of judgment also foregrounded the role of mediating apparatus—of images, of schemata and principles, of the imagination—in forming sensory perceptions into phenomenal appearances and relating concepts to intuitions. It was the mediating apparatus of judgment that especially interested Johann Gottlieb Fichte and Friedrich Wilhelm Joseph Schelling. Both took up Kant's

emphasis on judgment as an activity, reflecting on the processes of thinking in its encounters with the external world. But they also highlighted the unconscious and indeterminate aspects of such processes and called into question Kant's claims to establish the necessary conditions for cognition. It was Schelling, however, who developed these reflections on cognitive processes into a philosophy of nature that critically examined the modes of judgment and methods of inquiry of the natural sciences.

Johann Wolfgang Goethe and Novalis also engaged with studies of the natural world and had the ambition of making contributions to scientific knowledge as well as to analyses of its methods. Goethe offered his opinion on scientific experimentation, arguing that, like artistic appraisal and production, it requires cultivating techniques for mediating between phenomena and their conception. The poet's conception of organic formation or morphology was intertwined with its method of inquiry, a mode of cultivated perception that Goethe regarded as at once a seeing and a knowing. In Novalis, Goethe's experiment as mediator becomes an instrumental operation, through which material processes are rendered cognitively meaningful and concepts made concrete through tools. But Novalis also maintained that instruments have their own independent agency, modifying the powers and thoughts of the investigator, which the investigator directs at the material, and conversely, modifying the resisting effects of the material, which it directs at the investigator. Experimental instruments as mediators, at once ideal and real, do not simply produce a unity of thought and sense but play out the tensions between them. Both Goethe and Novalis contributed to a developing critical understanding of experimental reasoning, positing that the space of experiment and conceptual understanding, the space of mediation, must be rendered imaginatively through figurative languages, under which they included analogies, metaphors, and symbols as well as pictorial images of organic forms and graphic modes of representations. Reflections by naturalists and physiologists on their methods of inquiry into organic vitality and their validity at the turn of the nineteenth century were increasingly influenced by these critical analyses.

The contributions of critical philosophy to the development of understandings of organic vitality were not solely analyses of the modes of cognition and experimental reasoning, however. Kant offered a new conception of living organisms as reciprocally causes and effects or means and ends of themselves,

developing this formulation through his reflections on the activity and form of the judgment that engendered it. Kant's conception was taken up and cited repeatedly, by naturalists and physiologists attempting to understand how living beings distinguish themselves from their physical environment, through inward activity and formation as well as through outward development and interaction with the world. Schelling also enlisted Kant's formulation of the circular connection of means and ends in thinking through the double involution of organic life, conceiving the capacity of the organism to engage the surrounding world as dependent on a reciprocal receptivity and activity within itself. Drawing on contemporary studies of organic vitality, Schelling singled out excitability and generative processes as marking the distinct capacities of organic bodies.

Critiquing the appeal to vital powers to account for these capacities, Schelling regarded excitability and a formative drive as “boundary concepts [*Grenzbegriffe*]” of empirical natural science. The expressions “boundary object” and “boundary concept” are familiar to scholars in science studies—through the influential analysis of Susan Leigh Star and James R. Griesemer and its development by Ilana Löwy—as objects or concepts shared by a number of stakeholders or knowledge groups, which are plastic enough to contain radically different meanings for each group while also immutable enough to allow communication, cooperation, and common projects between them.¹ Schelling's notion of boundary concepts is epistemic, not social, if also relational. He introduced boundary concepts as mediating or synthetic concepts, as means of thinking how material products are formed within and through the ongoing dynamic processes of the natural world as relatively stable and bounded entities. Living beings are one such product, distinguished by their internal complexity and functional integrity as well as by their ability variously to respond to and incorporate their material surroundings. Both Kant's and Schelling's conceptions of organic vitality were forged through reflections on the limits of possible knowledge of natural phenomena but also through their fascination with new inquiries into the phenomena of life. In Kant's case, the tensions in conceptions of organic vitality destabilized his ambitions for a complete system of knowledge of nature. In Schelling's case, organic vitality became exemplary of natural processes, making his philosophy of nature a philosophy of life.

This study thus faces in several directions. It explores how the recognition of epistemic limits—the boundaries of knowledge—developed not only through

reflections on experimental practices and instruments but also through philosophical analyses of experience and judgment, and through Romantic critiques of the dissonances between appearances and their representations. It further explores how attempts were made in practice to traverse the spaces between percept and concept, not only through new tools and techniques of experimental reasoning, but also through imaginative and cognitive acts and through figurative languages and images. Experimental reasoning, boundary concepts, and figurative languages all offered means to apprehend different modes of organic vitality in distinction from and yet in relationship to the larger natural world. The borders of organic vitality—its boundary with the inorganic—were not thus rendered definitive. Rather, by questioning the limits of cognitive and experimental reasoning in and through the process of investigating a new domain of organic vitality, sketches for a science of life opened up, rather than circumscribed, the space of inquiry.

In the following pages, these claims will be made concrete through detailed examination of particular figures, debates, and contexts. Jena became the key site for the story of organic vitality that this book unfolds from the 1790s through to the 1820s. The University of Jena was the center of Kantian critical philosophy and German idealism more broadly, with both Fichte and Schelling beginning their careers at Jena. It was also in Jena that early German Romanticism developed. Goethe's poetic fame and administrative acumen made the nexus Jena-Weimar the cultural capital of German philosophy, art, and science at the turn of the nineteenth century. But Jena remained a small provincial town, unlike the capitals of London or Paris. Much of German intellectual life was mediated through a rapidly developing periodical culture, with many new scientific, philosophical, and critical journals appearing, some only briefly, but others with long and successful runs. Such venues also enabled extensive reviews of French, English, and Italian work. Thus, if Jena remains a key center for this story, it is a site situated in a broader nexus of concerns within Europe. Germans struggled to forge their own identity in the years around 1800. Developing in the shadow of achievements of other lands as well as the promises and failures of the French Revolution, their projects were articulated with a critical sense of historical limitations as well as potential. The question of the boundaries of a science of life were thus explored in the context of reflections on the boundaries not only of experimental inquiry and philosophical critique but also of cultural and historical development.

