

Introduction

THIS book is a study of the *human motor*, a metaphor of work and energy that provided nineteenth-century thinkers with a new scientific and cultural framework. Through this metaphor, scientists and social reformers could articulate their passionate materialism, embracing nature, industry, and human activity in a single, overarching concept—labor power. Their vision of a society powered by universal energy offered continental Europe, undergoing its industrial revolution, an exhilarating explanation for its astonishing productivity. In that vision, the working body was but an exemplar of that universal process by which energy was converted into mechanical work, a variant of the great engines and dynamos spawned by the industrial age. The protean force of nature, the productive power of industrial machines, and the body in motion were all instances of the same dynamic laws, subject to measurement. The metaphor of the human motor translated revolutionary scientific discoveries about physical nature into a new vision of social modernity.

In his *Discourse on Method* (1637) Descartes described the animal machine as “made by the hands of God, incomparably better ordered [and] more admirable in its movements than any of those which can be invented by men.”¹ He compared the marvelously ingenious mechanical *homunculi*, or automata, constructed by seventeenth-century craftsmen with the living machines produced by nature: but only the

human machine was capable of speech and reason—endowments that attested to the presence of the soul. During the nineteenth century, Descartes' animal machine was dramatically transformed by the advent of a modern motor, capable of transforming energy into various forms. For European physicists and physiologists, Descartes' distinction between the animal machine and the human being was no longer meaningful. The human body and the industrial machine were both motors that converted energy into mechanical work. The automata no longer had to be denied a soul—all of nature exhibited the same protean qualities as the machine.

From the metaphor of the motor it followed that society might conserve, deploy, and expand the energies of the laboring body: harmonize the movements of the body with those of the industrial machine. Consequently, European scientists devised sophisticated techniques to measure the expenditure of mental and physical energy during mechanical work—not only of the worker, but also of the student, and even of the philosopher. If the working body was a motor, some scientists reasoned, it might even be possible to eliminate the stubborn resistance to perpetual work that distinguished the human body from a machine. If fatigue, the endemic disorder of industrial society, could be analyzed and overcome, the last obstacle to progress would be eliminated.

This image of the body as the site of energy conservation and conversion also helped propel the ambitious state-sponsored reforms of late nineteenth- and early twentieth-century Europe. The metaphor of the human motor lent credibility to the ideals of socially responsive liberalism, which could be shown to be consistent with the universal laws of energy conservation: expanded productivity and social reform were linked by the same natural laws. The dynamic language of energy was also central to many utopian social and political ideologies of the early twentieth century: Taylorism, bolshevism, and fascism. All of these movements, though in different ways, viewed the worker as a machine capable of infinite productivity and, if possessed with true consciousness, resistant to fatigue. These movements conceived of the body both as a productive force and as a political instrument whose energies could be subjected to scientifically designed systems of organization. Thus, the classical traditions of nineteenth-century social thought, as well as the radical ideologies of the early twentieth century, shared the belief that human society is ultimately predicated on the unlimited capacity to produce and that this “social imperative” mirrored nature's own unlimited capacity for production. The laboring body was thus interpreted as the site of conversion, or exchange, between nature and society—the medium through which the forces of

nature are transformed into the forces that propel society. This book is concerned with tracing the origins and implications of this image of “labor power” as the fundamental imperative that links society and nature in nineteenth-century thought.

A central argument of this study is that modern *productivism*—the belief that human society and nature are linked by the primacy and identity of all productive activity, whether of laborers, of machines, or of natural forces—first arose from the conceptual revolution ushered in by nineteenth-century scientific discoveries, especially thermodynamics. Historians and philosophers of science have frequently pointed out that the metaphors and images employed in the great scientific theories of the age, those of Hermann von Helmholtz, Sir William Thomson (Lord Kelvin), and Rudolf Clausius, were shaped by larger theological and social perceptions. However, the impact of their image of nature for a modern conception of work has received little attention. Of particular importance was the contribution of the German physicist and physiologist Hermann von Helmholtz, who elaborated the universal law of the conservation of energy in 1847. Helmholtz, a pioneer of thermodynamics, argued that the forces of nature (mechanical, electrical, chemical, and so forth) are forms of a single, universal energy, or *Kraft*, that cannot be either added to or destroyed. As Helmholtz was aware, the breakthrough of thermodynamics had enormous social implications. In his popular lectures and writings he strikingly portrayed the movements of the planets, the forces of nature, the productive force of machines, and of course, human labor power as examples of the principle of conservation of energy. The cosmos was essentially a system of production whose product was the universal *Kraft* necessary to power the engines of nature and society, a vast and protean reservoir of labor power awaiting its conversion to work.²

