Science and Scientism in Nineteenth-Century Europe

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CHAPTER 5

The Rise of Materialisms and the Reshaping of Religion and Politics

The Romantic nationalism that fired the audiences for Fichte's 1807 *Addresses to the German Nation* and Auguste Schlegel's 1809 *Appeal to the German Nation* led immediately to the establishment of many organizations intended to prepare Germans for the day when they would be liberated from French hegemony and become free again to develop as Germans. The year 1808 saw the establishment of the *Tugenbund*, or Society for the Practice of Civic Virtue, in Königsberg, with branches throughout Germany. In 1810 the *Deutsche Bund* was established in Berlin to spread throughout German-speaking lands. In 1811 the first *Turngesselschaft*, or Gymnastics Society, intended to develop both the bodies and minds of youth for the coming struggle, was initiated; and after 1810 new Patriotic Singing Societies sprang up in virtually every significant town. When Napoleon began to retreat from Russia in the spring of 1813, Frederick William III of Prussia issued a call to rise up against the French, and young middle-class intellectuals associated with these organizations flocked as volunteers into the various militias that served alongside the regular army. Then, once the fighting was over, the students and young academics established *Burschenschaften*, or "fraternities," which promoted Romantic idealist views and looked forward to ever greater glories for the German nation.

Alas, the political, economic, and academic realities of post–Napoleonic Germany diverged rapidly from student expectations. At the Congress of Vienna in 1815, the political life of the Germanies became dominated by the socially and religiously conservative Austria, led by Prince Klemens von Metternich, who was the architect of the German Confederation. Though each of its thirty-nine member states retained great autonomy, the Confederation, under Metternich's guidance, had a conservative and anti-democratic impact. For the most part, the traditional nobility was confirmed in its feudal rights over peasants, public lands, and local courts; and with rare exceptions that nobility opposed any form of nationalism that would constrict its local authority. The clergy were granted state pensions; and freedom of the press, speech, and assembly were limited

Even in Prussia, where there was a strong liberal tradition within the government bureaucracy, the 1820s saw the reestablishment of noble control over local government.

After the 1817 student festival near Jena, state concern over the activities of the *Burschenschaften* grew; and in 1819 Metternich brought together a group at Karlsbadruhe in Bohemia to draft a set of decrees that shut down the fraternities, tightened press censorship, made gymnastic societies illegal, and established police surveillance in the universities. This move led to the dismissal of numerous outspoken academics, even when, as in Oken's case, they tended to be conservative themselves. Again in 1832, after twenty-five thousand people attended a German unification rally at the Hambach Festival in May, Metternich reacted repressively, this time getting the German Confederation to forbid all public meetings, to restrict the right of local sovereigns to extend the rights of citizens, to regulate universities more closely, and to place suspicious political figures under surveillance.

At this point, a substantial number of liberal-leaning faculty members, especially in law and the cameral sciences (named for the room in which the prince's advisors met), were dismissed from their positions.[1] As a consequence, there was an increasing politicization and polarization of academic life, with some faculty members, such as Johannes Müller, becoming increasingly reactionary; while most students and other faculty members were increasingly radicalized. One group, the so-called Gottingen Seven, who were dismissed from academic positions for their political views, banded together in 1837 to establish the newspaper, *Deutsche Zeitung,* which pushed the limits of allowable liberal expression.

A few years later, in 1842, a more radical group in Cologne established *Die Rheinische Zeitung für Politik, Handel, und Gewerbe* (Rhenish Newspaper for Politics, Trade, and Industry). This group hired a young philosophy graduate named Karl Marx as editor. Within a few months the Prussian cabinet shut the paper down and Marx went into exile, first in Paris, then in London. With rare exceptions, because idealist philosophy, traditional religion, and *naturphilosophisch* science were all associated with political conservatism, younger liberal and radical students tended to move away from all three and to develop intellectual perspectives that combined materialism, extremely heterodox religious views, and liberal to radical political perspectives.[2]

At the same time, economic conditions in the Germanies were changing rapidly under external pressures and as a consequence of liberal reforms promoted by camerally trained bureaucrats. One consequence was that although productivity, especially agricultural productivity, increased rapidly, so that aggregate per capita income was rising in most regions of Germany during the first half of the nineteenth century, a concentration of wealth in small segments of the population meant that there were wide pockets of severe economic distress, especially among agricultural workers and the traditional artisanal classes.

Throughout Germany between 1805 and 1835, population increases averaged about 40 percent in a region that was overwhelmingly rural and agrarian. (In 1850, less than 5 percent of the Prussian and less than 4 percent of the Bavarian population lived in towns of twenty thousand or more, whereas more than 34 percent of the British population did.)[3] At the same time, economic reforms led to the effective concentration of landholdings in smaller numbers of hands and to increased productivity. One result was that the Germanies became major exporters of foodstuffs, but another result was the creation of a huge army of landless underemployed agricultural wage laborers whose real income declined precipitously between 1820 and 1847.

Some of those workers moved into the towns, where liberal reforms were gradually undermining the traditional guild practices that had, for example, limited the number of persons entering most artisanal professions. The creation of a relatively unrestricted labor market undoubtedly drove production costs down, and in those few factories that were established in the first half of the century, some of the increased profits were passed on to labor; so factory wages seem to have risen faster than the cost of living. Factory production was slow to come to Germany, however; and in almost all traditional crafts, the chief result of the influx of new workers was to increase unemployment and to drive incomes down. The rapid economic decline of a once-prosperous and well-educated artisan class led to growing organized unrest among German workers beginning in the 1830s.

The economic decline of the previously comfortable artisanal class had a critical immediate impact on German culture because this class was not only highly literate, but it had also produced a substantial fraction of the student bodies and faculties of *Gymnasia* and the universities—recall that Kant's father had been a harness-maker, Johannes Müller's father was a shoemaker, Fichte's father had been a silk ribbonmaker, Oersted's was a pharmacist, and the poet, Johann Schiller's was a baker. As long as the financial stability of their world seemed relatively assured, such sons of tradesmen and craftsmen could focus their attention on Romantic literature or idealist philosophy without much worry about how their activities related to the world of material production and consumption. But as the livelihood of their families became increasingly problematic, the attention of the sons of the burgher class became increasingly turned toward the material conditions of life.

The social and economic considerations mentioned above served to selectively amplify the importance of specific developments that were occurring within the academic disciplines represented in the universities. As we shall see, the most important initial developments probably occurred within the humanistic and theological disciplines, but these soon spread outward to change the way in which the natural sciences were understood and the status that they enjoyed both within the academy and within the broader community.

Natural Science and Religion from Kant to David Strauss

We look first at some of the developments in theology that emerged in connection with Kantian philosophy. On one level these developments are particularly important because the conservative German state of the early nineteenth century drew heavily from religious authority to support its own legitimacy. Moreover, the whole meaning of the uniqueness of the German nation was bound up for the idealists and Romantics with its special religious role. Thus anything that challenged traditional understandings of religious authority also challenged the foundations of the state. At the same time, however, Kantian philosophy contained within itself features that were bound to challenge critical aspects of traditional religious authority and to shift the major locus of intellectual support for religion away from the natural theological traditions that had dominated eighteenth-century religious discourse throughout Europe.[4]

Given his distinction between the spatiotemporal and causal world of natural phenomena and the moral-choice-laden noumenal world, Kant was forced to argue for a radical disjunction between scientific knowledge, which was the legitimate and certain creation of speculative reason, and theology, which was not. In the *Critique of Pure Reason,* he wrote, "I maintain that all attempts to employ reason in theology in any merely speculative manner are altogether fruitless and by their nature null and void, and that the principles of its employment in the study of nature do not lead to any theology whatsoever. Consequently, the only theology of reason which is possible is that which is based upon *moral laws,* or seeks guidance from them. . . . [With respect to religion,] I have therefore found it necessary to deny knowledge in order to make room for faith."[5] In making this claim Kant was clearly not intending to denigrate either natural science or theology. He was simply saying that one could not legitimately infer claims regarding either domain from arguments that were appropriate to the other.

For the nineteenth-century German student of theology, then, two central questions emerged out of Kantian philosophy. First, in the absence of a rational, natural theological warrant, what kind of warrant exists for religious beliefs? Second, and perhaps even more crucial for many of those seeking to cope with the social and economic chaos of early-nineteenth-century Germany, in the absence of a natural theological account, how was one to understand the relationship between God and the material world within which human actions take place? For Kant's philosophy not only deprived religion of the support of natural science, it also deprived the material world of moral significance.

In 1837, David Friedrich Strauss (1808–74) identified three fundamental groups of German theologians who were struggling with these issues during the first half of the nineteenth century. First were what he called the "believers": traditionalists who were basically uninfluenced by Kant's philosophical arguments because

they contended that religious faith had never depended on the ability to provide rational knowledge about God or his Word or World in the first place. For the most part, such figures tended to understand the miracles of the Bible and the doctrine of salvation through Christ as mysterious and supernaturally produced. Indeed, according to many in this group, our chief warrant for believing the divine character of Christ was his ability to perform miracles. Second, there were the mediators, whose views were associated largely with those of Schelling and Friedrich Schleiermacher (1768–1834). Most members of this group tried to combine biblical and philosophical elements in a moderate stance aimed at holding German Christians together in the face of a series of intellectual and political pressures toward schism. Finally, there was the speculative or philosophical school, with whom Strauss identified. The views of this group were derived largely from the philosophical perspective of Hegel.

In the remainder of this section, we will be concerned primarily with the views of the speculative theologian, David Strauss. But since Strauss's doctrines were largely a response to those of Schleiermacher, we characterize his views briefly first. Schleiermacher accepted the Kantian notion that religion cannot be grounded in phenomenal knowledge. But like many others, he could not accept Kant's claim that there is an autonomous human moral sense, or faculty of practical judgment, that grounds religion. Instead, he developed Schelling's notion that we have a feeling of absolute dependence on the Absolute as spiritual beings in much the same way that we recognize our absolute dependence on the physical universe as physical beings. It is this feeling of absolute dependence that is the foundation for all religion. Religion is thus born out of precognitive, prevolitional feelings (*Gefühl*) for Schleiermacher.

Virtually all of modern liberal Protestant theology derives from Schleiermacher's emphasis on affective experience as the source of religious impulses, but Hegel found this notion appalling because it seemed to him to preclude the possibility of any cognitive component to religion. If Schleiermacher were right, Hegel fumed, "a dog would be the best Christian, because it has this feeling [of dependence] most intensely."[6]

One consequence of Schleiermacher's views was that he took a vastly different view of biblical miracles than the believers at the same time that he accepted the divine source and historicity of the Bible. For Schleiermacher, whether or not one believed in miracles was irrelevant to whether one was a Christian. God's presence could be felt in ordinary natural events. It did not need to be proven supernaturally. Indeed, it could not be "proven" at all by the argument that because some event was not understandable, it therefore had to have a supernatural, divine cause.

Though Schleiermacher made a significant break with traditional Christian theology, his religion remained orthodox in many ways. Throughout his *Speeches on Religion* of 1799, his *The Christian Faith* of 1803, and in his frequently repeated

Berlin lectures on "The Life of Jesus," delivered during the 1820s and 1830s, he continued to identify the historical Jesus of Nazareth with the saving Christ, even though he refused to commit himself to either naturalistic or supernaturalistic explanations of the supposed miracles reported of Christ.

The man who more radically transformed theological discourse in his own *Life of Jesus,* published in 1835, just three years after he had attended Schleiermacher's lectures at Berlin, was David Strauss. Strauss, born in 1808, the son of a downwardly mobile merchant family in Wurtemberg, entered the school of theology at Tubingen in 1825 to complete his theological training. There, because he and several friends found the philosophy faculty dull and inept, he established a study group to read contemporary German philosophy, beginning with Kant's critical works. But Kant seemed to him perverse in his emphasis on the extremely limited range of human knowledge. Fichte's abstract Idealism had little more appeal. On the other hand, Schelling's *Naturphilosophie* and its extension in Hegel's *Phenomenology of the Spirit* excited the young Strauss so much that after receiving his doctorate from Tubingen and serving (successfully) for about a year as pastor to a small congregation, he left for Berlin to study with Hegel.