THE RETURN TO THE PRESENT

Histories of science are inevitably informed by our present preoccupations—by extant histories of a place and time, by present scientific discourses and epistemic commitments, and by ongoing critical analyses of the project of science. Georges Canguilhem argues that the history of science is in constant flux, constantly engaged in critical self-correction. He ties the shifts in the history of science to those of science. Science is a historical enterprise—in a process of becoming, subject to delays, divergences, and crises, and marked by profound shifts as well as continuities of development. As scientific objects shift, through methodological and theoretical self-rectification, so too does the history of science. Michel Foucault takes up this notion of a recurrence in his historiographical reflections: “*Recurrent redistributions* reveal several pasts, several forms of connexion, several hierarchies of importance, several networks of determination, several teleologies, for one and the same science, as its present undergoes change.”⁷² Hannah Landecker productively employs the concept of historical recurrence in *Culturing Life: How Cells Became Technologies* in telling the history of cell cultivation. Her book “articulates one of the several pasts of contemporary biology and biotechnology, as its present undergoes change and the unit of the cell becomes more scientifically, technically, philosophically, and economically important to how living things are thought about and manipulated.” She emphasizes that “recurrence is not the reappearance of the same or a return of the repressed, but a set of emphases with which to recognize a genealogy that has always been there.”⁷³ Hans-Jörg Rheinberger signals the centrality of epistemic concerns to Canguilhem’s understanding of historical recurrence. Canguilhem emphasizes that the objects of science are not from derived natural objects, and thus the history of science cannot be written as if it were a natural history. The objects of science are not independent of the scientific discourses that constitute them nor of the techniques and theories that produce knowledge of them. He concludes that the history of science should take as its object not scientific objects but the history of these scientific discourses. Understanding the historical development of science requires understanding its epistemic commitments, its shifting methods and norms, and its ongoing critique and rectification of its own theories and practices. Rheinberger defends Canguilhem from accusations of providing teleological analyses and normative claims, pointing out that for Canguilhem today’s truth cannot be the end point of historical study, for it is itself historical,

a product of the present moment and its discourses, and also in a condition of change or becoming. Indeed, the history of science shows the extent to which discredited notions, attitudes, and methods themselves discredited others in their time, and present commitments will in turn be discredited. But Rheinberger respects Canguilhem's insistence that the history of science is irreversible, and its epistemic shifts require the history of science to be rewritten along with them.⁴

One could add a layer of analysis to these notions of historical recurrence. Historical, philosophical, and social studies of science do not only take their lead from science's self-understanding of its scientific objects, methods, and theories. They also critically reexamine what science is, has been, or might be, posing challenges to representations of science within scientific communities as well as their larger publics, both in the past and in the present. New methodological and critical commitments of scholars studying the development of scientific discourses and practices thus recurrently reconstitute their objects of study. The past does not stay the same but is continually reconstituted through our present critical commitments. Any history of the formation of the life sciences and their larger contexts in the years around 1800 needs be mindful, then, of past histories and their historiographical commitments, of present science and its discourse, its theories and methods, and also of current critical reflections on scientific knowledge, its methods, and its infrastructures.

There is a long tradition of histories of German biology, and of organic vitality more generally, of the latter eighteenth and early nineteenth centuries. Many such histories are organized through categories of vitalism and organicism.⁵ In past histories, even thoughtful historians have used the appellation "vitalist" to dismiss the contributions of a whole generation or whole groups of physiologists and naturalists. Individual historical actors have been classified into vitalists or mechanists, according to historians' conceptions—and often awkwardly, with some individuals appearing in different categories in different histories. The focus on organicism has drawn attention to ideal types and comparative anatomy but often to the neglect of studies of dynamic functions and comparative physiology, and of simple forms of life. Arguably, developing studies of organic phenomena and vitality alongside developing studies of active powers in physical and chemical phenomena blur any clear demarcations of mechanism, vitalism, or organicism. These categories, however, have provided historians a means of making sense of a confusing mass of texts and of mapping relationships between

figures. They also have drawn attention to a new preoccupation with vitality in the period, and with the difficulties of explicating the varied modes and forms in which vitality appeared. Important recent studies have even argued for the positive contributions of these historical understandings of vitalism and archetypes to the development of biology.⁶

My work is deeply indebted to these histories; it is with such histories that I began and with which I continue to engage. But this book troubles and rethinks histories that reinscribe ideas of substantive vital powers and archetypes. It locates reified ideas of *Lebenskraft* as special powers or principles of life to a relatively brief moment, to a polemic arising in response to purported chemical explanations of life, in the early 1790s. It makes the case that the term *Lebenskraft* was used more broadly and critically as a synthetic expression for complexes of organic processes underlying the appearances of life. It also argues that the emphasis on organization as grounded in archetypes overlooks the judicious use of boundary concepts in empirical inquiry into living organizations and their relationships to their environments. In the history presented here, ideas of vital powers and archetypes are neither deterrents nor stimuli to the history of biology. They dissolve as the primary agents of historical change as our attention is shifted to more diverse and concrete modes of organic vitality manifested through various investigative practices and critical conceptions in specific contexts.

In his history of science or historical epistemology Canguilhem signals the significance of epistemic breaks, a notion that Foucault develops in his archaeology of discursive formations. In *The Order of Things (Les Mots et les choses)* Foucault contends, famously, that before the emergence of the science of biology, “life itself did not exist,” emphasizing a radical shift between the discourses of biology and those of classical natural history.⁷ Inspired by Foucault or not, a number of historians have attempted to mark what is new in nineteenth-century biology by way of a break or shift from earlier preoccupations with vitalism and organicism, and with anatomy and classification. The experimental physiology of François Magendie, Claude Bernard, or Hermann von Helmholtz or the embryology of Karl Ernst von Baer have been presented not as the development of earlier investigations and concepts but, rather, as the product of new practices, discourses, and infrastructures. If historians of science increasingly attend to the complexities of historical change, many remain committed to analyses that emphasize how scientific objects and practices were products of the discursive

formations that delimited the conceptual possibilities of thinking in the years around 1800.⁸ John Zammito's *The Gestation of German Biology: Philosophy and Physiology from Stahl to Schelling* (2018) is one of the few works contesting such accounts, arguing for progress throughout the eighteenth century leading to the development of biology.⁹ The project here, while attending to the constraints on modes of thinking, practice, and expression in German contexts at the turn of the nineteenth century, explores the space of change in which proposals for a science of life gradually took shape. It thus seeks to open up to analysis the tensions, instabilities, and ambiguities resulting from shifting understandings and practices in that historical border zone.

As the present of the study of life undergoes changes, its recurrent distributions reveal new pasts or allow us to recognize genealogies that have always been there. The sciences of life are currently undergoing striking transformation—through new research in areas such as stem cells and epigenetics, symbiosis and microbial life, lateral gene transfer and gene editing, and synthetic life and computer simulations. These new areas of inquiry provoke not only a rethinking of what life is and what it might become but also rethinking what it has been. With our eyes opened to the capacities of organic matter presently found possible, investigations of organic vitality in the first steps toward a science of life might be seen differently. The generative and regenerative capacities of simple organisms, of polyps and infusoria; of epigenesis, degeneration, and cultivation; of grafting, hybrids, and monstrosities; of the continued vitality of organic parts in artificial conditions—studies of organic vitality at the turn of the nineteenth century become newly striking and significant from the perspective of developments in the life sciences at the turn of the twenty-first century. What is important in the history of biology shifts with the emergence of new discourses, investigative practices, and theoretical commitments. But arguably, in the present moment in the life sciences, scientists are further from deciding what life is than when biology was first proposed. Instead, they are demonstrating in striking fashion the complexities surrounding the production of knowledge of organic vitality. The questions being addressed are not so much about what organic vitality is as about what we can know about it, and how that knowledge emerges in the dialectic between conception and phenomena as mediated by instruments and experimental arrangements in specific contexts. Philosophical and social studies of science have turned their attention to these complexities in illuminating ways. In rethinking or rewriting the history of biology, the critical lenses that science

studies and that the history of science have brought to bear on the current life sciences offer suggestive analyses for examining similar questions in the past.