The remarkable generosity of nature implicit in energy conservation was diminished by the almost simultaneous discovery of the *second law of thermodynamics*, which explains the irreversibility and decline of energy in *entropy*. The second law of thermodynamics, identified by Rudolf Clausius, established that in any isolated system the transfer of energy from a warmer to a colder body is accompanied by a decrease in total available energy. The optimism of energy conservation was thus offset in the 1850s and 1860s by the revelation that, in practical terms, there was also an inevitable dissipation of force, that only a fraction of the total existing energy is available for conversion and that “the entropy of the universe tends to a maximum.”³

The great discoveries of nineteenth-century physics led, therefore, not only to the assumption of a universal energy, but also to the inevita-

bility of decline, dissolution, and exhaustion. Accompanying the discovery of energy conservation and entropy was the endemic disorder of fatigue—the most evident and persistent reminder of the body’s intractable resistance to unlimited progress and productivity. Fatigue became the permanent nemesis of an industrializing Europe.

As a result of these discoveries, the image of labor was radically transformed. It became *labor power*, a concept emphasizing the expenditure and deployment of energy as opposed to human will, moral purpose, or even technical skill. The doctrine of energy thus contributed to a decisive break with the two great traditions that combined to form the Western idea of labor: labor was neither spiritualized as in the Christian worldview, nor deprecated and identified with degradation as in the ancient Greek word *ponos*, which translates as pain or travail.⁴ Equally absent here is the ancient craft ideal of labor as an activity not confined to satisfying needs, but as an ennobling, poetic “accomplishment” (a vision that modern socialism translates into labor as the true path to redemption from alienation and the ennobling of human nature). In the energetic image of labor the intellectual, purposeful, or *teleological*, side is incidental. Marx, too, viewed labor power (in contrast to labor) as devoid of purpose and meaning, a purely quantifiable output of force, subject only to abstraction. As mechanical work, as “*Arbeitskraft*,” labor power is entirely indifferent to the nature of its material form.⁵

The discovery of labor power—and its subsequent elaboration in political economy, medicine, physiology, psychology, and politics—was emblematic of a society that idealized the endless productivity of nature. Semantically, this meant that the word *work* was universalized to include the expenditures of energy in all motors, animate as well as inanimate. The Promethean power of industry (cosmic, technical, and human) could be encompassed in a single productivist metaphysic in which the concept of energy, united with matter, was the basis of all reality and the source of all productive power—a materialist idealism, or as I prefer to call it, *transcendental materialism*. The language of labor power was more than a new way of representing work: it was a totalizing framework that subordinated all social activities to production, raising the human project of labor to a universal attribute of nature.

The nineteenth-century distinction between labor and labor power thus expressed a remarkable shift in the magnitude of social explanation. Labor became an ordering principle of both nature and society. The classical political economists of the eighteenth century, like Adam Smith and David Ricardo, clearly foresaw the productive potential of

the division of labor and of working machines. But they could not yet grasp that the work of hands, tools, and even complex mechanical devices were insignificant when compared with the technological revolution that produced the very forms of power that propelled industrial progress. Only labor power could adequately express the equivalence of force that was the true *perpetuum mobile* of the nineteenth-century industrial revolution. With the discovery of labor power, work was no longer an anthropological constant or a social and economic activity. Labor power became, in the philosopher Agnes Heller's terms, "the motivating force of human [and we might add, natural] history."⁶ Nineteenth-century Europe was transformed by work and energy. It is not surprising, then, that the central doctrine of scientific materialism—the unity of matter and motion in energy—succeeded in erasing the distinction between them.