Strauss arrived in Berlin in late 1831, just weeks before Hegel's death from cholera, so instead of studying with Hegel, he began to attend Schleiermacher's lectures. But Strauss brought to them a profoundly different approach, grounded in his study of Hegel. For Hegel and for Strauss, religion and philosophy have the same content, which is focused on the participation of humanity in divinity.[7] But religion must clothe the content in representation [*Vorstellung*] while philosophy deals with the content directly as concept [*Begriff*]. Like Schleiermacher, Strauss was inclined to believe that there had been a historical Jesus; and like Schleiermacher, he was inclined to discount the importance of miracles as warrants for belief. But Strauss went far beyond Schleiermacher, both in denying the credibility of all of the miracle stories and in denying the historicity of almost all of the particular events reported of Jesus' life. In fact, in his *Doctrine of Faith,* published in 1840, Strauss extended his attack on biblical literalism in interesting ways by drawing on Karl Burdach and Gustav Carus's *naturphilosophisch* understanding of biological change to undermine the Genesis story of Adam and Eve as the original parents of humankind: "According to science, all organic beings are produced originally from the inorganic. In particular, there is no doubt that our planet has acquired its present state gradually, that it was uninhabitable for organic beings in primitive times, and that these have originated gradually without having had ancestors, that is, through dissimilar reproduction."[8] Humans, like every other species, had evolved gradually under the pressure of the internal formative force (*Bildungstrieb*), and could not have emerged from a single pair of "original" parents.

From Strauss's Hegelian perspective, even if the biblical stories of the creation and of Jesus and his miracles were factually false, they could legitimately "rep-

resent" true aspects of the union of God with the universe and with man. They were fictions, or myths, created in a particular historical context to represent or symbolize a particular stage of that union for participants in a particular culture. In his later years, Strauss believed that because the historical process in which the Spirit continued to express itself in human self-consciousness was ongoing, the old, biblical, myths could no longer represent the highest religious consciousness. Instead, he turned to Darwinism and natural science to discover his religious truths.[9] But in his early and most influential works, Strauss still understood himself to be a Christian and he continued to hold that religious truth was represented in the biblical stories.

Indeed, the application of critical techniques to the biblical narratives by Strauss were intended, in Fred Gregory's words, "to force theological attention where it belonged, on the spiritual truth behind the life of Jesus,"[10] by demonstrating that traditional literal interpretations of the Gospels were impossible and that the biblical stories must, then, be understood as mythic symbols or imaginative representations of philosophical truths rather than as the truths themselves. Because of such views, Strauss found himself effectively ostracized from the evangelical Lutheran theological community. He lost his appointment at Tubingen and he became increasingly embittered and increasingly critical of traditional Christianity; so that in his later works, he no longer considered himself Christian at all.

The "Sensualist" Materialism of Ludwig Feuerbach

One of the most important stages in Strauss's growing estrangement from Christianity grew out of his interest in another young Hegelian theologian-turned-philosopher, Ludwig Feuerbach (1804–72), whose works were to transform the thrust of German philosophy during the 1840s and to point the way to a number of materialist attacks on all forms of Idealism. Strauss wrote of Feuerbach immediately after his publication of *Toward the Critique of Hegelian Philosophy*, in 1839, *The Essence of Christianity* in 1841, and *Preliminary Theses for the Reform of Philosophy* in 1842, "To-day, and perhaps for some time to come, the field belongs to him. His theory is the truth for this age."[11]

Feuerbach was born in 1804, son of the distinguished liberal Bavarian jurist Anselm Feuerbach and his wife Wilhelmine Troster. By age sixteen he showed an intense interest in religion, taking private Hebrew lessons during his time in the *Gymnasium* at Ansbach. From there he went to study theology at Heidelberg. Like Strauss, Feuerbach was introduced to Hegelian philosophy as a theology student, and like Strauss he made the pilgrimage to Berlin to study with Hegel. But Feuerbach arrived in 1824, early enough to study with the master as well as to attend the theology lectures of Schleiermacher.

At this point, Ludwig, along with his brothers, was (probably wrongly) sus-

pected of being a member of a secret organization. As a consequence, he came under police observation and he was denied formal admission to the university for several months. His older brother, Karl, was actually put in prison, where he attempted suicide. This experience, along with his concurrent fascination with the eighteenth-century French egalitarian materialist philosopher, Claude Adrien Helvetius, seems to have turned Feuerbach's politics increasingly toward radical democracy.

For financial reasons, Feuerbach had to leave Berlin for Erlangen in 1826. There, while he completed a basically Hegelian doctoral dissertation, Feuerbach began to study anatomy, and this study seems to have raised questions in his mind regarding whether Hegelian philosophy treated the natural world, or world of phenomena, fairly. For Hegel, as for Fichte, the identity between the laws of nature and the laws of thought followed from the fact that nature was ultimately created out of thought. Schelling had been bothered by this asymmetry, so he had posited an Absolute that was neither thought nor thing and was prior to both. The two manifestations of the Absolute then interacted in such a way that both Nature and Spirit evolved out of their interaction. Feuerbach was dissatisfied with this answer as well, but for nearly ten more years he continued to write as a Hegelian Idealist in spite of his growing concerns.

In 1829, Feuerbach became a *Privatdozent* in philosophy at Erlangen, with the expectation that he would move up the academic ladder to professor, but his publication of *Thoughts on Death and Immortality* in 1830 put an end to those hopes. Though it was published anonymously, Feuerbach was widely known to have been the author of this work, which challenged the traditional Christian notion of an otherworldly Heaven. Heaven and the notion of immortality, Feuerbach suggested, were representations or symbols of the search for the perfection of life in the here and now.[12] By persisting in the illusion of literal immortality, humans actually held themselves back from a complete submission to God. "True and complete surrender to and submersion in God," he wrote, "is possible only when the human recognizes death as true, real, and eternal."[13] Most importantly, in holding off their expectations of perfection for an afterlife, humans were relieved of the responsibility to make the best of their present lives. Thus, Feuerbach wrote that his overarching purpose in *Thoughts on Death and Immortality* was "to cancel above all the old cleavage between this side and the beyond in order that humanity might concentrate on itself, its world, and its present with all of its heart and soul."[14]

It should hardly be surprising that Feuerbach's attack on the doctrine of immortality produced a serious response in the political and theological communities, for it was widely held that the possibility of endless punishment in an afterlife was crucial as an instrument of social control. Without that inhibitor, who knows what kinds of immoral, illegal, and socially disruptive acts people might engage in? After his authorship of *Thoughts on Death and Immortality* became officially

known, the authorities at Erlangen, and throughout the Germanies, made it clear that Feuerbach would never get a regular academic appointment.

Throughout the mid 1830s the increasingly embittered Feuerbach published a very successful series of works on the history of philosophy from a Hegelian perspective, but then in 1837 he took up anatomical and physiological studies again, and his philosophical writings began to show an increasing interest in empirical natural science. In his *Philosophical Fragments,* under the title, "Bruckberg 1836–41," for example, he wrote: "All abstract sciences stunt man; only natural science reinstates him as an integral being, makes use of all the capacities and senses of the whole man."[15] In an 1837 study of Leibniz, he wrote: "Empiricism has facilitated the freedom and independence of thought—it has delivered us from the bonds of belief in authority by referring us to the holy, inalienable natural right of autopsy and self-examination."[16] From this time on he refocused attention from the realm of the rational ideal to the realm of concrete experience. In Kantian terms, Feuerbach increasingly focused on the notion that sensory intuitions are prior to intellectual cognitions in the formulation of knowledge, so that the idealist tendency to posit the existence of extra-sensory "objects" had no adequate foundation any more than Kant's positing of the noumenal thing-in-itself.

Feuerbach's new empirical emphasis was at the very heart of *The Essence of Christianity,* a work that rocked the foundations of German philosophy. In the preface to that work he insists: "I unconditionally repudiate *absolute,* immaterial, self-sufficing speculation,—that speculation which draws its material from within. I differ *toto coelo* from those philosophers who pluck out their eyes that they may see better; for *my* thought I require the senses, especially sight; I found my ideas on materials which can be appropriated only through the activity of the senses. I do not generate the object from the thought, but the thought from the object; and I hold that alone to be an object which has an existence beyond one's own brain. . . . I attach myself, in direct opposition to the Hegelian Philosophy, only to *realism,* to materialism in the sense above indicated. . . . I am nothing but a *natural philosopher in the domain of mind;* and the natural philosopher can do nothing without instruments, without material means."[17]

Though Feuerbach proclaimed himself now a materialist, his views incorporated a strange and ultimately unstable amalgam of classical materialist, Hegelian, and Humian emperico-positivist views that took on the form of a kind of inverted Hegelian idealism. Feuerbach continued to use the Hegelian distinction between religious representations and philosophical conceptions that had informed his own *Thoughts on Death and Immortality* and Strauss's *Life of Jesus,* focusing on the claim that religious dogmas ought to be understood as symbols of truths rather than the truths themselves. In addition, he continued to accept the Hegelian notion that the laws of nature are the laws of our thinking, but whereas for Hegel this assertion was true because thought imposed its structure on nature,

for Feuerbach it was now to be understood as true because nature imposed its structure on thought. For Hegel, cosmic history and its later stage, human history, was constituted through the gradual self-revelation of the Idea, or God, whereas for Feuerbach, God was constituted by the gradual self-revelation of Man through his interaction with the cosmos.

Even the structure of *The Essence of Christianity* was Hegelian, in the sense that it began in part 1 by exploring the truths represented through Christianity, then it turned in part 2 to exploring the contradictions contained in Christian theology, and it concluded with a new religious synthesis in which man comes to realize "that there is no other essence which man can think, dream of, imagine, feel, believe in, wish for, love, and adore as the *absolute,* than the essence of human nature itself."[18] Ultimately, for Feuerbach, there is a union of the human and the divine. But whereas for Hegel this union was achieved because in some sense God gradually created self-conscious humanity in his image, for Feuerbach, it was achieved because humanity, made gradually self-conscious, has finally realized that God is nothing but a representation of its own attributes and aspirations—thus his insistence that the most fundamental philosophical truth underlying religion is that "Theology is Anthropology."[19]

The occasion for Feuerbach's change of perspective was undoubtedly his reconnecting with the empirical science of physiology. The reasons, however, are almost certainly much more closely related to his feeling, already present in 1830, that idealist philosophy and the religion that it supported had lost touch with the experiences of ordinary humans and with the moral focus that Reformation Lutheranism and Kantian theology had both insisted upon. This general disillusionment with contemporary Christianity was no doubt amplified by the personal problems he had faced as a consequence of the complicit relationships between state and church in nineteenth-century Germany. These issues became increasingly important in the face of the economic crises facing many Germans during the 1830s and 1840s and the perceived insensitivity to those crises on the part of church and state authorities.

Those materialist philosophers whom Feuerbach admired, especially Helvetius, had been highly critical of the failure of Christian authorities to act positively to improve the living conditions of the mass of humankind and had bemoaned the way in which political and clerical authorities acted together to protect their interests against the interests of the great majority. In his 1846 introduction to the first volume of his collected works, Feuerbach highlighted both the moral and the political issues and the significance of his own sensual-materialist position: "[The question is] not whether God is a creature whose nature is the same as ours but whether we human beings are to be equal among ourselves; not whether and how we can partake of the body of the Lord by eating bread but whether we have enough bread for our own bodies; . . . not whether we are Christians or heathens, theists or atheists, but whether we are or can become men, healthy in soul and

body, free, active, and full of vitality. . . . I deny God. But that means for me that I deny the negation of man. In place of the illusory, fantastic, heavenly position of man which in actual life necessarily leads to the degradation of man, I substitute the tangible, actual, and consequently also the political and social position of mankind."[20] That is, Feuerbach insisted that any account of religious beliefs had to begin from an assessment of the concrete material and social conditions of human lives. For Feuerbach, as for Schleiermacher, religion was based on man's recognition of his dependency. But according to Feuerbach, Schleiermacher had failed to recognize that theology went deeply wrong when it posited something over and above the natural world and one's fellow humans as the object of that dependency. In their imagination, theologians created a transcendent God, placing humankind in an unnecessary state of humility and subordination.

Feuerbach's was a position that had tremendous appeal to liberal and radical young people during the 1840s, when social and economic distress and inequity was an increasingly obvious fact of life and when religious institutions were often functioning as arms of the state to enforce intellectual conformity and economic injustice. Thus the young Karl Marx wrote admiringly in 1843 that Feuerbach's critique of religion "ends in the teaching that, *man is the highest being for man,* it ends, that is, with the categorical imperative to overthrow all conditions in which man is a debased, forsaken, contemptible being forced into servitude."[21] And reflecting back in 1888, Friedrich Engels wrote that after the *Essence of Christianity* appeared, "we all immediately became Feuerbachians."[22]

The failure of the 1848–49 uprisings in Germany and the reestablishment of Prussian military dominance by April of 1849 left most liberal and radically oriented intellectuals deeply discouraged. But those who built upon Feuerbach's materialist philosophy generally refused to acknowledge defeat. They constituted a cadre of optimistic opponents of traditional authority and the social status quo who almost welcomed persecution by the authorities as a sign of their own significance.