Sarah Franklin provides vivid images of biotechnology at the turn of the twenty-first century through her studies of cloning and in vitro fertilization; she argues that the fecund coupling of “reproductive substance and technological innovation not only produced new kinds of biological relative but revealed a new condition of biological relativity, through which nature and artifice become interchangeable.”¹⁰ Indeed, in the contemporary life sciences, experimental instruments are not simply means for extending human perception and giving objects shapes through which they can be perceived—or for making life apparent and intelligible. They are research technologies that shape both the materialization and the conceptualizations of the phenomena studied. Karen Barad uses the notion of intra-action to call attention to the entanglements of experimenters and objects, discourses and ways of seeing, apparatuses and practices, through which some kinds of phenomena come to matter while others are rendered invisible.¹¹ Cornelius Borck, in his history of brain research, shows how various technologies or devices have acted as cognitive tools mediating between organic structures or functions and the meaningful world of experience. Technological devices are media in the sense that they transmit and transform information about the brain according to technical specifications; they have also served explanatory purposes by modeling specific functions attributed to the brain. Donna Haraway suggests that technologies be regarded not simply as mediations but as organs and, conversely, that our sensory organs be regarded as technologies embodying particular perspectives on the world; technology and organs thus become partners infolding others to one another in world-making encounters. She regards objects as boundary projects; if boundaries materialize through specific social interactions and mapping practices, they remain shifting, risky, and generative.¹²

Recognizing the diversity, the metaphoric or figurative operations, and the ongoing transformations of experimental technologies prevents a field of inquiry from being enclosed within any one, or from confusing media and message, and opens research to the role of new techniques and tools in dynamic and imaginative knowledge and world making. Rheinberger presents experimental technologies as modes of differential reproduction, in which established trials are repeated, but in novel ways, to displace and destabilize prior experiments and concepts and to generate new perspectives and understandings. Each new

experiment embodies traces of past experiments and understandings, but tools and techniques can also lead to unanticipated excesses, and material processes may subvert particular acts of theoretical signification, as each material trace produced is continually referred to and displaced by others.¹³ All of these scholars study specific experimental technologies in specific contexts of the modern life sciences, yet their critical reflections are suggestive of issues facing the experimental study of organic life more widely. They all share developing concerns with experimental technologies and media in historical and social studies of science more broadly.

Attention to the tools and techniques of investigative practice within particular contexts of physiology and natural history can also be found in recent studies of the eighteenth century—such as Mary Terrall’s work on René Antoine Ferchault de Réaumur and the practices of natural history, Hubert Steinke’s work on the debates surrounding Haller’s experiments on irritability, Andreas-Holger Maehle’s work on experimental pharmacology, or studies of the controversies surrounding Galvani’s experiments.¹⁴ Such studies enrich our understandings of the historical development of biology. The present study of organic vitality draws on the rich analytic tools offered by these scholars, while attending to the important differences that arise in the particular investigative practices it examines.

These approaches to the study of experimental technologies, in both the present and the past of the life sciences, invite a rethinking of established accounts of instrumental reason. There is a long tradition within critical theory of associating the rise of instrumental reason with the Enlightenment, as both a historical period and a larger project, with Theodore Adorno and Max Horkheimer’s *Dialektik der Aufklärung* (*Dialectic of Enlightenment*) being one of the first and most famous examples. Adorno and Horkheimer highlight how, through rationality and technology, human beings have gained domination over nature and domination over the inner nature of human beings—and how some human beings have gained domination over others. Written in 1944–1945, a fateful juncture in German history, the *Dialectic of Enlightenment* offers now common critiques of positivist assumptions of nature’s uniformity as objective fact, of the cultural worship of science, and of the technological exploitation of nature and others’ work. Adorno and Horkheimer also offer a critique of formalistic rationality with its drive to make all calculable and useful. If reason offers release from superstition, myth, and fear of the unknown, it provides in their stead an administrated order as its fulfillment. In abandoning larger meanings or

purposes, in calibrating ends to means and to what is technological or useful, reason turns knowledge into a commodity. Reason, Adorno and Horkheimer argue, thus becomes irrational and reverts itself to myth. Foucault also takes up the entanglements of power, knowledge, and technology, showing how the Enlightenment's disciplinary order was central to its mechanisms for making knowledge. He outlines how modern biology and medicine became new technologies of power in the nineteenth century, with the extension of state power over both political and physical bodies of a population through the regulation of public health and reproduction. More than a disciplinary formation, the power over life became an apparatus of control—biopower a biopolitics of the population. More recent studies of mechanisms of measurement, calculations of discipline and accountability, and institutional authority and management of natural and human forces, remain indebted to these earlier critiques of the apparatus of power, knowledge, and instrumental reason.¹⁵

It is precisely the work of critique, by providing an analytics of such apparatuses and their limitations, to resist becoming enframed by them. Attention to the specificity of disciplines and technologies of knowledge, to their historical and cultural situatedness, calls into question their claims to lasting or broader authority. Natural objects and human subjects continually resist capture within particular disciplines or technologies, that resistance creating instabilities and tensions and preventing the closure of formal systems. Recent work in science studies and the history of science shows the ways in which tools and technologies play mediating roles in the production of knowledge. Such experimental reasoning with and through instruments suggests a new view of instrumental reason. Its use need not result in the loss of meaning and the commodification of knowledge but can be the questioning or disruption of the sedimentation of particular understandings. If such experimental reasoning is concerned with means rather than ends, with the medial and instrumental production of concepts and the constitution of natural phenomena, it also demonstrates the projected or hypothetical nature of the ends of knowledge. The notion of historical recurrence might be regarded as an ongoing dialectic between means and ends; as established systems of knowledge are criticized, that critique prompts new modes of experimental inquiry along with new theoretical understandings and new discourses regarding the warrant and significance of cognitive claims. Attention to the apparatus of knowledge and discipline—to how nature, human beings, and life are captured by technologies and formal orders—is critically important.

Attention to how this apparatus continually undergoes transformation, and to the productive and imaginative role of experimental technologies in dynamic and differential knowledge and world making, is also critically important. What is instructive in the approaches offered by the works in historical and social studies of science cited above is that the proponents of these approaches consider both. These scholars thus offer a rethinking of the operation and value of experimental or instrumental reasoning that can be productively applied to the practices of experiment emerging at the turn of the nineteenth century.