This book examines a vast, though largely forgotten literature on work that appeared at the end of the nineteenth century, and by the beginning of the twentieth, proliferated into a scientific approach to the working body. Radical in its reduction of work to "economy of force," the language of labor power was not limited to one political or social ideology: it appears in popular science, in Marx's mature theory, in the laboratory fatigue study, in innumerable sociological and psychological treatises on work. Stripping labor of its extraneous social and cultural dimension, and revealing only its objectivity, this language could be found in socialist doctrine, in the arguments of liberal reformers, in parliamentary debates on social issues from the length of the working day to the term of military service.⁷

Nineteenth-century European thought was preoccupied with labor: with its political and economic interests, with its diverse forms of organization, with its intrinsic meaning, and with its productive potential. The emergence of successful working-class movements, the rise of a society propelled by a market economy and new technologies, and the great expansion of the factory system, especially in the last decade of the century, produced a panoply of discourses on labor in which ethics, science, and politics were entwined. Liberal reformers and conservative moralists divided disorderly from orderly and submissive workers, productive and upright workers—usually male—from dissolute and improvident workers, usually female.⁸ The same moral and political claims could be enlisted by socialists to condemn the "insalubrity" and risks of certain trades, to assail exploitation and suffering, and to demand an end to the factory system.

By the early 1890s, progressive scientists and reformers were attempting to end this cacophony of moralizing claims and to resolve the

“worker question” through science. These experts in fatigue, nutrition, and the physiology of the “human motor” sought to provide a neutral, objective solution to economic and political conflicts arising from labor—one that replaced moral exhortation with experiment and reasoned argument. Science subjected the body’s movements and rhythms to detailed laboratory investigation, to new techniques of measurement, and to photographic study, ultimately giving rise to a new discipline: the European science of work.

Nowhere is this attempt to replace moral discourse with science more evident than in the discovery of fatigue by European physiologists, especially after 1870. Though portrayals of fatigue could readily be found in the literary storehouse of *ennui*, lassitude, weakness, and world-weariness—for example, in the poetry of Baudelaire or in the novels of Flaubert, Barbey d’Aurevilly, and Joris Huysmans—they first appeared in medical literature only in the late nineteenth century.⁹ Judging from the sheer volume of scientific papers, popular works, and journalistic commentary, we can surmise that the problem of fatigue was epidemic among European workers, students, and even middle-class “brain” workers. An 1892 report on the state of French schoolchildren was hardly unique in its scrutiny of the diverse effects of fatigue: “Muscles without energy painfully support the body; the visage is pale; the carriage is enervated; the posture is weighted down; all of the external aspects of the child give the impression produced by a plant languishing and withering for want of air or sunlight. All of the functions of the organism descend into a characteristic state of decline.”¹⁰

Such vivid illustrations expressed a widespread fear that the energy of mind and body was dissipating under the strain of modernity; that the will, the imagination, and especially the health of the nation was being squandered in wanton disregard of the body’s physiological laws. Fatigue thus became the most apparent and distinctive sign of the external limits of body and mind, the most reliable indicator of the need to conserve and restrict the waste and misuse of the body’s unique capital—its labor power. Central to this book is the significance of fatigue, which replaced the traditional emphasis on idleness as the paramount cause of resistance to work. Its ubiquity was evidence of the body’s stubborn subversion of modernity.

The irreversible decline in force, which scientists and social philosophers had observed in entropy, led to grim predictions of the world’s imminent demise—a “heat death,” extinguishing all life in an abrupt, chilly end.¹¹ Less pessimistic spirits, like Helmholtz and the German popularizer of science Ernst Haeckel, resisted such apocalyptic premonitions; but the debate on the heat death of the universe was sympto-

matic of the scientific and literary anxiety of the age. Even if the cosmic apocalypse might be forestalled, scientific knowledge could not ignore the portentous social effects of fatigue.