Scientific Materialism and Political Liberalism

During the early decades of the nineteenth century, the materialist philosophical perspectives associated with Laplace among physicists, Helvetius and d'Holbach among social theorists, and Cabanis, among physicians, had relatively little appeal among German academics, in part because of their identification with French culture. But immediately after the publication of Feuerbach's *Essence of Christianity,* a variety of materialistic philosophies began to develop in Germany, especially among medical and biological scientists and among social thinkers. And each form of materialism seemed to have its own political agenda and implications.

The first of these to mature, and the one most closely associated with Feuerbach's own political views, was what Frederick Gregory has called "scientific"

materialism. It is virtually certain that the principle motives for the materialist turn taken by the major scientific materialists of the 1850s, Carl Vogt (1817–95), Jacob Moleschott (1822–93), and Ludwig Büchner (1824–99), derived from the humanistic religion and from the antagonisms to an arbitrary political and religious power structure that they shared with Feuerbach, rather than from their scientific activity. All three had fathers who were liberal physicians. Vogt's father lost his academic post at Giessen in 1834 because of his association with radicals, ending up teaching at a Hochschule in Zurich. Moreover, three of Vogt's maternal uncles were either imprisoned or forced to flee Germany because of their politics. After studying with Justus Liebig (1803–73) and the physiologist, W. G. Valentin, Vogt worked for five years as an assistant to Louis Agassiz, whose increasing religiosity Vogt deplored. When Agassiz left for America, Vogt, who was persona non grata in Germany because he had helped a fellow student escape from the police, moved to Paris, where he survived by writing science articles for *Allgemeine Zeitung* and where he began writing popular science texts. In Paris he formed close associations with the Russian anarchist Michael Bakunin (1814–76) and gradually adopted a materialist scientific perspective that he identified with that of Pierre Cabanis.[23]

Moleschott's father was an agnostic Dutch physician who sent his son to a German *Gymnasium* and then to the University of Heidelberg, where he became associated first with Feuerbach's writings and then with Feuerbach himself, before he began his materialist career, criticizing Liebig's acceptance of vital forces.

Büchner's older brother, George, was a politically active dramatist, who eventually became a communist, while his younger brother, Alexander, was charged with treason when he met with exiled German dissidents while on a trip to England. In 1845, Ludwig helped establish a student political society at Giessen, promoting Vogt's election to the Frankfurt Parliament in 1848, before he wrote a materialistically oriented medical dissertation on reflex actions.[24] It seems, then, that the materialism of the major scientific materialists involved a set of commitments that they brought to their science as a consequence of broader social and political considerations. Yet it is equally certain that each presented his antagonisms to idealist philosophy, traditional Christianity, and monarchist politics as emerging out of scientific activities and knowledge claims.[25] Additionally, they collectively managed to convince themselves and many of their readers—both those who sympathized with their perspectives and those who bitterly opposed them—that materialism was a natural consequence of scientific activity.

The overwhelming majority of German scientists by the 1840s had almost certainly become fed up with religious and philosophical controversies and simply wanted to get on with their work without committing to any particular metaphysical or religious position. They had no more use for the secular dogmatism of materialism than for the religious dogmatism associated with Christian conservatives. But from the perspective of those outside the sciences, the polemical zeal of

the materialists often made it seem as if they spoke for the scientific community as a whole.[26]

If the status of science had not been rapidly on the rise in Germany during the 1840s, the materialist's appeal to scientific authority in the name of humanistic religion and liberal politics would have had little general impact, but such was not the case. At least two different trends in German culture tended to raise the status of science across the spectrum of political and intellectual positions during the period between about 1810 and 1870. First, the notion of *Bildung* (self-cultivation), which had been so deeply linked to scientific scholarship (*wissenschaft*) by Humboldt, Fichte, and other early-nineteenth-century academic reformers, persisted within the educated elite of Germany, leaving even those whose professions were associated with law and theology with a sense of the central importance of scientific methods and content. For this group, which seems to have been most powerful during the early part of the century, science was understood as something to be pursued purely for its own sake, and theoretical and observational sciences tended to be more important than laboratory and applied clinical sciences.

Alongside this largely anti-utilitarian notion of science, a second perspective, usually associated with the prominence of economic liberal bureaucrats within a given state, grew rapidly after about 1830. The key to this perspective was at least in part the growing dominance that German translations of J. B. Say's *Traite d'economie politique* had in the teaching of the cameral sciences within the German university structure. First translated as *Abhandlung Über die Nationaloekonomie, oder einfache Darstellung der Art und Weise, wie die Riechtthumer enstehen, verheilt und versehrt warden*, by L. H. Jacob in 1807, Say's work, along with that of Adam Smith, guided most economic theorizing in Germany for nearly fifty years.[27] For our present purposes, Say's insistence on the importance of industrialization and on the roles of both scientific knowledge and a technically educated cadre of entrepreneurs and workers for increasing productivity are central. Well before there was a substantial market-driven pressure toward applied science in Germany, camerally trained bureaucrats under the influence of Say were promoting practically oriented scientific education.

This emphasis occurred in part at the level of vocationally oriented *Realwissenschaften*, so that German workers would be prepared for the transition from agriculture to manufacturing, which was "the path now being taken by Civilization as a whole."[28] With one eye on the industrial advances occurring in England, for example, the Baden minister for education in 1833, C. F. Nebenius, lobbied for the construction of a technical high school in Karlsruhe.[29] But the turn to applied sciences also occurred at the university level. As a consequence, argues Arleen Tuchman, "The construction of large research institutes, financed by state governments, occurred before science and industry formed the link that came to define much of Western culture, providing an essential, if not *the* essential,

driving force for the economy."[30] During the last third of the nineteenth century, science-based industries did play a central role in Germany's rapid economic growth, but the expectation that this must occur preceded the event, and science began to *appear* as a crucial feature of German economic life nearly half a century before there is much evidence that it had become so.

As a consequence of the growing emphasis on science within both vocational and university education, the appetite for scientific knowledge grew rapidly among middle-class Germans, and during the late 1840s and 1850s, a number of new popular scientific journals came into existence. Though scientific materialists published in virtually all of these journals, two of the most popular, *Die Natur: Zeitung zur Verbreitung naturwissenschaftlicher Kenntniss und Naturanschauung für Leser alle Stande* (*Nature: a journal for disseminating natural scientific knowledge and attitudes among readers from all classes*), founded in 1852, and *Das Jahrhundert, Zeitschrift für Politik und Literatur* (*The Century: A Journal of Politics and Literature*), founded in 1856, had strongly materialist editorial policies.

Perhaps even more important for the spread of scientific materialism, the public developed a huge appetite for popular books in natural science, which the materialists exploited very self-consciously. Writing of the circumstances under which his brother Ludwig came to write *Kraft and Stoff. Empirisch-naturphilosophische Studien* (*Force and Matter*) in 1855, Alexander Büchner describes his conversation with Ludwig when Ludwig brought the manuscript to him. Alexander suspected his brother of having written a Romantic novel. Ludwig tells him that he had, instead, written a work on natural science, and then he explained why: "This kind of thing has strong appeal these days. The public is demoralized by the recent defeat of national and liberal aspirations and is turning its preference to the powerfully unfolding researches of natural science, in which it sees a new kind of opposition against the triumphant reaction. Look at Vogt, Rossmässler, and Moleschott, all of them are finding good publishers."[31]

At Alexander's recommendation, Ludwig sent *Force and Matter* to the publishing house of Meidinger in Frankfurt. Within three years it had gone through five editions. By the end of the century it had gone through nineteen German editions, and in addition, it had been translated into seventeen different languages, becoming one of the great literary successes of the century.

Force and Matter

Among themselves, the big three German-educated scientific materialists, Vogt, Moleschott, and Büchner, published no fewer than sixty-three popular scientific monographs in addition to hundreds of articles in popular scientific journals. Because Büchner's *Force and Matter* was both the most popular and most comprehensive of these works, I will let it stand as an illustration of the whole genre,

though one should be aware that there were slight differences in perspective within the group and that over time, even Büchner backed away from the extreme self confidence regarding knowledge that he displayed in *Force and Matter.*

Scientific materialism contained a strong populist and anti-intellectual element that undoubtedly enhanced its appeal to a broad audience. Thus, in the preface to the first edition of *Force and Matter,* Büchner insists, "We shall seek to present our views in a generally intelligible form and to base them on known or easily comprehensible facts, and in doing so shall avoid all those philosophical technicalities the use or rather abuse of which has justly brought all theoretical, and especially German, philosophy into discredit in the eyes of both the learned and unlearned. *It is part of the very nature of philosophy to be intellectually the joint property of all.*"[32]

Laying out the fundamental claim of the entire scientific materialist movement, Büchner promises the destruction of traditional religion and idealist philosophy alike: "Starting from the recognition of the indissoluble relation that exists between force and matter as an indestructible basis, the view of nature resting upon empirical philosophy must result in banning every form of supernaturalism or idealism from what may be called the hermeneutics of natural facts, and in looking upon these facts as wholly independent of the influence of any external power dissociated from matter. There seems to us to be no doubt about the ultimate victory of this realistic philosophy over its antagonists. The strength of its proofs lies in facts, and not in unintelligible and meaningless phrases."[33]

Linked to an insistence that the materialist perspective must ultimately triumph, in the minds of the scientific materialists, was a tremendous sense of optimism about the extent of knowledge that had already been attained, about that which remained accessible to their methods, and about the positive societal benefits of that knowledge: "We shall be able all the better to understand [the world] and to control it, the more we endeavor to know it in its infinite fineness and its incredible energy and capacity, by means of observation, of investigation, of experiment. Experience has spoken here with sufficient clearness. The scientists, unfairly decried as materialists, have not only made it possible for our mind to penetrate by thought into the All and to obtain scientific certitude on questions and things which appeared forever sealed to it; but we also owe it to them that the human race is more and more borne upwards in the mighty arms of matter, known and controlled through its laws, and that we can perform by it works and acts, which in former times seemed possible only to giants and magicians."[34]

Büchner begins his major conceptual argument by denying the Kantian identification of matter with attractive and repulsive forces. It is true, he admits, that force and matter are indissolubly connected with one another, so that no matter can be found without force and no force can be found without matter. But he goes on to draw from Hermann von Helmholtz's mechanical formulation of the principle of the conservation of energy and from the widespread mid-nineteenth-

century interpretation of heat as constituted by the microscopic motions of the particles of matter, to argue that force and matter are two distinct but intimately connected entities. "Force," he writes, "may be defined as a condition of activity, or a motion of matter or of the minutest portions of matter or a capacity thereof."[35] This slightly awkward definition follows from the mathematical expression for energy used by Helmholtz for any system of particles, $\Sigma m_i V_i^2 + \Sigma\Sigma\, Y(r_i,r_j)$, where m is the invariant mass of each particle, v is its velocity, and Y(r) is some function, now know as a potential function, which depends upon the distance, r, between each pair of particles. The principle of the conservation of energy, which had been independently articulated in slightly different forms by Julius Robert Mayer (1814–78), James Prescot Joule (1818–89), and Helmholtz between 1842 and 1847, could thus be expressed by saying that the energy of a system consisted of an invariant expression that included the summation of the motions of the particles of a system plus the potential or capacity for those particles to move by virtue of their spatial relationship to one another. Since the German word, *Kraft,* is translated by both the English term, energy, and the English term, force, the Helmholtz equation can be restated in English as the claim that the sum of the forces, or motions and capacities to move, of all bodies in a closed system is conserved throughout any change in the system. According to this principle, which was a key element in all of classical physical theory after the 1840s, then, matter and energy, or matter and force are separately and independently conserved in all phenomena.

From this basic principle Büchner immediately concluded that the universe could not have been created ex nihilo as Christian theologians claimed. Neither force nor matter can be created out of one another, so if one conceives of a pre-existent creative force as the source of the universe, there is no way that it could produce matter. Nor can either force or matter come into existence out of nothing according to the conservation of energy principle. As a consequence, Büchner insists, "The universe, or matter, with its properties, conditions, or movements, which we name forces, must have existed from eternity, or,—in other words—the universe cannot have been created."[36] Büchner could not even imagine the possibility that the law of conservation of energy was created with the physical universe and thus could not serve as a preexistent constraint on the act of creation.