What is the place of German idealism in this rethinking of instrumental reason? In the *Dialectic of Enlightenment* Adorno and Horkheimer locate German idealism, and Kant in particular, at the center of formalistic rationality. Indeed, there is a long tradition of reading Kant as grounding objective knowledge in deductive reasoning and abstract consciousness, and as grounding value in formalism and an autocratic subject. Foucault is more generous. He argues that Kant's philosophy was central to the emergence of the modern episteme in its critical examination of the claims and limits of reason. If maintaining that the conditions of representation are a priori, Kant allowed that not all modes of thought are representational and thus opened a space for the empirical sciences. In introducing critique as the reflection on limits, Foucault regards Kant's questioning as at the same time an analysis of the limitations of his historical moment and an experiment with the possibility of going beyond those limitations.¹⁶

More recent scholarship on Kant emphasizes how he regarded human thinking as cultivating itself and learning to philosophize and judge critically, making human reason both means and ends of itself. It emphasizes how he regarded cognition as a dynamic process, in which the categories are not innate but, rather, products of the modes of thinking. It also emphasizes how he tethered human cognition to appearances and empirical encounters with the natural world, by means of imagination and its schemata.¹⁷ The analysis presented here is concerned more specifically with Kant's reflections on the judgment of living organisms and the analogies he drew between the self-organization of organisms and the self-organization of reason. But it situates these reflections in relationship to these broader analyses to argue that, for Kant, thinking is an activity reliant on medial processes that can be regarded as means or instruments for thinking. Analogous to the instruments of experiments, these analyses mediate between sensory intuitions and conceptual understanding. By drawing attention to the complexities and indeterminacies in Kant's account of reflective judgment, it

highlights not only how Kant was critically aware of the limits of reason but also how subsequent philosophers and even scientists engaged the critiques and indeterminacies presented by Kant to rethink the modes through which cognition of the natural world is generated.

If it has been accepted by many that Kant's philosophical ethos is a limit-attitude, a posture of epistemic modesty, many would be surprised by a claim of a similar posture in post-Kantian idealism and Romantic philosophy. Indeed, both German idealism and Romanticism are marked by a tendency toward transcendent metaphysics, and readings of Novalis or Schelling as positing an absolute idealism remain standard. In contrast, Manfred Frank argues that Novalis did not reject critical reflection for an absolute idealism, but rather, through critical reflection on the limits of reflection, he made present a feeling of being beyond or outside reflective reasoning. In a compelling analysis, Iain Hamilton Grant argues that, for Schelling, nature is primary and thought is but a part of the natural world and arises from it.¹⁸

The present project takes a different approach to both and argues that the oppositions between thought and the material world, between ideal and real philosophical systems, did critical work in Novalis and Schelling. Arguably both Novalis and Schelling regarded the dialectic between transcendental philosophy and philosophy of nature as inevitable. If mind can emerge only within nature, then nature requires thought for its self-understanding. Nature, however, always exceeds thought, while critical philosophies' endless interrogation of philosophies of nature prevents their completion. These oppositions were rather grandly expressed in German philosophy at the turn of the nineteenth century. But Tilottama Rajan suggests that Novalis and Schelling offer a modern mode of interdisciplinarity through a process of supplementation as the (in)completion of one discipline by another, with each exposing its other to what cannot be thought within it. Thinking analogically through another discipline opens a space for questioning and for the exploration of possibilities not allowed within a discipline's own domain.¹⁹ I argue here that both Novalis and Schelling regarded each philosophical system as particular, situated, its limitations exposed through the perspectives of other systems, thus provoking each system to reassess its claims, to question its settlement with particular understandings, and to engage in an ongoing critical reconfiguration.

Kant presented both teleological judgments of living organisms and judgments of beauty as modes of the reflective power of judgment, and while

highlighting their differences he thus also suggested their analogies. Novalis, Goethe, and Schelling developed these suggestions of intersections between cognition and aesthetics. They also directly linked the various forms of thinking to the forms of its expression in language. The rhetorical tropes and figures of language, its metaphorical and literary expressions, are productive of creative connections between representations of things or processes, but they also then situate knowledge claims in particular articulations. In drawing attention to the figures of language Romantic writers critiqued the abstractions of philosophical reflections but also engaged in modes of philosophizing.²⁰ Indeed, both philosophy and Romanticism can be regarded as kinds of critical theory, acting as supplements to one another in the mode of interdisciplinarity suggested by Rajan.

Such assessments of both German idealism and Romanticism are, at least in part, the result of new approaches to critique, which have opened historical texts to new readings. Recent works in Romantic studies—by Jocelyn Holland, Denise Gigante, Robert Mitchell, and Amanda Jo Goldstein—explore in quite different ways how science, philosophy, and poetics interanimate each other. They reinvigorate innovative work by Gillian Beer, Mary Louse Pratt, Lily Kay, and Evelyn Fox Keller on how language, and its figurative and grammatical operations, inform scientific understanding and bring nature to life for readers.²¹ It is thus not only the history of science but also the history of philosophy and the history of critique that is subject to recurrent redistribution. As methodological and theoretical shifts occur in critical theory, so too do the analyses of its objects of study, drawing attention to modes of critique present in the past. Such reassessments of Romanticism and philosophy are drawn on here to offer an account of the emergence of figurative languages of nature at the turn of the nineteenth century, as another means for mediating between phenomena and thought, alongside experimental practice and activities of judgment.

Attention to German idealist and Romantic philosophies as modes of critical theory—engaged by analytics of finitude, interdisciplinary logics, and figures of mediation—counter their caricature as naïve philosophies of representation, reflection, or correspondence. Nevertheless, these philosophies remain expressed in terms of oppositions between subjects and objects, thought and intuition, the transcendental and the material. The recent refrain of a turn to the nonhuman is a turn away from preoccupations with human subjectivity, ideas, and reflection and the binary oppositions to nature these engender. Recent critical interests in

the vitality and transformative potentials of material bodies and attention to the liveliness of matter seek a way out of these dualisms. Stefan Helmreich suggests caution here. He argues that much of the ontology proposed under the rubric of new materialism remains informed by developments in the natural sciences or cultural assumptions and their rhetorical forms. Life, he contends, is always already a trace of the shifting scientific and cultural practices that have asked after it, is always already something in the making in discourse and practice, and thus is the shadow of the biological and social theories meant to capture it.²² Indeed, new philosophies of vital materialism have an uneasy relationship with histories of vitalism; to counter the purported disenchantment of the world through systems of rationalism and scientism by repopulating the world with substantive powers and capacities posited as vitalizing echoes an uncritical appeal to vital powers presented in past histories of biology. Andrew Pickering proposes that an alternative to the opposition between accounts foregrounding nonhuman vitality and accounts claiming material vitality is always a product of scientific discourses of a time and place. He suggests that scientific practice is a mangle in which human and material agencies are enmeshed by a dialectic of resistance and accommodation—of the natural, technological, conceptual, social—that is productive of emergent material configurations and scientific understandings.²³ The present study can be regarded as an exploration of such mangles and dialectics. It argues that studies of organic vitality at the turn of the nineteenth century were experimentally, epistemically, and critically sophisticated. Indeed, proponents of contemporary forms of vital materialism might learn from the past, rather than simply setting up Enlightenment, Idealism, and Romanticism as false idols, the critique of which then purportedly justifies current positions.