Beginning with the “discovery” of fatigue by work-hygienists, physicians, and physiologists in the 1870s, this book traces the emergence of a distinctive European science of work. Etienne-Jules Marey, a remarkable French inventor-scientist, produced the first investigations of motion during the 1870s and 1880s. Marey’s techniques, which inscribed the body’s movements on smoked paper, gave rise to the laboratory study of fatigue. Angelo Mosso, a Turin physiologist who became the “Galileo” of modern fatigue research, and whose classic *La Fatica* (1891) was enormously influential, attempted to do for the working body what Helmholtz, Clausius, and Thomson had done for the universe: establish the dynamic laws of fatigue by rigorous experiment and new techniques of measurement. The Heidelberg chemist Wilhelm Weichardt’s striking announcement in 1904 that he had discovered a vaccine against fatigue ultimately proved a disappointment, but his quest was hardly considered frivolous: the utopian possibility that society might discover a way to eliminate fatigue was much too compelling.

Since the seventeenth century, labor had undergone a major reevaluation in the West. In philosophy and economics, the ennobling of labor as the origin of all wealth and the legitimate basis of property and selfhood was a crucial instrument in the extensive campaign against the “unproductive labor” of the nobility and the idle poor: labor was at once productive, rational, and moral. The transvaluation of labor was invigorated by John Locke and the classical political economists who drew on Calvinist doctrine to justify its centrality as the source of value, and by the Enlightenment *philosophes*, who publicized its virtues and secrets. “To raise the mechanical arts from the debasement where prejudice has held them for so long” was a chief purpose of Diderot’s famous *Encyclopédie*. As William Sewall has shown, the result was a “scientized, individualized, utopian projection of the world of work,” made publicly available like all other forms of scientific knowledge.¹² For Hegel, labor became the beginning point of human self-consciousness and autonomy, the source of universal truth. If labor was embraced by reason, its productive power was regarded as wholly rational: the old nemesis of idleness, consistently subjected to reason’s disapprobation, was identified with corruption, vice, villainy, and the venality of courts.

Throughout the eighteenth and early nineteenth century, the vast European population of beggars and vagabonds became the subject of countless secular and theological treatises on the sin of idleness, and of

a proliferation of laws prohibiting dissolute behavior. These writings and practices were directed not simply against the scourge of idleness, but at raising the moral worth of labor in the eyes of the few remaining skeptics. As Auguste Comte once remarked: “We must invest material labor with a philosophical importance demanded by its social value.”¹³

This book describes how, by the last quarter of the nineteenth century, this protracted reevaluation of labor evolved into a far more detailed scientific program for transforming and deploying human labor power. By the 1890s an international avant-garde of fatigue experts, laboratory specialists, and social hygienists created a new field of expertise in which science and politics intersected. For the European science of work, the study of fatigue, of the dynamic movements of the body, and of physical changes during work, became part of a broader strategy of social modernity—one that attempted to solve social problems through empirical research and rational principles.

In this new constellation of knowledge and politics, the state was the “visible expression of the invisible bond that unites all living beings in the same society.”¹⁴ Social justice, reformers claimed, would inevitably lead to expanded productivity: “Social intervention to preserve the integrity of the social organism,” noted the Belgian hygienist Louis Querton in *The Yield of the Human Motor* (1905), permitted “society to exercise its right to take from it a maximum of efficiency.”¹⁵ Social justice, conservation of energy, increased output, and greater efficiency were interrelated since “heredity, milieu, lodging, [and] education exercise a great influence on the personal productivity of the worker.”¹⁶ These ideas were attractive to many socialists who also considered exploitation a “social drain” on the productive power of the nation.¹⁷ For late nineteenth-century liberals the economic and social benefit of state policy was to transcend class conflict and substitute scientific neutrality.

This book is an attempt to chart the path from moralism and the old religious proscription on idleness to the new social ethic of energy conservation. In France and Germany *fin-de-siècle* liberal reformers employed what I call a productivist calculus to address the question of how to balance economic well-being with social justice. As the condemnation of idleness was appropriate to a society with its moorings in religious conviction, the calculus of energy and fatigue was syncretic with a more scientific age. Max Weber concluded in *The Protestant Ethic and the Spirit of Capitalism* (1904/5) that a victorious capitalism no longer needed the religious asceticism of the work ethic. But Weber (although he commented elsewhere at length on the “psychotechnics of labor”) declared an ending where, in fact, there was a metamorpho-

sis: the traditional work ethic became the ethos of labor power. Weber's elegiac image of the declining work ethic in the modern age proved premature: "The rosy blush of its laughing heir, the Enlightenment, seems also to be irretrievably fading, and the idea of duty in one's calling prowls about in our lives like the ghost of dead religious beliefs."¹⁸ What could be a more appropriate incarnation for this errant spirit in the age of the industrial dynamo than the new calculus of energy and fatigue? With the emergence of energy as the universal principle of work, the old ghost acquired a material carriage, and the image of work was given a scientific pedigree. The metaphor of the human motor succinctly expressed this profound change.