In an interesting short chapter entitled, "The Value of Matter," Büchner argued that it was principally Pauline Christianity that turned people in the ancient Mediterranean world toward "that foolish conception which looks upon matter as a crude, dismal, inert something, hostile or opposed to spirit."[37] Materialism, he argued, was much more evenhanded. It did not denigrate the idea of spirit, indeed it also venerated the concept. It simply argued that "spirit can only exist on a substratum of organized matter, and that not a shadow of a proof can be brought forward to show that spirit can attain to an independent existence outside of matter."[38]

Drawing from Vogt, who in turn drew from Cabanis, Büchner offered an in-

terpretation of spirit, or psyche, that made it an emergent property of organized matter. Thus, he continued, "The simple solution of the problem [of the relationship between matter and spirit] lies in the fact that not only *physical* but *psychical* energies inhere in matter, and that the latter always become manifest wherever the necessary conditions are found, or that, whenever matter is arranged in a certain manner and moved in a certain way in the brain or nervous system, the phenomena of sensation and thought are produced in similar fashion as those of attraction and repulsion are under other conditions."[39]

Decrying all dualistic theories that set matter and spirit in any kind of opposition to one another, Büchner promoted a philosophical monism that he sometimes described as being neither idealistic nor materialistic, but rather, "simply natural."[40] In doing so, he prepared the way for the Monist religious movement of Ernst Haeckel and Wilhelm Ostwald, which was formally organized at the beginning of the twentieth century.

Turning to the issues of determinism and moral responsibility raised by Kant, Büchner begins by reiterating a position superficially similar to that taken by the Kantians. That is, he insisted on the necessity and immutability of the laws of nature. Büchner, however, argued that such an insight was not a precondition of scientific knowledge, but rather a consequence of the extended study of nature.[41] Given the immutability of natural law, there can be no room in nature for morality or compassion. Büchner quotes Feuerbach on this issue, insisting that "nature answers neither the questions nor the plaints of man; she inexorably flings him back upon himself."[42] Natural science, then, offers no warrant for the belief in a personal God who might respond to human desires or prayers by intervening in events. Indeed, it effectively precludes such a belief.[43]

Next, he proceeds to undercut the Kantian argument for a noumenal world, writing, "We are only busying ourselves with that world that is accessible to our means of intelligence, and can find no scientific reasons compelling us to believe that behind this world there is another, a higher one, independent of the influence of the laws of Nature, and perhaps arranged in an entirely different fashion. . . . *Let every one believe whatever and as much as he likes, and let his fancy have free scope where science forsakes him!*"[44]

Having turned the world of traditional religion and morality into a creation of the human fancy, Büchner proceeds to consider another key Kantian question: How does it happen that our minds are suited to an understanding of nature? Here he takes the line developed by Feuerbach, claiming that since the mind was produced by natural law it is consequently able to recognize it. "Could it be otherwise," he asks, "considering that Nature's laws have created the mind and that the same forces are at work in it which rule the world and Nature? Hence the laws of thought and of our minds must be in unison with the most recondite principles of the laws governing in Nature, and hence the laws of thought are also the laws of the universe."[45]

In what had become one of the longest chapters by the fifteenth German edition of *Force and Matter* (published in 1884), Büchner confronted the issue of teleology or design, which was so important to both natural theologians and to Idealist and Kantian, as contrasted with materialist, biologists. Well before Darwin and Haeckel, Büchner had offered an evolutionary and natural selectionist critique of teleology grounded in Lamarck's notion that organisms can transmit to their progeny characteristics that they acquire in the process of adapting to their environment; and he never abandoned this Lamarckian view, though he increasingly focused on natural selection.[46] Second, he drew on the work of Helmholtz on the human eye to point out that careful analysis of our organs of vision suggest that they are really very clumsy and imperfect optical instruments.[47]

As a counter to the purposelessness of the universe, Büchner turns once again to Feuerbach, "the philosopher, *par excellence* of emancipated and self-contained humanity," who finds purpose in the human attempt to realize its own ideal self.[48] Anthropology, or the study of man, thus becomes the highest materialist science, and the final half of *Force and Matter* is completely devoted to exploring various dimensions of human existence, beginning with the thorny question of the relationship between the brain and the mind. In this connection, Büchner reviews the huge anthropometric, physiological, and biochemical literature correlating physical and chemical features of brain structure and function with notions of "intelligence" and mental health, repeating all of the purported evidence that supported belief in the mental inferiority of non-Europeans[49] and of the lower classes within Europe.[50]

It is in these sections on the physiological foundations of class and racial differences that Büchner most clearly separated himself from the more radical dialectical materialists. Like many liberal reformers, Büchner detested social injustices. He was a co-founder of the *Deutscher Bund für Bödenreform* (the German Confederation for Agrarian Reform), and he served as a liberal in local and regional governmental bodies for fifteen years. But he was not a believer in equality, nor did he believe in coercive social programs, such as those promoted by the communists and Social Democrats.[51]

Like the Parisian physiologists Cabanis and Bichat at the beginning of the century, Büchner admitted, for the most part, that he could not explain *how* mental phenomena arise from physical and chemical processes in the brain. "It is quite sufficient," he insisted, "to have proved by facts the necessary, indissoluble and normal connection between the brain and the mind."[52] Similarly, when he turned to discuss the special mental phenomenon of consciousness, he wrote: "How and in what way the atoms, nerve cells, or, to speak generally, matter, began to produce and bring forth sensation and consciousness, is quite unimportant for the purpose of our investigation; *it is sufficient to know that such is the case.*"[53] Yet he could not always rest satisfied with the convincing claim that mental events are correlated with physical ones, and in a chapter on "thought"

he pressed on to claim that thought, or "psychical activity," was nothing other than "a particular manifestation of that great, universal, and simple natural force which sustains the eternal cycle of energies, revealing itself now as mechanical, now as electrical, now as mental force."[54] This notion that "psychic" energy was just another form of energy that had to be conserved unless transformed into another typical form seems to have been widely accepted among German materialists, and it played a major role in shaping Sigmund Freud's (1856–1939) theories of mental functioning.

Like the major works of the other scientific materialists, Büchner's *Force and Matter* was only indirectly political. Its major themes celebrated the ongoing triumphs of empirical science and claimed that the implications of that science were generally anti-authoritarian, anti-theological, and anti-idealist, but it stated no positions with respect to party politics.

Tactical Materialism, "Organic Physics," or Physiological Reductionism in the Service of the State

The aggressively anti-religious stance of the scientific materialists had little or no significant impact on the research practices of German scientists, but there was a more limited form of materialism that did. This form also spread into popular scientific literature, and it had a major impact on German governmental policies toward scientific research. Without seeking initially to explore the broad philosophical implications of their position, advocates of what came to be called "organic physics" focused on investigating physiological processes as if they were completely understandable in chemical and physical terms. As early as 1842, Emil Du Bois-Reymond (1818–96) wrote that he and a fellow student, Ernst Brücke (1819–92), in Johannes Müller's Berlin physiological laboratory, pledged to act as if the following statement were true: "No other forces than the common physical-chemical ones are active within the organism. In those cases which cannot at the time be explained by these forces, one has either to find the specific way or form of their action by means of the physical-mathematical method or to assume new forces equal in dignity to the chemical-physical forces inherent in matter, reducible to the forces of attraction and repulsion."[55]

Soon Du Bois-Reymond and Brücke were joined by another Müller *protégé*, Hermann von Helmholtz, and by Carl Ludwig (1816–95) from Marburg. Though it is probably not true that their views dominated German physiology in the second half of the century, it is certainly true that the research programs of the organic physicists constituted a serious and substantial segment of mainstream German biology.[56] It is even more true that the efforts of this group played a major role in generating the public and governmental support that made the German university system the center of experimental and clinical scientific research in the second half of the nineteenth century.

Like the scientific materialists, this group tended to be strongly opposed to *Naturphilosophie* and the idealism with which it was associated. Unlike the scientific materialists, however, they tended to be either silent about religious and political issues or openly orthodox and conservative. In part for this reason, and in part because they tended to be more philosophically sophisticated, these organic physicists or physiological reductionists sought to distance themselves from scientific materialists as much as from those influenced by *Naturphilosophie,* identifying both perspectives as fundamentally metaphysical rather than scientific. Thus, argued Helmholtz:

> There are two characteristics . . . which metaphysical systems have always possessed. In the first place man is always desirous of feeling himself to be a being of a higher order, far beyond the standard of the rest of nature; this wish is satisfied by the spiritualists [idealists]. On the other hand, he would like to believe that by his thought he was unrestrained lord of the world, and of course by his thinking with those conceptions, to the development of which he has attained; this is attempted to be satisfied by the materialists.
>
> But one who, like the physician, has actively to face natural forces which bring about weal or woe, is also under the obligation of seeking for a knowledge of the truth, and of the truth only; without considering whether what he finds is pleasant in one way or the other. His aim is one which is firmly settled; for him, the success of facts is alone decisive.[57]

There is something ironic about this passage as it relates to the scientific materialists, for in their public roles, the organic physicists became much more vocal apologists for the uses of science in manipulating the world than any of the scientific materialists had been. At its origins organic physics had relatively little to do with social applications, but over time both Du Bois-Reymond and Helmholtz became formulators of and spokespersons for Baden and Prussian scientific policy respectively, and they increasingly emphasized the central role of science in industrialization in order to promote state support for scientific research. By 1862, when he became rector of the University of Heidelberg, Helmholtz chose the importance of applied science as the theme of his inaugural address. "Knowledge is power," he insisted, "and no age has been in a better position to realize it than the present one. . . . Even the proudest and least cooperative absolutists states have had to acknowledge that the power of the state rests on its wealth, which depends on command over the forces of nature and their application to agriculture, industry, and transportation. . . . No nation which wants to remain independent and influential can fall behind in the task [of developing knowledge of the natural sciences and their technical application]."[58]

Nothing else that I can think of, however, approaches Du Bois-Reymond's *Kulturgeschichte und Naturwissenshaft* (*Natural Science and the History of Culture*) of 1878 in its praise of material progress and its linkage of that progress to natural science:

> Wherever something to be physically achieved remains withheld from man, there the calculus of his spirit presses forward with its magic Key. . . . What the wishing wand did by magic, geology freely performs: freely it brings forth water, salt, coal, petroleum. The number of metals continues to increase, and though as yet, chemistry has not found the philosopher's stone, tomorrow perhaps it will. For the present it vies with organic nature in the production of the useful and the pleasing. From the black, stinking heaps of refuse, which turn every city into a Baku, it borrows the colors by comparison with which the magnificence of tropical feathers turns pale. It prepares perfumes without sun or flowers. Has it not even solved Samson's riddle, how to make sweet things out of loathsome material?
>
> Gay-Lussac's preserving art has not merely wiped out the difference between the seasons on rich men's tables. The poison monger sees with angry despair his tricks unmasked. The scourges of smallpox, plague, scurvy are under control. Lister's bandage protects the wounds of soldiers from the entrance of deadly germs. Chloral spreads the wings of God's sleep over the soul in pain, indeed chloroform laughs, if we wish, at the biblical curse of womanhood.
>
> So were Bacon's prophetic words fulfilled: *Knowledge is power. All the peoples of Europe, of the Old and the New Worlds, travel along this road. . . . If there is one criterion which, for us, indicates the progress of humanity, it is. . . . the level attained of power over nature.*[59]

These statements by Helmholtz and Du Bois-Reymond are consistent with the claim made by Timothy Lenoir that the organic physicists, in fact, played a major role in formulating a new ideology grounded in the satisfaction of material interests and that between the late 1850s and the 1870s, they "were among the leading spokesmen of the rising industrial bourgeoisie."[60]

There is a sense in which the reductionist presumption of the organic physicists was as much an imposition on *their* science as that of the scientific materialists was on *their* understanding of science. But generally speaking, the organic physicists imported their reductionist tactics for reasons linked to their research careers rather than for reasons related to broader social issues. Helmholtz offered a particularly candid discussion of how he became committed to organic physics in an autobiographical address that he gave when he was seventy years old. As a student in the *Gymnasium* where his father was a relatively poorly paid teacher of German literature, Helmholtz had become fascinated with optics, rational mechanics, and mathematics. But when it came time for him to go on to study at a university his father and family dissuaded him from following his inclination to study physics on the grounds that it offered very poor job prospects. Instead, he was convinced to train in medicine at state expense at the Friedrich Wilhelm Institute for the Education of Army Surgeons in Berlin. Medical training involved at least some scientific background, it virtually guaranteed employment, and it saved the family money.

In Berlin, Helmholtz worked in the institute library, where he began on his

own to read mathematical physics through the classic papers of the Bernoulli's, D'Alembert, and so on. As a consequence of considering how various forces would have to be related to one another in order that perpetual motion might be possible, Helmholtz wrote his famous 1847 paper, "Über die Erhaltung der Kraft," on the conservation of energy, using the basic strategies of eighteenth-century rational mechanics. At the same time, he began to study physiology formally, and it soon became obvious to him that his knowledge of physics gave him a real competitive advantage among physiologists and medical students: "I ascribed my success in great measure to the circumstance that, possessing some geometrical capacity, and equipped with a knowledge of physics, I had, by good fortune, been thrown among medical men, where I found in physiology a virgin soil of great fertility; while, on the other hand, I was led by the consideration of vital processes to questions and points of view which were usually foreign to pure mathematicians and physicists."[61]

One of his first attempts to exploit his physical knowledge for physiological purposes involved the invention of the ophthalmoscope, an instrument for observing the retina of the eye, which depends for its functioning on an understanding of the optical properties of the eye. This instrument was so successful in generating recognition for Helmholtz that he quite self-consciously decided to "establish and maintain my reputation as an investigator," by applying physical principles to physiological problems. Helmholtz's commitment to organic physics was thus based principally on a pragmatic judgment that he could parlay his unusual combined background in physics and medicine into a successful scientific career.