Some authors of recent projects of vital materialism have proposed more productive relationships with philosophical and critical traditions. Catherine Malabou, for example, offers a fresh reading of Kant's account of the self-organizing of reason. She highlights the epigenetic processes informing his conception of the transcendental. She then also calls for a biology that would include speculative philosophy. Elizabeth Grosz offers an original rendering of the problems of matter and life, as well as human sense, consciousness, and freedom, through a rereading of nineteenth-century philosophies of life, such as Henri Bergson's. She highlights how such philosophies emphasize the indeterminism of becoming, the plethora of possible orders, and the mixture of processes and

forces, as the condition under which individuation and events occur, and that these enable new and unexpected orders of existence, life, and even freedom to emerge.²⁴ Grosz's focus is on enlisting earlier thinkers toward her larger project of a new philosophy of vital materialism, however, rather than providing a critical and historical reading of their contributions.

Claire Colebrook explicitly defends critical theories in the face of attempts to transcend the human by imagining some greater nonhuman world. The claim to step outside humanism, she argues, is enabled only by one's capacity to imagine oneself as other than a history that one can view as one distant panorama. The universalizing gesture in which one's world opens to consider life in general is always contaminated by its very condition. She counters that "the concept of the human has always been split, and has always implied self-negation; man is the being who has no nature other than that he decides for himself."²⁵ The same could be said for any figure of the organism or enclosed self-sufficient being; everything in life is already split from itself, with tendencies toward creation of complexity and order as well as toward fragmentation and destruction. Colebrook concludes that we need theories that engage both, rather than turning to the deceptive logic of a nonhuman organic holism.

Colebrook's argument is in defense of current theory. My argument here is that already in German critical and Romantic philosophies can be found theoretical reflections on the oppositions between thought and world, on the possible means of mediating such oppositions, and on the limitations and indeterminacies of knowledge systems that were critically productive. These philosophies did not abandon the material world for the abstractions of representation; rather, the engagement with new studies of organic vitality stimulated a rethinking of their systems. If these philosophies remained limited by the time and place in which they were conceived, they nevertheless offered not a way out of but a way into their situation—making sense of the world as finite, thinking beings embedded in nature.

Keller, Helmreich, and Franklin, along with Michel Morange, have all remarked, variously, the repeated return to the question "What is life?" and the indeterminacies found in any given answer.²⁶ Arguing that life forms are informed by forms of life, Helmreich argues that the instabilities of our present conceptions of life are a reflection of the present dissolution of social norms and theoretical moorings. As proliferating technologies are unwinding the facts of life, and the disciplines attempting to make sense of them are in transformation,

life itself can no longer be taken as a given. He suggests that this ungrounding of biology today runs together with the ungrounding of critical theory.²⁷ If the current moment has drawn attention to these instabilities and transitions with striking force, arguably they can also be found in the past, if not perhaps to the same degree. Seeing them is in part a matter of looking for transformations rather than forms of life, of attending to spaces of change rather than to discursive norms. It is also a matter of allowing new discourses and practices and new critical theories to help us see what was there all along, the critical recognition that there was no determinate grounding for life or biology in the years around 1800 but, rather, a series of experimental investigations, conceptions, and epistemic debates regarding what a science of life is or might be.

My analysis of a return to the present, then, is not an argument for allowing present scientific understandings to be imposed on our readings of the past, in an outdated teleological history of science. Rather, I argue for an appreciation of the historical recurrence in a broad sense, prompted by changing scientific discourses and their epistemic commitments as well as by changing critical theories. The striking transformations of the life sciences at the turn of the twenty-first century invite us to reconsider the modes of organic vitality when projects for a science of life gradually took shape at the turn of the nineteenth century, and the entanglements of living matter with technologies today draw attention to those entanglements in the past. Developing historical and social studies of science more broadly further prompt us to reconsider these shifting theories and practices of the sciences of life. New critical analyses also produce new readings of past modes of critique and philosophical theory and suggest reevaluations of their relationships to developing understandings of the natural world. This study draws on these analytics to offer a new perspective on organic vitality as it took shape in German contexts around 1800.

DÉJÀ VU

German Romanticism is most immediately associated with literary works and critique, and the primary contributions of individuals such as Goethe and Novalis. But Goethe and Novalis were also interested in how visual images or graphic representations could act as epistemic tools for mediating between concepts and precepts. Novalis argued that Johann Wilhelm Ritter's diagrams of his galvanic

experiments offered a figurative language of nature; Novalis suggested that such figurative languages blurred the distinction between verbal and visual expression and offered means for rendering thinking more concrete and seeing more abstract. Alexander von Humboldt similarly regarded visual representations (in the forms of maps and graphs) as effectively combining empirical measure, cognitive judgment, and aesthetic appraisal. Historians of science—such as Lorraine Daston and Peter Galison or Thomas Hankins and Robert Silverman—have explored how such images and graphs aided the study of nature at the turn of the nineteenth century.²⁸ Artworks in the years around 1800 in turn engaged critical theories, depicting visually some of the epistemic preoccupations of their contemporaries. Caspar David Friedrich's images in particular stand out for their visual rendering of complex philosophical reflections that helped both communicate their subtleties and enact them affectively.

Indeed, Friedrich's 1818 painting *Wanderer over a Sea of Fog* has become an iconic image of German idealism and Romanticism (figure I.1). The central figure seems to be the embodiment of the Kantian subject, whose gaze gives meaning to the world, even as this world remains an unknowable mystery to him. The wanderer appears lost in contemplation and self-reflection, mesmerized by the natural vistas as if experiencing a spiritual experience. The human figure dominates the image, establishing the vertical and horizontal axes and the symmetry of the painting; the entire landscape converges on him. He replaces the avenue of sight, in the absence of a connecting ground or gradual progression of objects into its depths. The figure is turned away from the viewer, his face concealed, anonymous; we cannot see his face, but we share his vision as if it were every man's. The sublimity of the scene seems cast within this subject position. Yet a closer examination of the painting suggests a more complex reading. The position of the human subject appears unstable, at once in the clouds and on solid ground. If the image depicts a longing for the infinite, it presents that infinite as unrepresentable, a divine everywhere, but also absent. The image places the human figure in an intermediary space. His view is mostly concealed, and the scene, shrouded in fog, reveals only fragmentary and specific forms, rather than a unified whole.