The great epistemological break with positivism—the cognitive monopoly and idealization of the scientific method along with a search for general laws of both nature and society—and with the centrality of labor in European social thought, both began in the early part of this century. Nietzsche provided the credo for the antipositivist revolt when he charged that "the faith on which our belief in science rests is still a *metaphysical faith*."¹⁹ His protest against the moral and political supremacy of epistemological models—especially that of physics—drawn from the study of nature became the central tenet of the philosophical critique of modernity, which subsequently guided many European intellectuals in their decisive rejection of the hegemony of science in the first decades of the twentieth century.²⁰

The great social thinkers at the turn of the century—Weber, Freud, Durkheim—argued for the autonomy of the cultural sciences (sociology, psychoanalysis, anthropology) from older scientific models, though each remained convinced, albeit differently, that labor, defined in largely energeticist terms, was central to their enterprise. Freud transposed the energetic model of nature to sexuality; Weber saw routinized, time-bound labor as the characteristic feature of Western rationality; and Durkheim argued that the division of labor irreversibly destroyed the coherence and integrity of traditional culture. At the same time, however, each began to question the ontological status of labor as the *prime mover* of man and nature: Freud rooted labor in instinctual life; Weber, in asceticism and religious conviction; and Durkheim, in community. Each introduced significant aspects of hermeneutic uncertainty into the interpretation of culture. Despite their shared commitment to the Enlightenment ideal of science, their work ultimately helped to loosen the supreme hold of natural science on intellectual life.

Weber especially remained aware of this issue in his many reflections on the paradoxical implications of positivism. He clearly recog-

nized the extension of instrumental rationality as a style of thought—mathematicization, expertise, bureaucratic and legal formalism—and as a practice—the enormous development of industry and productivity, the extension of market forces and administrative methods to ever-increasing domains of social experience. The advance of instrumental rationality undermined and weakened the capacity of reason to resist effectively the imperatives of increasingly rationalized power. Ironically, its *raison d'être*—neutrality and scientific responsibility—rendered reason powerless to formulate binding values, social ideals, or “ends.” Reason was itself implicated in, and subordinated to, larger nonscientific purposes. Weber criticized positivism and scientific naturalism, singling out the social energeticists—Ernest Solvay and Wilhelm Ostwald—for their “umstülpung,” or spillover, of the “world picture” of scientific disciplines into the “worldviews” of the social sciences, where they ought not have a place.²¹ Yet, for all his prescience, Weber did not investigate the expanding role of social knowledge in the modern state. Always the pessimistic liberal, Weber defended the neutrality of the sciences, as he could conceive of no real alternative apart from ideology or prejudice.

The impact of positivism on social knowledge and on the nineteenth-century ideal of reform politics has somehow escaped the scrutiny of historians.²² In this work I have focused on the way social modernity emerged from its connection with the insights gained from the scientific discoveries about energy, and their social implications for understanding labor power and fatigue: How laboratory studies of the laws of motion governing the working body contributed to the great political struggles around the “labor question” in the late nineteenth and early twentieth century. By pursuing the tropes of energy and fatigue in the efforts of physiologists, psychologists, economists, social scientists, and reformers, I have traced how scientific concepts became part of a growing body of social knowledge.