Once he had established an assured position in this way, Helmholtz admitted, his commitment to a physicalist approach to living systems continued to intensify, at least in part for simple psychological reasons. "The ideas of an individual," he wrote, "which he himself has conceived, are of course more closely connected with his mental field of view than extraneous ones, and he feels more encouragement and satisfaction when he sees the latter more abundantly developed than the former. A kind of parental affection for such a mental child ultimately springs up, which leads him to care and to struggle for the furtherance of his mental offspring as he does for his real children."[62]

If Helmholtz's advocacy of organic physics seems by his own admission to have been driven to some degree by opportunism and psychological processes more than by any objective intellectual justification, that of Du Bois-Reymond, who was the chief organizer and entrepreneur among the organic physicists, was even less grounded in matters of intellectual principle, if one can believe the analysis of Timothy Lenoir.[63] Lenoir sees Du Bois-Reymond's rebellion against vitalist and teleological perspectives as a calculated move to achieve career advancement unjustified even by the kind of predisposition for physics that Helmholtz began with. Prior to 1842, Du Bois-Reymond had shown substantial interest in Hegel

and Schelling, and he may have been drawn to Müller's laboratory precisely because of the latter's lingering tendencies toward teleology and vitalism.

Since Müller was deeply involved in university administration, he depended heavily on assistants in running the lab, and these assistants tended to be hypercritical of the younger students, who they sometimes recognized as intellectually superior and who they saw as potential competitors for any jobs that might be opening up. When Du Bois-Reymond arrived in Berlin, an extremely ambitious young man in 1840, he took up the tradition of embryological studies that was one of the early lines of research developed by Müller, and one that remained most closely linked to teleological issues. Carl Reichert, a senior graduate student who directed the laboratory's work in this area, was severely critical of Du Bois-Reymond's work, claiming that he did not "know how to think in the spirit of nature."[64] The dejected young man decided that if he was to succeed as a physiologist, he would have to move into a completely new field. Following another suggestion of Müller's, he took up a neurophysiological problem, the question of how certain electrical fishes manage to produce electrical discharges. In order to get support in learning the physics that he would need to take up his new subject, Du Bois-Reymond formed a scientific club, the forerunner of the Berlin Physical Society, along with Ernst Brücke and three other interested graduate students.

It turned out that Du Bois-Reymond was brilliant at developing instrumentation for detecting very small charges and currents in living tissues without being so intrusive that normal functioning was greatly distorted, so he was able to achieve significant new results on a number of electrophysiological problems. But now he and those who joined him, such as Brücke, faced a new problem. The dominant German traditions in physiology were embryological and morphological. How could the new upstarts convince others that their chemical and physical approaches were important enough to deserve support and to command academic appointments?

It was in this connection that Du Bois-Reymond's entrepreneurial, oratorical, and literary talents came in to play. And it was in connection with seeking patronage for his new discipline that Du Bois-Reymond focused on cultivating support for his kind of experimental science outside of the academic power structure, both among younger academics and among those outside of the university who were promoting industrialization and material progress. He did manage to convince the professor of physics at Berlin, Gustav Magnus, that physiological problems opened up a new and promising domain for physical investigation, and he recruited Magnus to become the single professor to join in establishing the Physical Society of Berlin in 1845. Moreover, he marshaled an additional fifty-three members, twenty-two of whom were reform-minded *Privatdozenten,* including Gustav Kirchoff and Hermann von Helmholtz, and the rest, military engineering officers (including Werner Siemens), instrument makers, and mechanics-ambitious men who were all interested in industrial entrepreneurship.

In 1858, partly because of his research successes, partly because of the support that members of the Physical Society were able to mobilize, and partly because of his growing reputation as a lecturer, Du Bois-Reymond succeeded Müller as professor of physiology at Berlin. Then from within that position he managed, with the help of Rudolph Virchow, to orchestrate a reform of the medical examination system, replacing the old examination on philosophy with a new examination on the physical sciences that focused on chemistry, physics, and experimental physiology. Thus the organic physics approach to physiology became a prerequisite for medical licensing, and enrollments grew.

Throughout the 1860s, wherever and whenever liberal attitudes prevailed, the organic physicists hitched their wagon to the cause of material progress and to the claim that scientific research was the engine that would drive increases in agricultural and industrial productivity, as well as in public health. Helmholtz, for example, provided leadership for academic reform in Baden, where state support for laboratory and clinical facilities grew rapidly through the 1860s. Du Bois-Reymond supported the anti-militarist policies advocated by the *Deutches Forscrittspartie* in Prussia between 1862 and 1866, when it seemed as if the advocates of a constitutional state committed to material and intellectual progress through science were ascendant. When it became clear to Du Bois-Reymond that Bismarck's monarchist-militarist policies would prevail, however, he remained true to his long-term principle: do anything to promote the discipline of organic physics. He became the chief academic spokesman for Bismarck's policies. Returning to the *volkish* rhetoric of Fichte, in major speeches during 1869 and in August of 1870, at the very beginning of the Franco-Prussian War, Du Bois-Reymond praised the Prussian military as the chief agent of that German unification that had long been sought, arguing in direct contradiction to his claims of two decades earlier, that it had been able to accomplish "what our railroads and telegraphs, our trade and industriousness, our laboratories and institutes of natural science could not achieve."[65]

On October 6, 1870, Otto von Bismarck wrote to Du Bois-Reymond expressing gratitude for his support and especially acknowledging the impact that his speeches had in convincing the English that the German attacks on France were "a great moral and national uprising against an unwanted enemy attack."[66] Within three months, Du Bois-Reymond had applied to the cultural minister of the new unified Germany to build the most expensive scientific research institute ever constructed. By the end of August, 1871, the first installment of funding had been approved.

None of this story is intended in any way to discount the real scientific achievements of the organic physicists or to suggest that they were not genuinely fascinated by the topics they explored and convinced that their physicalist program offered the most promising approach to studying them. Nor is it intended to deny that their promises that experimental science could provide a driving force

for increasing agricultural production, industrial production, or military power contained a substantial grain of truth. It does, however, suggest that these arguments were less than completely disinterested and that they were often even self-consciously aimed primarily at increasing the status and resources of their own academic discipline. It is certainly true that the organic physicists managed to insinuate themselves within the structures of both academic and state power and that they used their positions to elevate the status of not just their particular approaches to science and scientific education, but of science and scientific education in general.

Dialectical Materialism, Marxism, and Scientific Socialism

The third form of nineteenth-century German materialism, which the Russian Marxist, G. V. Plekhanov (1856–1918), dubbed "dialectical materialism" in 1891, was less directly involved in the practices of mid-nineteenth-century natural scientists than either of the other two, although its proponents certainly understood it to be scientific and it did eventually come to play a role in directing the scientific activity of Soviet scientists in the twentieth century.[67] One could, however, make a strong case that it has played a substantially greater cultural role than either scientific materialism or the tactical materialism of the organic physicists. Through its incorporation into the corpus of Marxist thought, it became part of the theoretical backbone of almost all working-class political movements and radical revolutionary movements from the late nineteenth through the late twentieth centuries. Moreover, it played a key role in the formulation of much modern social scientific theory. This form of materialism, which its formulators, Friedrich Engels and Karl Marx, variously identified as "new," or "modern," materialism, grew up, like scientific materialism, as an extension of Ludwig Feuerbach's views. But instead of renouncing the Hegelian elements in Feuerbach, it actually amplified them and tried to link them to recent developments in the mathematical and natural sciences.

Neither Marx nor Engels had formal academic training as a scientist, but both to some degree, and Engels to a very great degree, educated themselves in mathematics and the natural sciences. In the second edition of his *Anti-Dühring* in 1885, Engels describes the commitments to dialectical logic, to materialism, and to a detailed understanding of contemporary science that went into the formulation of dialectical materialism: "Marx and I were pretty well the only people to rescue conscious dialectics from German idealist philosophy and apply it to the materialist conception of nature and history. But a knowledge of mathematics and natural science is essential to a conception of nature which is dialectical and at the same time materialist. Marx was well versed in mathematics, but we could only partially, intermittently, and sporadically keep up with the natural sciences. For this reason, when I retired from business and transferred my home to London,

thus enabling myself to give the necessary time to it, I went through as complete as possible a 'moulting' as Liebig calls it, in mathematics and natural sciences, and spent the best part of eight years on it."[68]

In the division of labor between the two close collaborators, Marx and Engels, it was Engels who wrote most extensively on issues of dialectical materialist scientific method, especially as they pertained to the natural sciences. Marx concentrated on providing the social scientific foundations for the policies that he promoted for the various working-class revolutionary organizations that he and Engels provided leadership to over a nearly forty-year period. The two men worked closely, however, and not only did Marx read over and approve Engels's writings on scientific method as long as he lived, he implicitly and, less frequently, explicitly, incorporated dialectical materialist methods into his social analyses. Moreover, there is an extremely important sense in which the basic elements of what later became dialectical materialism informed all of Marx's writings, beginning with his dissertation, *On the Difference between the Democritean and Epicurean Philosophy of Nature,* which was completed in 1839. In that work Marx unambiguously committed himself to a materialist philosophy based on that of Epicurus, but informed by Hegelian logic.

It was extremely important to Marx, to Engels, and to subsequent nineteenth- and early-twentieth-century Marxists that dialectical materialism be understood to accurately reflect the best in contemporary scientific practice and that Marx's social investigations be understood to be rigorously scientific. This is so because it was on the basis of their claims to be providing objective, scientific assessments of the situation that Marx and Marxists were able to wrest leadership of the working-class movement from anarchist elements lead by Michael Bakunin, from charismatic figures such as Ferdinand LaSalle (1825–64), from established and venerated revolutionaries, such as Pierre Proudhon (1809–65), and from a host of other utopian visionaries who hoped to bring about liberal reforms and radical improvements in the living and working conditions of the laboring poor without the necessity of violent revolution.

Over and over again, Marx lashed out viciously at leaders of factions within the working-man's movement with whom he shared many basic goals, but whom he identified as promoters of policies that were unworkable and unrealistic because they were based on an inadequate understanding of the conditions that the proletariat faced. In an attack on Proudhon, whom Marx actually had substantial respect for, he articulated this position particularly clearly: "It is not enough to desire the collapse of these forms [the social forms that lead to the oppression of working people], one must know in obedience to what laws they came into being, in order to know how to act within the framework of these laws, since to act against them, whether deliberately or not, would be a futile and suicidal act and would, by creating chaos, defeat and demoralize the revolutionary class, and so prolong the existing agony."[69]

One consequence of Marx's tendency to attack virtually all of his fellow radicals, except for Engels, who showed no open need for independence, was that he eventually alienated nearly everyone with whom he worked. Bakunin, an early associate in Paris during the 1840s, ended up viewing Marx as "malicious, vain, quarrelsome, intolerant and autocratic . . . and insanely vindictive,"[70] and this seems to have been a widespread assessment. On the other hand, Marx and Engels were successful in using their claims to a uniquely objective perspective to eliminate opposition and to gradually unify proletarian movements around Marx's interpretation of history and his policies. Thus, when the Second International Workingman's Party was established in 1889, it was completely dominated by self-professed Marxists, although this did not mean that there wasn't internal conflict among variant interpretations of Marxism.

Like Positivism, with which it shared more than Marx or many of his successors would have been inclined to admit, Marxism has been understood differently by virtually every interpreter. And like Comte's, Marx's writings are often divided into earlier and later periods, with serious debate about how much continuity there was across the divide. In Marx's case, however, the earlier writings have a more humanistic cast, while the later are more scientific or scientistic, whereas the opposite was true for Comte. Furthermore, in Marx's case, there is little question that throughout most of the nineteenth and early twentieth centuries, it was the later, scientistic, Marx, as interpreted by Friedrich Engels, who was vastly better known and more important. In fact, the bulk of Marx's writings that predated the *Communist Manifesto* of 1848, were not published until the late 1920s and early 1930s. As a consequence, only in the twentieth century were the more humanistically oriented early writings widely disseminated and attended to. In what follows, though I will refer to some of the earlier writings to establish a background, my major focus will be on "scientific" Marxism as it appeared in *Capital*, as it was presented by Engels, and as it was understood by both the members of the First International and by the first generation of Marxist disciples, including Karl Kautsky (1854–1938), G. V. Plekhanov, and V. I. Lenin (1870–1924), who led the Second International and who guided the Russian Revolution.