The *Rückenfigur*, a figure seen from behind with its back to the viewer and looking into the scene of the painting, became Friedrich's signature. Joseph Koerner offers a penetrating analysis of how these turned figures define Friedrich's landscapes as encounters of the subject with the world.²⁹ In comparison



Fig. 1.1. Caspar David Friedrich, *Wanderer over a Sea of Fog*, 1818 (Kunsthalle, Hamburg).
Photograph by Elke Walford. Courtesy Art Resource, New York.

to earlier examples of staffage in artworks, they act as reflective foils of both artist and viewer, mediating not the meaning but the experience of the landscape. Friedrich's landscapes present themselves as something seen, rather than as something simply there; the Rückenfigur emphasizes the point that the scene is infused with the beholder's gaze. The halted traveler as a trope of experience, or as surrogate for the artist and audience, is a common rhetorical motif in Romantic literature. In the poetry of William Wordsworth, for example, the poet traveler is arrested by what he sees in the landscape, his journey punctuated by pauses that take the form of meditations on life and death, infinitude and finitude, nature and art. Friedrich's landscapes offer a similar doubled emphasis on the specificity of natural things and constitutive role of intervening subjectivity. The subjectivity externalized in the figure of the halted traveler is implied in, but agonistic to, nature's particularity. The turned figure also hides what repeats our looking, the gaze of the subject or the eye in the picture. If the Rückenfigur is a trope for the original act of gazing by the artist wandering in nature, that gaze and the painting's origin lies hidden, and what is seen is the artist in the landscape of remembered experience. The hidden gaze reminds us of our own blindness to what lies behind us and to where we stand; our gaze also lies in the field of an other. Friedrich's Rückenfigur marks the reflexive self-consciousness of Romantic art, its doubling of seeing and being seen, and thus the awareness that we see from a particular point of view.

Koerner contrasts two paintings and draws attention to the affective qualities of Friedrich's landscapes and their Rückenfiguren. The first, *Early Snow* (c. 1828; figure 1.2), depicts nature seemingly uncontaminated by a human gaze. The snow lies untouched, the scene frozen. But someone is already there, a path already made into the forest, mediating between our view and the dark woods. The path veers off, beyond what the painting offers, presenting an unknown path before which we wonder where its original travelers have gone. To pursue this *Holzweg*, this path into the woods, is to enter the new, but with obscure origins in the past. The second painting, *Chasseur in the Forest* from 1813–1814 (figure 1.3), offers a similar scene, but a traveler has entered the woods. His presence changes everything; the woods are now his woods. The traveler is a stranger, literally—a French chasseur in a German forest, after French invaders have been defeated in the wars of liberation. He is a figure that draws the viewer into the landscape, making it seem closer; yet he also adds an otherness to the landscape, making nature experienced only from afar. Friedrich's landscape has an uncanny quality,



Fig. 1.2. Caspar David Friedrich, *Early Snow*, c. 1828 (Kunsthalle, Hamburg).



Fig. I.3. Caspar David Friedrich, *Chasseur in the Forest*, 1813–1814 (Folkwang Museum, Essen). Courtesy Art Resource, New York.

at once familiar and unfamiliar. The halted traveler doubles as the viewer, exposing the strangeness, the reflexive distance of the age. The scene depicts romantic *Eigentümlichkeit*, a term with a cluster of associations—peculiarity, characteristic, own, proper, strange.³⁰

Friedrich's art is a mode of *Erlebniskunst*, or art of experience, best affectively understood by standing before the artwork and looking into it. The *Monk by the Sea* from 1809–1810 (figure 1.4), for example, engages its beholder in a unique viewing experience. When I stood before the painting, my eye was caught by the monk in the foreground but quickly moved up from the diminutive figure to the larger bright sky scape of the background, only to find no perspectival convergence on which to settle. Moving between foreground and background, monk and sky, my eye darted across the line of the horizon like the intermittent gulls and breaking waves marked in the painting by small white spots. I felt increasingly drawn into the dark clouds and sea of this middle space, as if into a chasm. Koerner's account of Friedrich's method in creating the painting enriches this viewing experience. Both X-rays and contemporary accounts reveal how the middle strip of dark clouds and sea were the work of ongoing revision, making it especially dense, in contrast to Friedrich's usual way of working by applying color in thin transparent glazes and with little physical presence of paint. Koerner explains how, instead of moving easily into the depth, the viewing eye becomes baffled by the palpable paint, with the dark clouds and sea weighing physically on it. The leap from foreground to sky is thus a leap across a disruption of conventional perspective. It is also a leap that enacts the image's ostensible plot, the monk standing at the brink of the world, yearning for passage beyond the materiality of earthly existence to transcendence, a leap of the imagination across the dark space separating the particular from the whole. Koerner then presents how Friedrich's contemporaries ironized the pretense of providing a definitive reading, or viewing, of the artwork. A coauthored review of the *Monk by the Sea*, on its exhibition in Berlin in 1810, contrasts Heinrich von Kleist's feelings and insights evoked by the painting with a staging of the public's conversations and misunderstandings authored by Clemens Brentano and Ludwig Achim von Arnim.³¹ The review doubles the work of Friedrich's Rückenfiguren by offering a series of beholders' views as mediating our own view of the scene of the painting. It also situates the painting historically, within the context of German Romanticism and idealism.



Fig. I.4. Caspar David Friedrich, *Monk by the Sea*, 1809–1810 (Nationalgalerie, Berlin). Photograph by Andres Kilger. Courtesy Art Resource, New York.

Koerner analyzes how Friedrich's Rückenfiguren shift the temporal fabric of the landscapes in which they are present. These figures depict visually the complexity of reflections on historicity with German Romanticism and philosophy. With *Chasseur in the Forest*, for example, we oversee the experience of someone who was already there in a past, long before our arrival. We are not the first on this scene, as the traveler is both spatially and temporally before us. But we are also not the last, as when we engage and enter the space of the painting we feel ourselves looked on from behind. The landscape seems lonelier and sadder when inhabited by the turned figure. The raven at the margin of the painting not only separates us from the figure but signals death. Many of Friedrich's landscapes depict the changing season and the stages of life, tying the history of nature to human history. But the Rückenfigur also bestows on the landscape a sense of belatedness. Indeed, our lateness on the scene seems the subject of the painting. The temporal shift these figures seem to evoke is produced by our encounter with the representation of an other; the landscapes seem already seen, even if

we are viewing them for the first time. Koerner likens this experience to a sense of *déjà vu*. It is the feeling that what we are experiencing has already happened, and that we have been thrown back to a past moment of our life. While the illusion lingers, we experience a sense of expectancy, as we anticipate what we will recall and await the turning of this feeling into memory and the recovery of a lost past. When the memory does not come, the feeling fades, yet the illusion persists of a past origin of the experience, and the anticipation becomes a nostalgia for something that never occurred. The Rückenfigur produces a similar feeling of a past made present, which stands before us already there in a place we hope to be. If we seem to occupy the past, it is only a trace of the past, the gaze of the Rückenfigur turned not toward its future but into a now concealed past anterior to its own presence. We are its future, the community of viewers who pass behind. The Rückenfigur wanders in a space between past and future, embedded in a past we can never experience, yet whose memories we hope to recover, in endlessly deferred anticipations.³²

The French chasseur wandering defeated and lost in the German woods also reminds the viewer of the larger historical, cultural, and political contexts of Friedrich's paintings—French and British hegemony in the eighteenth century, the French Revolution, and the revolutionary and Napoleonic wars with German states. The revolution was unprecedented, confusing, dismaying, as it moved from promise through terror to failure. These events produced fractured German responses. Friedrich's political painting *Two Men Contemplating the Moon*, was one response; Friedrich painted two versions in 1820 and 1830 (figure 1.5). The two men—in fact, Friedrich and his student—are dressed in their forefathers' jackets and flanked, on one side, by a ruined tree symbolizing the passing of the old order and, on the other, by an evergreen symbolizing hope. The painting depicts at once nostalgia for a perceived past cultural and political unity and the prospect of a new liberal nationalism emerging after the Napoleonic wars.³³ As we look at these figures today, they seem to look both toward the past and toward the future; we cannot help but see them through the perspective of the subsequent unfolding of German history. But to suggest a linear path from the turn of the nineteenth century to the mid-twentieth century belies the thick forest with its multiple pathways that stood before any traveler at that time.