This book argues that the science of work transformed the perception of work in Europe. Breaking sharply with earlier doctrines of moral and political economy, the new science focused on the body of the worker. Predicated on the metaphor of the human motor and buoyed by a utopian image of the body without fatigue, the search for the precise laws of muscles, nerves, and the efficient expenditure of energy centered on the physiology of labor. The European science of work promised to overcome the negative effects of badly organized, exploitative, and irregular work. Claiming to transcend class interests, after 1900 its advocates became increasingly involved in politics. In controversies over the length of the workday, occupational accidents, and military

training, the science of work sought to deliver an objective and nonpartisan answer to the most vexing social issues. Yet the greatest weakness of the science of work lay in its most compelling assumption, that the body was a motor, and that scientific objectivity and expertise were sufficient to provide an objective solution to the worker question.

The arrival of the American Taylor system in Europe shortly before the First World War dashed those hopes. At the outset the European scientists criticized Taylorism for its primitive conception of the worker and for its crude methods. But ultimately both methods shared a similar image of work: the body—not the social relations of the workplace—was the arena of labor power. After the war there was growing recognition that the two methods were not incompatible and that a rapprochement would benefit both. Nonetheless, the image of a human motor persisted well into the post-World War II period. By the mid-1950s, however, the image of work drawn from that metaphor began to wane. Automation promised to liberate work from the materiality and physicality—muscles, nerves, energy—of the body. With the disappearance of the metaphor of the human motor, the centrality of work in European thought began to disappear as well.

Chapters 1 through 5 expand on that burgeoning discourse on fatigue and energy in the natural sciences, in physiology, in medicine, and in psychology. These chapters deal with the discovery of fatigue as both a pathology and a prophylaxis against the demands of modernity; with the formation of the idea of labor power in Helmholtz and Marx with its metamorphosis into the economy of work by Etienne-Jules Marey and his students; and with the emergence of a European science of work.

Chapters 6, 7, and 8 examine some of the practical social implications of the new energy doctrine after 1890: the growing problems of neurasthenia and mental fatigue in psychology; the anthropology of work; and the institutionalization of social energetics as an influential movement. Some basic differences between the science of work in Germany and in France are relevant here (the French were more physiological; the Germans, more psychological in orientation). The general focus, however, remains broadly Continental—a perspective, I believe, justified by the international character of the movement, and by the simultaneous development in both France and Germany of empirical programs for studying fatigue in industry. A crucial aspect of these chapters is also the calculus of energy expenditure, or productivity, and reform that was applied to economic and social issues emerging from the problem of fatigue: the personal productivity of the worker; the deployment of energy in society; and above all, class conflict. Chap-

ter 8 considers the efforts of physiologists, psychologists, and social reformers to apply the principles of energy conservation, with varying degrees of success, to a spectrum of social problems from inadequate nutrition to the lack of rest pauses, to industrial accidents, and even to the fitness of military recruits.

The final chapters explore the broader political consequences of fatigue research and the science of work in the first half of the twentieth century. Chapter 9 focuses on the reaction of European physiologists and work experts to the American system of scientific management, Taylorism—a challenge that divided European critics on the eve of the First World War and anticipated the assimilation of the science of work to a broader set of managerial strategies in the war's aftermath. The war was also decisive as a laboratory for discovering military and nonmilitary uses of the new energetics and for preparing the way for the widespread use of aptitude testing, the industrial fatigue study, and "psychotechnical training." Chapter 10 examines the interwar period, when "rationalization" became the catchword of various technocratic and political movements. Socialist, communist, and national socialist ideologies, which embodied versions of productivism and adopted aspects of the science of work, paradoxically led to the politicization and professionalization of the science of work during the 1920s and 1930s. The conclusion reconsiders recent debates about "the end of the work-centered society" in terms of the eclipse of the energeticist calculus and the centrality of the body in nineteenth-century visions of work.

My chief concern throughout has been with the problem of labor power in thought and politics. I have tried to show the consequences of the conflation of the natural and social sciences around the problem of labor power and to examine how a knowledge of work became institutionalized in various contexts. These efforts constituted a key element in a new form of social modernity, one in which social control and enlightenment were intertwined. The concepts of energy and fatigue reflected the paradox of this social modernity, at once affirming the endless natural power available to human purpose while revealing an anxiety of limits—the fear that the body and psyche were circumscribed by fatigue and thus could not withstand the demands of modernity.