Lenin was fond of saying that Marx's great accomplishment was in synthesizing elements from classical German philosophy, classical English political economy, and French socialism and revolutionary doctrines into a single coherent system.[71] This seems to be an accurate and almost universally acknowledged assessment, though different interpreters might assign the various elements differing levels of importance. There can be relatively little doubt that in terms of Marx's temporal development, French socialist elements preceded and continued to inform his reactions to German philosophy, to revolutionary rhetoric, and to political economy.

Marx was born at Trier in the Rhineland, May 5, 1818. His father, Heinrich (b. Herschel) had officially converted from Judaism to Lutheranism in 1817 in order to continue to practice law following the passage of Prussian anti-Jewish legislation in

1816. But Heinrich's religious sympathies seem to have been most consistent with the universalist and humanitarian emphases of the Saint-Simonian New Christianity, which spread in Germany during the early 1830s.[72] Karl's few extant *Gymnasium* exercises suggest that his own views were similarly shaped. In an essay on choosing a profession, for example, the young Marx emphasized "the good of mankind and our own perfection," and argued on the one hand that our choices are already limited by the social relationships that we find ourselves in and on the other that our choices should reflect the talents that we possess—all themes consonant with Saint-Simonian views.[73] More illuminating was his response to an examination question that asked him to "demonstrate, according to the Gospel of Saint John, XV, 1–14, the reason, the nature, the necessity, and the effects of the union of believers with Christ." Completely avoiding biblical references or the writings of any Christian theologian, Marx offered a historical discussion of the gradual development of human morality in which the Christian doctrine of unification in Christ plays an important and progressive but transient role on the way to a more universalist morality.[74] In a way, the most remarkable thing about this essay is that the examiner found its completely heterodox views worthy of a pass, though he did complain about the lack of specifically religious arguments.

Later in his career, Marx distanced himself from what he increasingly viewed as the sentimental moralizing tone of Saint-Simon and his own youthful essays. Indeed, in *The German Ideology,* which was written in 1846, after he had identified himself with communism, he insisted that "communists do not preach *morality* at all."[75] As he became more sophisticated with respect to political economy, he also gave up on the Saint-Simonian hope for an end to class conflict through inter-class cooperation and chided the Saint-Simonian socialists for their utopian views. Furthermore, Marx later viewed Saint-Simonian efforts to provide evidence for their views as dilettantish. Nonetheless, a number of key elements of subsequent Marxist doctrine almost certainly found their initial appropriation via Saint-Simon or his followers. The emphasis on an economic foundation upon which political and intellectual superstructures are constructed; the focus on class conflict as a mechanism for historical change; the identification of a series of great historical stages, including ancient, feudal, modern, and future, the first three of which find themselves undermined by changes in modes and relations of production that were nurtured within them; the argument that particular developments must be evaluated in terms of their roles in a particular developmental context—all of these are to be found in the Saint-Simonian corpus, and, if we are to believe Marx's 1859 preface to his *A Contribution to the Critique of Political Economy,* they continued to guide his studies. Thus, he wrote:

> The general conclusion at which I arrived, and which, once reached, became the guiding principle of all my studies can be summarized as follows. In the social production of their existence, men inevitably enter into definite relations, which are independent of their will, namely relations of production appropriate

> to a given stage in the development of their material forces of production. The totality of these relations of production constitutes the economic structure of society, the real foundation, on which arises a legal and political superstructure and to which correspond definite forms of social consciousness. . . . It is not the consciousness of men that determines their existence, but their social existence which determines their consciousness. At a certain stage of development, the material productive forces of society come into conflict with the existing relations of production or . . . with the property relations within the framework of which they have operated hitherto. From forms of development of the productive forces, these relations turn into their fetters. Then begins an era of social revolution. The changes in the economic foundation lead sooner or later to the transformation of the whole immense superstructure. . . . In broad outline, the Asiatic, ancient, feudal and modern bourgeois modes of production may be designated as epochs marking progress in the economic development of society. The bourgeois mode of production is the last antagonistic form of the social process of production—antagonistic not in the sense of individual antagonism but of an antagonism that emanates from the individual's social conditions of existence—but the productive forces developed within bourgeois society create also the material conditions for a solution to this antagonism. The prehistory of human society accordingly closes with this social formation.[76]

There is one further link between Saint-Simonianism and Marx's work that is tremendously important: that is the value that they both place on human self-actualization through labor. We saw in chapter 2 that Saint-Simon proclaimed that his highest goal was to encourage the creation of a society in which every individual would have the maximum opportunity to develop his or her own faculties through rewarding labor. Similarly, as we shall see below, one of the most persistent driving themes of Marx's work is not simply that workers are in some sense "robbed" of much of the exchange value of their labor, but more importantly, that capital exercises a "despotic" control over the laborer and turns work into a process that is intrinsically unrewarding, because not self-directed. This issue is articulated most clearly in *The German Ideology*, written around 1846, in a section in which Marx explains why the existence of a true community rather than a mere state is so important: "Only within the community has each individual the means of cultivating his gifts in all directions; hence personal freedom becomes possible only within the community. In the previous substitutes for the community, in the state, etc., personal freedom has existed only for the individuals who developed under the conditions of the ruling class, and only insofar as they were individuals of this class. The illusory community in which individuals have up till now combined always took on an independent existence in relation to them, and since it was the combination of one class over against another, it was at the same time for the oppressed class not only a completely illusory community, but a new fetter as well. In the real community the individuals obtain their freedom in and through their association."[77]

It is certainly true that all of the elements discussed above could have been found outside of the Saint-Simonian tradition, for the general sense that laws, politics, and intellectual life constitute a superstructure built upon the economic foundations of society had become commonplace during the second half of the eighteenth century both within the tradition of philosophical history flowing from Montesquieu, Turgot, Adam Smith et al., and within the French materialist tradition flowing from Helvetius.[78] The focus on the claim that labor should be self-fulfilling was present in the works of Smith and Ferguson and it was highlighted by the Ideologues, De Tracy, and Say, as well as by such Saint-Simonian contemporaries as Charles Fourier. Moreover, Marx's interpretation of historical change, with its emphasis on the notion that forces for change emerged from within any given social and economic structure, and with its insistence on the context dependency of value, was certainly reinforced by, if it did not originate in, his study of Hegel. Nonetheless, even though Marx seems to have been temperamentally unable to acknowledge his intellectual debts, Engels was inclined to emphasize the Saint-Simonian background of Marxist doctrine, writing in his *Anti-Dühring*, "In Saint-Simon we find the breadth of view of a genius, thanks to which almost all of the ideas of later socialism which are not strictly economic are contained in his works in embryo."[79]

Like Saint-Simon, Marx was also convinced that the detailed laws that are obeyed by society could only be discovered from the historical record. By sometime in the spring of 1850, he had decided to produce a detailed historical study of the processes by which the capitalist system of production and social relations had come into existence and by which it would surely self-destruct. Marx worked on *Capital* for nearly twenty years, interrupted by periods of journalistic and narrowly targeted polemical writing. By the time the third and final volume had been edited by Engels after Marx's death, it had reached nearly three thousand pages and constituted what Isaiah Berlin has characterized as "the most formidable, sustained and elaborate indictment ever delivered against an entire social order, against its rulers, its supporters, its ideologists, its willing and unwilling instruments, against all whose lives are bound up with its survival."[80]

Marx was obsessed with regard to the scientific validity of his analyses in *Capital,* so before we turn to its content, which involved a critical revision of classical political economy as well as a prediction of the imminent collapse of capitalism and the consequent triumph of the proletariat, we should consider its method, which brings us to the role of German philosophy and Hegelian dialectic. When Marx left the local *Gymnasium,* he entered the Law faculty at Bonn, largely because of parental pressure. After two years, he left for Berlin to study philosophy in spite of his father's qualms. Hegel had been dead for half a decade, and the young Hegelians, led by Bruno Bauer and David Strauss, were in the ascendant.

Marx was repelled by the speculative idealist side of Hegelianism, and he shared

with Feuerbach an emphasis on the need to keep scientific theorizing closely controlled by an extensive experience of the phenomena being theorized about. "Those who dwell in intimate association with nature and its phenomena," he wrote at the beginning of his doctoral dissertation, "grow more and more able to formulate, as the foundations of their theories, principles such as admit of a wide and coherent development: while those whose devotion to abstract discussions has rendered unobservant of the facts are too ready to dogmatize on the basis of a few observations."[81] In part because the materialists of antiquity laid claim to being among the first to fuse empiricism with theoretical attempts to understand the hidden causes of phenomena, Marx chose to write his doctoral dissertation on the differential ethical implications of the systems of the two great classical materialists, Democritus and Epicurus. But Marx was also impressed by Hegelian dialectical logic and its emphasis on historical development: thus, his attempt to fuse materialism with dialectical principles.

In this fusion, one other element, probably derived from *naturphilosophisch* sources, is significant in Marx's own attempts to distinguish his materialism from the merely mechanical materialism associated with such figures as Descartes in the seventeenth century. Like Epicurus, Marx insists that motion is a quality inherent in matter, but he understands "motion" in a particularly expansive way: "Among the qualities inherent in matter, motion is the first and foremost, *not only in the form of mechanical and mathematical motion, but chiefly in the form of an impulse, a vital spirit, a tension—of a 'Qual,' to use a term of Jacob Bohme's—of matter. The primary forms of matter are the living, individualizing forces of being inherent in it and producing the distinctions between the species.*"[82] For Marx, then, as for the empiricist physiologists who had been inspired by *naturphilosophisch* ideas, material entities contained within themselves special forces that guided their temporal development. Nearly simultaneously, Friedrich Engels was studying *Naturphilosophie* and Hegelian philosophy on his own and coming to similar conclusions, although Engels remained much more openly sympathetic to the goals and methods of *naturphilosophisch* science than Marx. Indeed, in his first substantial exposition of dialectical materialism, *Anti-Dühring*, he wrote that, "the *Naturphilosophen* stand in the same relation to consciously dialectical natural science as the utopians [such as Saint-Simon] to modern communism."[83]

Given Engels's favorable understanding of the historical role of utopian socialism, though he viewed it as retrogressive since the rise of Marxist, "scientific" socialism, we can reasonably take this as a favorable comment on the historical role of *Naturphilosophie*. He was quick to admit that *Naturphilosophie* "contains a great deal of nonsense and fantasy." But, he continued, "that there was also in it much that was sensible and rational began to be perceived after the theory of evolution became widespread."[84] Especially important in stimulating dialectical understanding, for example, was the *naturphilosophisch* emphasis on polarities

and the way in which opposites came together in such a way as to destroy one another in the process of creating a qualitatively new entity. Similarly, according to Engels, the *natuphilosophisch* insistence on transformations, metamorphoses, and the significance of change over time were all critical notions that, incorporated into dialectical materialism, helped to distinguish it from the crude and static "vulgar itinerant-preacher materialism of a Vogt and a Büchner."[85]

In both the *Anti-Dühring* of 1878 and *Dialectics of Nature,* which was written between 1873 and 1883 (though only published in 1925) Engels laid out what he viewed as the three central "laws" of dialectical logic articulated by Hegel, and purported to show how they could be "abstracted" from natural phenomena and human history. These laws are

> The law of the transformation of quantity into quality and vice versa;
> The law of the interpenetration of opposites; [and]
> The law of the negation of the negation.[86]

In *Anti-Dühring,* Engels purports to show for each of these laws how it is derivable from natural phenomena, how it is illustrated in some human or social phenomenon that is not related to Marxism, and then how it is utilized by Marx within the structure of *Capital.* For example, in discussing the law of the transformation of quantity into quality, Engels discusses phase transformations from ice to liquid water to steam, in which "merely quantitative changes of temperature bring about a qualitative change in the condition of the water." Then he discusses the several series of compounds of carbon, hydrogen, and oxygen, in which "we have a whole series of qualitatively different bodies formed by the simple quantitative addition of elements." Turning to human phenomena, Engels cites Napoleon's observation about combat between the French cavalry, which was well disciplined but lacked very highly skilled riders, and the Mamelukes, who lacked discipline, but were superb horsemen. According to Napoleon, whenever three Frenchmen met two Mamelukes, the Mamelukes always won, one hundred Mamelukes and one hundred Frenchmen usually fought to a draw, three hundred Frenchmen could usually beat three hundred Mamelukes, and a thousand Frenchmen could always defeat fifteen hundred Mamelukes. Thus, simply changing the scale of the confrontation between French and Egyptian cavalry changed the outcome of the confrontation. Finally, Engels pointed out that for Marx, a "minimum sum of exchange values was necessary to make possible its transformation into capital," and "the cooperation of a number of people . . . creates a new power, which is essentially different from the sum of [their] separate forces."[87]

The law of the negation of the negation is particularly clear in successive transformations of energy from one form into another or in the production of new life from the decay products of the old, and it is an absolutely essential characterization of the historical process by which capitalist production—itself the negation

of petty bourgeois production—creates the conditions for its own destruction. In Marx's words, "Capitalist production begets, with the inexorability of a process of nature, its own negation. It is the negation of the negation."[88]

One might reasonably complain, as Dühring did, that the basic dialectical generalizations or laws are so vague and nonspecific as to be virtually useless for establishing any particular historical claim. But such a complaint would, according to Engels, suggest that the function of dialectical laws has been misunderstood. In characterizing the process by which capitalism will destroy itself as the negation of a negation, Engels argues, Marx does not seek to demonstrate the historical necessity of the process. "On the contrary," Engels insists, "it is only after he has proved from history that in fact the process has partially already occurred . . . he in addition characterizes it as a process which develops in accordance with a definite dialectical law."[89] That is, the assumption of dialectical laws does not play a role in *establishing* the particular claim regarding capitalism's self-destructive course. However, the fact that the claim happens to be formulatable as a particular case of a general dialectical law reinforces our assurance that it is correct.