For many German figures reflecting on their historical moment and its cultural and political contexts, there was a critical awareness that, if the present offered no model for going forward, the past was no longer viable and the future



Fig. I.5. Caspar David Friedrich, *Two Men Contemplating the Moon*, 1830 (Metropolitan Museum of Art, New York). Courtesy Art Resource, New York.

unpredictable. As historical consciousness developed in the midst of profound change, a crisis arose in teleological understandings of the human vocation. The rapidly changing world, with no defined end in sight, was unsettling. Schelling captured something of this mood with his rather cryptic reflections on history in the first lines of all drafts of *Die Weltalter* (*The Ages of the World*): “The past is known, the present is recognized, the future foreseen. The known is narrated, the recognized is presented, the foreseen is prophesied.” He elaborated that all begins in darkness, that no one can see the end, and that no individual event is intelligible on its own. History can only be experienced in narration, of which the present is but a moment in its development. No present is possible without a decisive past and prospective future, and yet the present must be overcome to make both the

past and future possible.³⁴ Schelling suggested we cannot but live in the present world constrained by the history we ourselves are making; critique can lift us out of our blind habits of thought, but it cannot free us from history. It is in such historical awareness that Foucault sees the appearance of the attitude of modernity.

This excursus on Friedrich's Rückenfigur indicates the complexity of historical stances in German Romanticism. It also provides a figure through which we can reflect on our position in relation to the past. Our presence in the past indeed changes everything. We cannot leave behind our attitudes, theories, and methods as we travel there, and so we often find what we are looking for. We can thus experience an uncanny sense of both familiarity and unfamiliarity in historical work. Of course, many have been there before us, and we cannot help but see the past through their gaze. Indeed, the view of Friedrich's Rückenfigur offered above looks through the insights of Koerner's rich art-historical work. We also anticipate that our views of a past moment will become part of the historical record, part of our cultural memory of how our history unfolded. But Friedrich's Rückenfigur does not point only to the past and present but also to the future, to the community of observers coming after. The ongoing processes of recurrent distributions also mean that the present moment can no more decide the past than previous analyses. Rethinking the past also does critical work, in prompting a rethinking of the present in relationship to its past and to its possible futures. James Clifford observes the significance of feeling historical, the visceral awareness of the loss of a given world; he uses the present social and political moment to make vivid the sense of feeling historical produced by the recurrent redistribution of critical positions.³⁵

If these remarks seem to indulge in the reflexive excesses often associated with German Romanticism and idealism or with contemporary theory, it is worth recalling the subject matter of Friedrich's paintings, the natural landscapes or experiences of nature. Friedrich was deeply engaged by Schelling's philosophy of nature, and his paintings can be read as a visual depiction of Schelling's complex philosophical arguments in a compelling and yet accessible way. The halted traveler mediates a double vision, the encounter of the subject with the material world. The present book studies the spaces of mediation that Friedrich makes so palpable—between the landscape and its viewers, between perception and conception. The turned traveler is one of several figures or devices for moving through those spaces that emerged in German contexts in the years around 1800 that are explored in this work.

COUNTERHISTORY

This is an interdisciplinary study that explores the intertwining of scientific inquiry, critical philosophy, and Romantic theory in the years around 1800. Although one of these endeavors is emphasized in each chapter, many of the historical agents discussed were engaged with all three. This study provides original accounts not only of the history of biology but also of the history of philosophy by reading one through the other. It also practices a close reading of texts and carefully traces the arguments, debates, and practices in historical materials. Critical commitments always inform the reading of the past, as argued above. But close reading, if done with care and attention, also has the capacity to surprise, to carry the reader in new directions, and to remake history. Close reading draws attention to the figures, the indeterminacies, and the incompleteness of texts, and their diverse renderings and dispersed meanings. In this study, I attend to the ambiguities and tensions in a text not with the aim of pointing to its failure; rather, I suggest how they provided openings to further thinking about questions concerning organic vitality that were generative of a space of change. I practice close reading here, then, as an interdisciplinary, historical, literary, and critical method.

The book begins with the polemics over vital powers in the early 1790s, tracing the many publications and reviews responding to Christoph Girtanner's provocation of a chemical explanation of organic life. Many of these authors cited Haller's mid-eighteenth-century experiments on irritability and sensibility—but without attempting their own trials. The second section of Chapter 1 looks at Haller's experiments, their widespread contestation, and how they came to be taken up as decisive in the early 1790s. Blumenbach's studies of organic formation in the 1780s also came to be widely cited as a part of these polemics. The last section of the chapter locates Blumenbach's experiments in the context of wider evidence for degeneration, regeneration, and generation in the practices of natural history in the late eighteenth century, and the intersections of physiology and natural history that those experiments suggested. The contrast between polemics over *Lebenskräfte* and Haller's and Blumenbach's experiments provides the background and sets the stage for the exploration of the experimental study of organic vitality at the turn of the nineteenth century.

Kant's *Critique of the Power of Judgment*, published in the same year as Girtanner's treatise, dedicated its second half to critical reflections on the conceptions

of living organisms as reciprocally means and ends of themselves. Chapter 2 introduces Kant's work by reviewing his engagement with the debates in natural history discussed in Chapter 1. It then examines Kant's reflections on living organisms within the influential frameworks for the modes of judgments and objective knowledge that he introduced and the implications of those frameworks for empirical demonstrations. These discussions are framed by highlighting the problematic place that living organisms continued to occupy within Kant's larger concerns with systems of scientific knowledge and the history of nature.