A WORD ON METHOD

So as not to burden excessively readers disinclined to lengthy prolegomena, I have sequestered my remarks on method to this sec-

tion. My investigation has concentrated on the intellectual and political implications of certain scientific concepts as they emerged in a zone between the specific concerns of the natural sciences and larger questions of social and political significance. To consider concepts like energy and fatigue as matters of broader social and cultural relevance is not in itself problematic. But, to ask precisely how these concepts operated socially and politically, how they were used, and in what contexts, raises some important questions about the traditional assumptions of both social and intellectual history.

There is no doubt that for some time a deep division has existed between historians of ideas concerned with the problem of the connection between language and meaning, and more conventional social historians who, for more than two decades, have investigated how political actors and social groups disenfranchised from political control and situated outside the purview of elite society articulated their social vision and experience. From the perspective of many social historians, the effort to integrate postmodern theory has resulted in an intellectual history, at best performative and literary, that cannot engage with social and political realities.²³ Intellectual historians like Dominick LaCapra and Hayden White, have convincingly argued, however, that social history is epistemologically and politically naïve: the historian assumes the position of omnipotent chronicler, moving his/her subjects through a carefully constructed narrative, without reflecting on how language, ideology, and emplotment undermine the very image of objective history that is being aimed at. By reducing ideas and events to underlying socioeconomic models that remain unexamined, social history cannot extricate itself from the conundrum that writing about the “real” involves confronting its own representations of the real. Moreover, they charge, social historians frequently engage in a nostalgic enterprise to resurrect from past social struggles a sense of social coherence and meaning. All history, in this sense, is contemporary history, but unself-consciously so.²⁴

However, several historians have recently tried to overcome this division and study how social visions and experiences were constituted through language and symbolic systems of meaning. They turned to the work of contemporary European philosophers—most often Michel Foucault, Jacques Derrida, and Jürgen Habermas—to reflect on the ways that problems of narrative and language might call into question the very categories of society, self, and experiencing subject that social historians invoke without hesitation. They argue that historians can productively investigate how class, gender, or any other social identity is constituted by language, and conversely, how language can fragment

or subvert even the most stable of identities.²⁵ My own work adopts the view that one of the most interesting consequences of this approach is that it permits us to see competing systems of knowledge as a central aspect of society; that the definition of society as composed of contending classes, or even of dominant and subordinate groups, is limiting. Ideas are not ancillary or supplementary to social practices and movements. On the other hand, the claim of a neutral knowledge to stand above class conflict is itself historical, a claim that is thematized in this book.

One dilemma that this ongoing debate raises is that both social and intellectual history have diminished the status of knowledge, particularly scientific knowledge, in nineteenth-century culture. For the purely linguistic approach all attempts at totality, most emphatically the scientific one, become entrapped in the paradoxical objectivist metaphysics exemplified by Descartes. The return to writing or language, as a vantage point to undermine the totalizing strategies of the social sciences, has meant not merely the radical subversion of meaning, but a homogenizing tendency to treat all works—even those once accorded the status of scientific knowledge—as textual exemplars of pure *poesis* rather than as socially powerful instruments. This position is not distant from Marxist social historians who judge the claims of science as bound to class and interest. Consequently, both approaches understate the role of science in the nineteenth-century public imagination and often neglect the fusion of scientific claims and social knowledge in its politics.

Even if we attend to the language of the sciences and the myriad attempts to apply scientific knowledge to society, we are still confronted with the other side of the dilemma than the one posed by the linguistically oriented historians of ideas—if metaphor and language determine the concepts and categories through which the world is represented, these concepts also derive from scientific traditions that have worldly consequences far beyond their status as literary expressions. Positivism is not merely a “metaphysic” but an institutionally anchored way of investigating and knowing the world. Although I have organized this study around a central metaphor and have been attentive to the role of language in the texts I have chosen, a fundamental problem for the cultural historian remains how science organizes, represents, and structures its knowledge along sometimes unconscious fault lines, often with unintended political and social consequences.