One final issue should be addressed before moving to some of the central arguments of *Capital.* That issue involves the tension between the determinist implications of scientific knowledge and the notion of human agency and urgency that pervades Marx's writings. Such a tension is, of course, not unique to Marx and Marxism. It is implicit in every claim, materialist, Positivist, or otherwise, which sees scientific knowledge as a foundation for action in and manipulation of the world. If the phenomenal world is truly and absolutely deterministic, there can be no effective way for us to influence its course. But this tension seems highlighted in Marxism because advocacy and claims to objectivity are both so passionately promoted.

I have already insisted upon the extent to which Marx and Engels used the claim that their opponent's policies were not predicated on an accurate understanding of social conditions and dynamics as a bludgeon against enemies within the workingmen's movement. This position was closely linked to their insistence that historical developments are inevitably driven by impersonal forces associated with economic interests and class identities rather than, as in the Hegelian case, by the ideas of World-Historical individuals. At the same time, both Marx and Engels violently rejected the view, often later associated with Darwin, that consciously guided action in the world was impotent. In the eleventh of his "Theses on Feuerbach," Marx articulated his frustration with philosophers in general on this issue by writing: "The philosophers have *interpreted* the world in various ways; the point, however, is to *change* it."[90] And in the third of his theses, he specifically criticized materialist philosophy as it had developed through the writing of Feuerbach: "The materialist doctrine that men are the product of circumstances and that, therefore, changed men are products of other circumstances and changed upbringing forgets that circumstances are changed precisely by men. . . . The coincidence of the chang-

ing circumstances and of human activity can only be conceived and rationally understood as revolutionizing practice."[91] Similarly, in one of the few passages in which Engels shows anything but unqualified admiration for the application of Darwinian insights to human social development, he writes: "Darwin did not know what a bitter satire he wrote on mankind, and especially on his countrymen, when he showed that free competition, the struggle for existence, which the economists celebrate as the highest historical achievement, is the normal state of the *animal kingdom.* Only conscious organization of social production, in which production and distribution are carried on in a planned way, can lift mankind above the rest of the animal world as regards the social aspect, in the same way that production in general has done this in the specifically biological aspect."[92]

Just how conscious intervention to direct human affairs could be efficacious in a deterministic universe was never clearly spelled out within Marx's works. Indeed, the relationship between moral choice and scientific knowledge in Marx has been the focal point of many of the most contentious battles among Marxists, with Karl Kautsky representing an extreme technological or economic determinist version of Marxism in his *Materialist Conception of History* of 1927, and V. I. Lenin representing a much more voluntarist version in *What Is to Be Done,* published in 1902. But Marx's insistence that the truth of scientific knowledge could never be known except as a consequence of its transformative power in human hands highlighted his own unwavering central belief that it must be possible to combine knowledge with true human agency. Indeed, what drew Marx to Epicurean materialism in his dissertation was the fact that Epicurus constructed a version of materialism in which we humans could "free ourselves" from the fear both of the arbitrary will of the gods and of the uncontrollable character of natural phenomena. Marx's sense that human agency, always appropriately informed by scientific knowledge, was responsible for the transformation of the means of production as well as potentially capable of transforming social relations, remained central to his thought. It is also indispensable to any understanding of how his claims to scientific analyses could go along with the constant exhortations to action that characterize his works.

Marx's insistence upon the possibility, indeed, the psychological necessity, of some form of self-determination even in a scientifically understandable world predated and probably stimulated his gradual immersion in the communities of radical political activists during the 1840s. But it seems to have been at least reinforced, if not intensified, as he went into exile in Paris when the radical tone of his early work as a journalist led the Prussian government in April of 1843 to shut down the *Rheinische Zeitung.* In Paris, Marx interacted with most of the major European political agitators of the time; became a self-professed communist; formed the close association with Friedrich Engels that lasted for the rest of his life; read widely in political economy; began to formulate his project of writing a detailed analysis of capitalism; and formed the opinion that unless

the various radical splinter groups, which often embraced nationalistic or ethnic agendas, could be brought together around some common vision and program, there could never be a successful proletarian revolution.

Expelled from Paris in 1845 at the behest of the Prussian government, Marx moved to Brussels, where he began to lecture and write for the *Deutsche Brüsseler Zeitung* in order to prepare working men for their role in what he viewed to be the imminent proletarian uprising. On a trip to England with Engels, Marx came into contact with the London-based German Workers Educational Association, which had recently joined a loose affiliation of local revolutionary societies to form the Communist League. Marx undertook organizing activities on behalf of the growing Communist League, and in 1847 the League commissioned Marx and Engels to produce a general statement of its goals and unifying beliefs. This attempt to provide a unifying vision and program for working class-revolution, *The Communist Manifesto,* was published just weeks before the first outbreak of Europe-wide revolutionary activity began in Paris early in 1848.

Though the stirring rhetoric of *The Communist Manifesto* has undoubtedly made it the most frequently read, relished, and reviled revolutionary tract in the Western world, it had little impact on the abortive, largely bourgeois-led, and liberally aimed revolutions of 1848. Marx's subsequent analyses of the revolutionary activity in France and in Germany during 1848 and 1849 confirmed him in his opinion that no "revolution" short of an international and probably violent uprising of the entire proletariat could be successful. Moreover, it convinced him of how ill informed and unprepared the proletariat was; thus it reinforced his desire to provide that scientific analysis of capitalism that could fully prepare people for the coming struggle.

This analysis appeared in *Capital,* of which Marx completed the first volume in 1867. Engels brought out the second and third volumes posthumously in 1885 and 1894. *Capital* provided most of the basic Marxian economic and sociological theorizing known during the nineteenth century. Many key Marxian concepts, such as alienation, utilized in *Capital,* had been explored more extensively in either *The German Ideology,* written during 1845 and 1846, but not published until 1926, or in the *Economic and Philosophical Manuscripts of 1844,* which were not published until 1932; but nineteenth- and early twentieth-century Marxism had to do without the insights provided by these works.

The basic strategy of *Capital,* which Marx had been previewing since the publication of *The Communist Manifesto,* was to offer an analysis of the capitalist system of production and capitalist social order that showed how it produced its own negation, which Marx believed would constitute a classless society of cooperative producers: the proletariat, free at last. But in a curious letter to Engels written in December of 1867 and aimed at discussing the most effective strategy for planting favorable reviews to stimulate interest in and sales of *Capital,* Marx suggested that the analytic structure be decoupled from the possibly disturbing

conclusions, laying emphasis on the former, and downplaying the latter. In his sample review, Marx wrote: "We must distinguish between the author's positive contributions . . . and the tendentious conclusions which he draws. The former constitute a direct enrichment of science: he has produced a new analysis of real economic conditions using a materialist approach. . . . Example 1) the analysis of money; 2) the 'natural' development of cooperation, the division of labor, the system of machinery and the corresponding social relations and social ties. . . . On the other hand, the author's subjective tendency, i.e., the way he imagines or presents the final result of the present movement, of the real social process, has actually nothing to do with the analysis itself—he was perhaps morally obliged and committed to this standpoint by virtue of his political affiliation and his past."[93]

In proffering this reading of *Capital,* Marx actually anticipated the way in which the work has been most often read for over a century. While orthodox Marxists and vehement anti-Marxists alike have always understood the work as a promise of the ultimate success of the proletarian revolution, a wide range of thinkers from almost every imaginable intermediate political perspective have managed to separate elements of Marx's discussion of capitalism and of the general relationships between economic life and other aspects of culture from the overarching political aim of the text and to incorporate his concepts and/or insights as central elements in virtually all of the social sciences in the twentieth century.

It is beyond the scope of this study to follow Marx's analyses in all of their often bewildering detail, but discussion of a few key concepts can suggest something about the ways in which Marx's work departed from the approach of other nineteenth-century political economists, something about how thoroughly he was able to integrate concepts and analytic strategies from the various traditions from which he drew, and something about the new directions that he promoted in the social sciences.

In connection with virtually every concept that he used, Marx began by appropriating some traditionally defined notion or set of notions; then he transformed them so that they took on different meanings. This is particularly clear in his discussions of "alienation," which is used almost exclusively in its Marxian sense in modern sociological literature. The concept of alienation had been developed by Fichte and Hegel and it was used extensively by Feuerbach to indicate a self-initiated process by which the spirit or mind projected a part of itself onto something external and in some sense, opposed to itself. It was thus through a process of self-alienation that man created the gods as powers outside of himself, and therefore beyond his control.

In *Capital,* Marx retained the notion that alienation involves both a separation from the self and a loss of control. But he placed the cause of that separation and loss, not in some mental act, but in a historical process. This process gradually transformed a primitive system of production in which members of a community directly exchange services to meet one another's needs, into the capitalist system

of production in which workers are forced in isolation to create surplus-value for their employers. Moreover, into this process, he integrated the discussions initiated by Montesquieu regarding the tendency of commercial competition to undermine personal ties within communities,[94] as well as the discussions of Ferguson and Smith regarding the dehumanizing consequences of the division of labor pushed to its extremes in factory production.[95]

In the first stages of the process, the exchange of use-values whose meaning in the lives of community members is well understood, is transformed through the division of labor into an exchange of commodities, whose use is divorced from their production.[96] As the historical process unfolds, driven by the division of labor, social forces are created that increasingly seem beyond the control of individuals: "The social power, i.e., the multiplied productive force, which arises through the co-operation of different individuals as it is determined by the division of labor, appears to come about naturally, not as their united power, but as an alien force existing outside of them, of the origin and goal of which they are ignorant, which they thus cannot control."[97]

By the time full-fledged capitalism has emerged, virtually every aspect of human experience has been divorced from and turned against the individual laborer: "Within the capitalist system all methods for raising the social productivity of labor are put into effect at the cost of the individual worker; . . . all means for the development of production undergo a dialectical inversion so that they become means of domination and exploitation of the producers; they distort the worker into a fragment of a man, they degrade him to the level of an appendage of a machine, they destroy the actual content of his labor by turning it into a torment; they *alienate* from him the intellectual potentialities of the labor process in the same proportion as science is incorporated in it as an independent power; they deform the conditions under which he works, subject him during the labor process to a despotism the more hateful for its meanness; they transform his lifetime into working time."[98] Ultimately, within capitalism, then, humans become alienated from the products of their labor and from the processes of labor, for neither of these any longer relates directly to the satisfaction of human needs or to the accomplishment of human purposes. Virtually all subsequent discussions of alienation as a significant feature of advanced industrial societies draw from Marx's analysis.

For the most part, Marx and Engels accepted the rough scheme of Montesquieu as temporalized by the Scottish philosophical historians in describing the historical movement of dominant modes of production and social structures from hunting to pastoral to agricultural to commercial, though these categories were correlated with the Saint-Simonian categories of Primitive communitarian, Ancient tribal, Feudal, and Industrial (Capitalist). Moreover, Marx also accepted the existence of a separate static Asiatic system of production and society based on irrigation agriculture and the communal ownership of property.[99] But overriding

these categories was an implicit distinction between social structures dominated by communitarian notions—in which production was primarily for immediate use, in which relations among members were primarily personal and cooperative rather than impersonal and competitive, and in which the division of labor was limited by the existence of constricted markets—and societies dominated by commodity production, in which social relationships tended to be impersonal and competitive and in which the division of labor was constantly intensifying.