In the late 1790s scholars attempted to articulate a science of life, extending Kant's epistemic conditions for scientific explanation to chemical and physiological investigations of organic phenomena. Chapter 3 opens with a discussion of Johann Christian Reil's and Carl Christian Erhard Schmid's attempts to establish a basis for a science of life precisely by rejecting the chorus of appeals to *Lebenskräfte* that had dominated the early 1790s. It then examines the investigation of Galvani's experiments in the German context as contributing to an exploration of the relationships between inorganic and organic processes, focusing on the work of Christoph Heinrich Pfaff, Humboldt, and Ritter. It highlights their critical engagement with experimental reasoning and how they came to view organic, chemical, and electrical phenomena as necessarily entangled with the tools and techniques of their investigation. Finally it turns to new studies of degeneration and looks at how Blumenbach's inquiries were increasingly focused on comparative anatomy, as he built an anatomical collection at Göttingen and worked with portraits as new materials for a natural history of the human races. It compares Blumenbach's studies to Kielmeyer's, who developed a comparative physiology that attends to the material conditions influencing organic function and the history of living forms. These developments contributed to the enthusiastic reception of Erasmus Darwin's work in Germany at the turn of the nineteenth century. The emphasis in this chapter is on the ways in which experimental instruments and media shaped understandings of organic vitality.

Schmid was one of many professors at the University of Jena who critically presented Kant's work for the next generation of philosophers, scientists, and artists. Johann Gottlieb Fichte, however, was the most prominent and controversial interpreter of Kant; figures such as Schelling and Novalis engaged Kant's philosophy through Fichte's reading. Chapter 4 begins by looking at Fichte's writings on the science of knowledge, his exploration of the dialectics of philosophies of reflection, and his polemics over the public role of reason during his tenure at

Jena. It then turns to Novalis as a critical thinker. His study of Fichte led him to attend to the mediate processes of cognition and the different languages or media, from figurative expressions to galvanic experiments, through which the world is made apparent. Finally, it turns to Goethe's morphological investigations and his arguments for the relationships between aesthetic appraisal and experiment for apprehending the metamorphosis of living forms.

Schelling's work built on all of these developments. Chapter 5 details how Schelling drew on contemporary studies of excitability and generative processes to depict the boundary conditions of living organisms within the dynamic becoming of nature, and how, drawing on Fichte's critical idealism and Romantic philosophy, Schelling explored the epistemic conditions and limits of a philosophy of nature. It finally considers Schelling's works on the history of the world, which emphasized how every philosophy and every science is bound to its historical time and particularity of expression, and yet also how even the history of nature is imbued with the active life of freedom.

The last chapter reconsiders articulations of a science of life in light of Schelling's philosophy of nature, Novalis's and Goethe's figurative languages of nature, and experiments on organic vitality that were examined in the previous chapters. It opens with an examination of Foucault's analysis of the epistemic conditions for the appearance of biology in the early nineteenth century. Contra Foucault, it argues that texts introducing biology as a science do not mark a new epistemic formation reflecting a rupture with the eighteenth century but, rather, enact an ongoing process of transition. Treviranus's work, in particular, is used to frame the ways in which investigations of organic vitality in the late eighteenth century were continued and developed to open new areas of inquiry in the early nineteenth century. The chapter begins by examining the focus on organic functions in the physiological textbooks of the early nineteenth century, grouped around excitability, (de)generation, and sensibility. It then looks at new studies of generation and degeneration, in particular the work of Lorenz Oken. Finally, it considers studies of the relationships of living organisms to their physical environments, focusing on the contributions of Humboldt. The chapter develops Keller's insight that the demarcation of a science of life generated a tension that both set out the autonomy of biology and living beings and questioned that very autonomy.

I offer this account of organic vitality in German contexts as a counter-history to histories of vital powers and organicist theories, and to readings of

Schelling's and Novalis's thought as philosophies of absolute idealism. Instead, this study engages the experimental practices of the life sciences in the years around 1800. My argument is that instrumental explorations of organic bodies expanded the domain of organic vitality and its boundary with the inorganic, confusing any clear delineation of the living and the nonliving. This study also highlights the preoccupation with the material world and empirical inquiry that runs through idealistic and Romantic philosophies. It is concerned with contemporary reflections on the epistemic challenges posed by experimental reasoning and by knowing and acting from within the nature and argues that new modes of critique produced postures of epistemic modesty. The boundaries this analysis foregrounds thus concern the boundaries of knowledge as well as the boundaries of life. More specifically, my argument is that boundary concepts were introduced by Schelling as a means for discerning—empirically and intellectually—how organic individuals and kinds take shape and persist in relationship with their environments. This study further explores how attempts were made in practice to traverse the spaces between percept and concept, not only through new tools and techniques of experimental reasoning but also through new figurative languages both rhetorically and visually. If attending to the constraints on modes of practice, thinking, and expression in German contexts at the time, its focus is the exploration of the space of change in which proposals for a science of life gradually took shape. It seeks to open up to analysis the tensions, instabilities, and ambiguities resulting from shifting understandings and practices in that historical border zone. My conclusion is that the indeterminism marking the science of life was productive in opening up new domains of inquiry without claiming to capture life in a theory or technology.

In this book, then, I ask after not only the historical emergence of a science of life but also the epistemic problems that accompanied this emergence. This work is not intended, however, as a contribution to projects of historical epistemology insofar as those projects draw conclusions about the historical development of science in general. It does not endeavor to assess the common conditions under which the sciences take shape and change over time, even if finding stimulus from analyses into experimental technologies in the life sciences more generally. It is not the study of epistemological concepts as objects that change historically, as in Daston and Galison's study *Objectivity*, although it draws on their characterizations of epistemic virtues and arguments regarding how objects of scientific inquiry emerge. It is also not an analysis of concepts or words in their historical

sites as part of a larger concern with how our philosophical problems became possible, in the sense of Ian Hacking's *Historical Ontology*, although it allows that the concerns developing in the years around 1800 have an ongoing relevance to historical and philosophical studies.³⁶ It does not make broad claims regarding the archaeology of the history of knowledge or regarding the genealogy of science—whether tracing positive contributions to existing knowledge systems, or tracing how changes in systems of discourse are connected to changes in the practices of social power structures, or whether these changes are tied to unitary ideologies or to multiple and contingent developments. My analysis is historically and culturally specific and limited.

But in offering a new account of organic vitality, of epistemic reflections on the experimental investigations of life, and of critical and Romantic philosophies in relationship to both at the turn of the nineteenth century I pose a series of challenges to the larger histories of biology and histories of philosophy that we have been telling ourselves. This study does not simply draw attention to developments previously overlooked or underemphasized or questionably construed. It invites reflection on what are the consequences for the history of biology if, from its first formation, the science of life was conceptually and experimentally far more sophisticated than is often assumed. Certainly some developments in the history of biology might need to be reconsidered as a transformation of, rather than as a turning away from, earlier contributions. What have been regarded as lingering legacies of a romantic biology might need to be reassessed. It also calls for a closer examination of the agendas of historical agents in depicting German biology in a negative light. It invites similar reflection on the contributions of critical and Romantic philosophies. Although studies of German idealism and Romanticism have become richly sophisticated, the study of their philosophies of nature and their relationships to the contemporary life sciences remain undeveloped. Considerations of the epistemic challenges currently posed by the new sciences of life might also benefit from a deeper awareness of their longer history. These reflections extend well beyond the scope of this study, but at the conclusion I present them as questions I hope to provoke through this book.