The point of this book is not to synthesize these two largely incompatible approaches, but rather to work beyond the boundaries that each of these perspectives has set; to offer without either excessive reverence

or fear and trembling, a “third way” of encountering social developments, texts, and discourses. I have attempted to negotiate the byways of the nineteenth-century discourse of labor power in the context of scientific developments, and in politics, without discounting its claims to objectivity, neutrality, and universality. In other words, I have not reduced these claims to mere ideological ruses through which a hegemonic class subtly achieves its ends. At the same time I have been conscious that this discourse has had significant social and political ramifications, not the least of which were linked to its claim to stand apart from social conflict. Crucial to its *raison d’être*, this aspiration to political neutrality is, as we have noted, a pervasive problem in the evolution of social knowledge.

There is no dearth of social histories documenting changes in the labor process during the “second industrial revolution” of the late nineteenth century. Labor historians have elaborated a rich and textured picture of the replacement of skilled artisanal labor by machinery and factory work; the breakup of the power of local workers’ organizations; the rise of a new industrial working class of unskilled, and often female, workers; the emergence of a new form of collective action—riots, rituals, and strikes—and more sophisticated techniques of surveillance and discipline by the state and capital. Historians have attempted to unearth how community and kinship have produced affective solidarities and sustained struggle while sometimes exacerbating patterns of prejudice and traditional modes of dependency. Although attention to family, sexuality, culture, and language served to acknowledge that production was not the alpha and omega of history, these domains were still often defined by their proximity (outside of, reactive to) to production. Having abandoned Marxism, many social historians became skeptical of theory and dismissed their own, earlier productivism as a methodological error. The correction of error, however, frequently evades full analysis of the problem: in this instance, disregard of Marxism’s productivist assumptions as a powerful historical force meriting critical investigation. Rarely interrogated were the constricting effects of productivism on the labor movement’s vision and practices—the ways that labor movements helped workers to adapt to industrial processes, accelerated improved techniques of production, and excluded significant dimensions of culture and politics not central to production. Most important, the ways in which scientific ideas, epistemological frameworks, and reform strategies redefined labor (and its practical consequences) eluded most social historians because they did not emerge directly from class conflict.

By contrast, historians of ideas have long been aware that a major

thrust of modern social theory—both in the German tradition of the Frankfurt School and in French poststructuralism—has been concerned with precisely this question: how both nineteenth-century heirs of the Enlightenment, rationalism in general, and, scientific Marxism in particular, have helped to perpetuate and extend technical and cognitive systems derived from the model of production.²⁶ As Max Horkheimer and Theodor Adorno, the central figures of the Frankfurt School, asserted in their brilliantly opaque *Dialectic of Enlightenment* (1947), positivism read back onto human nature the attributes of inorganic nature while modeling its method and goals on the social project of conquering and dominating nature.²⁷ Similarly Marx, in Jürgen Habermas's words, introduced "a principle of modernity that is grounded in the practice of a producing subject" whose historical goal is to realize the potential of technology.²⁸ Though suggestive, this critique did not provide an adequate historical account of the link between positivism and productivism in nineteenth-century thought; nor did it investigate how that vision became institutionalized in concrete forms of social knowledge specific to the imperatives of industrializing Europe.

This book examines some of these lacunae in social and intellectual history. It argues that the scientific language of labor power and the hegemony of productivism were not merely "corruptions" of Marxism or of the labor movement, but integral aspects of the intellectual framework of nineteenth-century materialism. Furthermore, although Marx's theory plays an important part in this story, it is by no means the only, or even the central one. Rather, by focusing on less well known individuals and texts—whose influence did not resound in the realm of grand theory but in the laboratory, in the social sciences, in economics, or in parliamentary chambers—I hope to show that similar sets of assumptions governed the ideas of physiologists, psychologists, socialists, and liberal thinkers and reformers.

For this reason I have paid particularly close attention to how the language of scientific discovery and scientific practice contributed to the evolution of a body of social knowledge concerned with work. Science constructed a model of work and the working body as pure performance, as an economy of energy, and even as a pathology of work. It produced a vast array of new disciplines concerned with society—social statistics, social medicine and hygiene, and a science of work—which framed political arguments and influenced their outcome. In short, science participated in a much larger web of ethical, social, and political entanglements.

For this insight the cultural historian is indebted to Michel Fou-