For Marx, though the division of labor, with its concomitant drive toward commodity production and the use of money, had been constantly negating elements of community throughout the entire historical process, it was in the transition from feudal society to capitalist society that the most dramatic shift occurred. In 1887, Ferdinand Tönnies formalized this set of distinctions and made it central to modern sociology and political theory by identifying premodern social structures with the term *Gemeinschaft* (community) and modern social structures with the term *Gesellschaft* (society).

One of the central tests of the extent to which a particular society had moved away from existence as a community, according to Marx, was the extent to which a sense of common interests and purposes had been displaced by well-developed "class" distinctions and class consciousness. Once again, Marx took a term that had been gaining currency within the eighteenth-century tradition of philosophical history as a generic synonym for "estate," "order," "rank," or indeed, any group of persons bound together by some set of common interests or attributes, and he gave it a meaning that is more restricted in its extent but much richer in its connotations. Starting from the general insistence that the most fundamental and meaningful processes and relationships in society are derived directly from the character of its economy, Marx insisted that the most important groupings of people must depend upon the economic roles that exist within society.

In communitarian societies there are no interests that divide any group of persons from any other. Though some division of labor may occur based on gender or on the differential distribution of talents, all members of the community stand in a relationship of equality to one another as producers of goods or services that are consumed directly by their fellow community members and as consumers of the goods and services of others. But in all societies beyond the stage of primitive communism, divisions based on economic function emerge, and "classes" are formed. Furthermore, these classes inevitably have different interests, and the conflict that grows out of the struggle of each class to promote its own interests provides the driving force for social change. Marx's view of the role of classes and class conflict are most directly and simply stated at the beginning of the first major section of *The Communist Manifesto:*

> The history of all hitherto existing society is the history of class struggles. Freeman and slave, patrician and plebeian, lord and serf, guild-master and journey-

> man, in a word, oppressor and oppressed, stood in constant opposition to one another, carried on an uninterrupted, now hidden, now open fight, a fight that each time ended, either in a revolutionary reconstitution of society at large, or in the common ruin of the contending classes. . . . The modern bourgeois society that has sprouted from the ruins of feudal society has not done away with class antagonisms. It has but established new classes, new conditions of oppression, new forms of struggle in place of the old ones. . . . Our epoch, the epoch of the bourgeoisie, possesses, however, this distinctive feature: It has simplified the class antagonisms. Society is more and more splitting up into two hostile camps, into two great classes directly facing each other—bourgeoisie and proletariat.[100]

In *Capital,* Marx explores in excruciating detail the many mechanisms through which the capitalist system of production can concentrate capital and drive members of intermediate classes down into the proletariat, so that large-scale capitalists and members of the proletariat eventually face one another in a stark confrontation. Moreover, he rehearses the way in which the increasing use of machinery in modern factories enables capitalists to extract surplus-value from workers in ever more efficient ways, increasing their control over the workers and driving the share of the products of their own labor retained by the proletariat ever downward.

He discusses the processes by which large-scale capital begins to drive workers into unions out of a sense of self preservation: by bringing many workers together into factories, pushing to make the working day longer, making wages lower, and appropriating to itself all of the value of the increased productivity that it generates. Advanced capital thus creates the conditions under which the proletariat gradually becomes aware of its existence as a class and of the interests shared by working persons everywhere. Finally, Marx details the way in which the fundamental driving principle of capitalist production, the tendency to extract maximum surplus value from labor by increasing the production of commodities without regard for their use-values, initially leads to increased material plenty and to the continuing accumulation of capital, but eventually to overproduction, the creation of ever-intensifying economic crises that necessitate ever-intensifying attempts to exploit labor and, presumably, eventually to a revolution of the proletariat.

One might reasonably ask why neither the capitalists nor the proletariat can see what is happening and take steps to avoid the impending collapse. Some "revisionist" Marxists, such as Eduard Bernstein (1850–1932), actually argued that they might, and in his *Evolutionary Socialism* of 1899, Bernstein projected the possibility of a peaceful creation of the ultimate socialist society as a consequence of changes in capitalist economic developments. But for most Marxists, such a possibility was precluded by the fact that every class, other than the proletariat, was blocked from an objective understanding of its own circumstances by the existence of a "false consciousness," or "ideology."

Like alienation, ideology was a term appropriated and transformed by Marx.

Among the French *Idéologues,* the term signified any set of largely unexamined presuppositions shared by a significant number of people regarding salient features of the social world in which they lived. Such presuppositions might accurately reflect an independently existing external reality or not, and the groups that shared ideologies might be constituted in any number of ways, based on the sharing of interests that might be founded in common membership in religious communities, occupational roles, legal status, political groupings, wealth, and so on. The only certain thing that one could say is that every person lived his or her life from within some constellation of presuppositions, or *ideology,* for quite literally, people live in a world of ideas.

Marx does not disagree with the claim that people base their actions more on what they believe to be the case than on what is "really" the case. But he refocuses attention on the material factors that go into the creation of the "consciousness" of any person or class in the first place. As we saw above, in the *German Ideology,* Marx insisted that, "it is not the consciousness of men that determines their social existence but their social existence that determines their consciousness." But, for Marx, the social existence lived by any person is just that of his or her own class, so it would seem that the consciousness, the world of ideas and beliefs, of any human must be limited by the experiences and interests of the class to which he or she belongs. There is, however, an important caveat to this notion. Until a class develops its own consciousness, because the means for inculcating ideas and values in any society are controlled by the ruling class of that society, "the ruling ideas of each age have ever been the ideas of its ruling class."[101] As a consequence, the dominant *ideology* in any time or place reflects the immediate interests of the ruling class, rather than anything approaching an objective understanding of conditions.

At the time of the publication of *The Communist Manifesto,* argued Marx, the proletariat had not yet developed its own consciousness. Those who spoke on behalf of working men up to that point had been members of the bourgeoisie, and because "the bourgeoisie naturally conceives the world in which it is supreme to be the best,"[102] the "bourgeois socialism" that preceded Marxism was naturally formulated to perpetuate bourgeois values and a social structure that left the bourgeoisie comfortably in control. Thus, for example, we get the Saint-Simonian society managed by bankers and entrepreneurs.

Especially through the works of Karl Mannheim (1893–1947) in the 1920s and early 1930s, the Marxian suggestion that no understanding of social relations can be free of values and political implications—that every conceptualization is somehow ideologically loaded—has come to represent the all but universal view among social theorists. Indeed, it has become the foundation of a field of sociology called the "sociology of knowledge."[103] Many of those who emphasize the inescapable ideological content of social theorizing continue to argue that economically based class considerations constitute the ultimate foundations of

ideologies. Moreover they insist that because ideologies inevitably reflect the interests of the dominant class at any time, they must be conservative in their very nature. In the late twentieth century there was a growing sense among those who were not orthodox Marxists that group identities based on gender, nationality, ethnicity, religion, and so on, are vastly more important in shaping the life experiences, and thus the ideological orientations, of individuals than Marx and Engels had allowed.

Even without considering the possible noneconomic elements that might enter into ideologies, Marx's emphasis on the inevitable presence of ideological elements in social theories created an important set of paradoxes and problems for Marxists and non-Marxists alike. If Marx was correct, how could nineteenth-century Marxist theorists, almost all of whom came from bourgeois family backgrounds, claim that *they* were capable of objectivity and value neutrality in apparent violation of their own principles? One might imagine that in a future "classless" society there would no longer be recognizable ideologies because the salient features of the experience of all human beings would be identical. Then an "objective"—that is, a universally agreed upon—understanding of society would be virtually assured. But the nineteenth century remained a century dominated by class antagonisms, and even Marx and Engels were members of the bourgeoisie. Even if Marxism was capable of expressing the true interests of the proletariat, those interests were still "class" interests in the nineteenth century and could not be understood as the foundation for a value-free and politically neutral science of society. On the other hand, if Marx was correct in a strong sense, no other group could claim to have a nonideological scientific perspective from which to condemn the Marxist perspective as illegitimate because it was informed by particular class interests.

At a very fundamental level, Marxism and Positivism faced precisely the same intellectual problem with respect to the incorporation of socio-cultural presuppositions into scientific theory, although the problem was vastly more visible in Marxism because of its heightened emphasis on the connection of theory with practice and because of the Marxist restrictive insistence that these socio-cultural presuppositions must inevitably be grounded in economic class considerations. Furthermore, the Positivist and Marxist responses to their respective problems were remarkably similar. In each case a relativist and progressivist vision of understanding emerged in connection with the simultaneous claims that: 1) at any stage even the best knowledge available must inevitably contain at least implicit, and sometimes explicit, residues of the cultural presuppositions of its creators; 2) a method, or philosophy of science, can be developed that will allow one to minimize, but not necessarily eliminate, both the number and the impact of these cultural assumptions; and 3) the ultimate test of the philosophy of science or method adopted is the extent to which the theories created allow one to predict the outcomes of events and to transform the world through the knowledge produced.

It was in connection with claim number 2, that Positivism and Marxism diverged. Positivism focused on the need for scientific thinkers to distance themselves from their own hopes and fears in creating scientific theories, to give up the hope of discovering the necessary causes of phenomena, and to avoid all hypotheses not capable of direct observational testing. On the other hand, Marxist dialectical materialism drew from the German tradition from Kant through the *Naturphilosophen* and Hegel in insisting that passionate engagement with one's subject of study was more likely to help than hinder knowledge production, that the search for causes was a central feature of any science, and that hypotheses should be restricted not by their direct accessibility to empirical test so much as by their consistency with rational criteria (in this case, dialectical logic).[104]

There is no doubt that Marxism was a scientistic movement. That is, it openly sought to extend methods derived from mathematics and the natural sciences to deal with social phenomena. With respect to Marxist claims that Marxism is scientific, however, we come back to an issue raised at the beginning of chapter 4. If we insist on applying positivistic criteria by which to judge such a claim, Marxism undoubtedly fails. If we open up our criteria to include those that had characterized German *Naturphilosophie* in the early part of the century, it is probably a reasonable claim. Once again, however, even if we were to agree that Marxism was and is indeed scientific, that would not justify the most important inference that Marx, Engels, and subsequent Marxists have wished to draw: that it was therefore also correct in all of its claims.

teenth Century: Problems of Form, Function, and Transformation (New York: John Wiley and Sons, 1971), 25.

61. See Erik Nordenskjold, *The History of Biology: A Survey* (New York: Tudor Publishing Co., 1936), 393.

62. Döllinger is discussed in Lenoir, *Strategy of Life,* 65–73, and Burdach is discussed by Lenoir on 73–77.

63. See, for example, Coleman, *Biology in the Nineteenth Century,* 42.

64. See, for example, Lenoir, *Strategy of Life,* 87.

65. Cited in Coleman, *Biology in the Nineteenth Century,* 50.

66. Cited in Erik Nordenskjold, *History of Biology,* 383.

67. Cited in Lenoir, *Strategy of Life,* 105.

68. See ibid., 103–11.

69. My discussion of the pre-1790s use of the terms "Romantic" and "Romanticism" is dependent on Raymond Immerwahr, "The Word 'Romantisch' and Its History," in Siegbert Prawer, ed., *The Romantic Period in Germany* (New York: Schocken Books, 1970), 34–63.

70. See Frank Manuel, *The Eighteenth Century Confronts the Gods* (Cambridge, Mass.: Harvard University Press, 1959), passim.

71. Friedrich Schlegel, *Kritische Fragmente,* 115, cited in Paul Roubiczek, "Some Aspects of German Philosophy in the Romantic Period," 303, in Prawer, *Romantic Period in Germany.*

72. H. A. Korff, *Geist der Goethezeit* 1:28, cited in Alexander Gode-Von Aesch, *Natural Science in German Romanticism* (New York: Columbia University Press, 1941; rept. AMS Press, New York, 1966), 31.

73. See Immerwhar, "'Romantisch' and Its History," 52.

74. Cited in Roubiczek, "Some Aspects of German Philosophy in the Romantic Period," 315.

75. Discussed in Immerwahr, "'Romantisch' and Its History," 57.

76. Cited in Roubiczek, "Some Aspects of German Philosophy in the Romantic Period," 315.

77. Cited in Gode-Von Aesch, *Natural Science in German Romanticism,* 140.

78. See ibid., 150–54.

79. On the organicist character of German late-Enlightenment historical thought, see Peter Hanns Reill, *The German Enlightenment and the Rise of Historicism* (Berkeley: University of California Press, 1975).

80. On this anti-statist element in Herder, see especially Frank Manuel's "editor's introduction" to Johann Gottfried von Herder, *Reflections on the Philosophy of the History of Mankind* (Chicago: University of Chicago Press, 1968).

81. Johann Fichte, *Addresses to the German Nation,* trans. R. F. Jones and G. H. Turnbull (Chicago: Open Court Publishing Co., 1922), 52.

82. Ibid., 232.

83. Ibid., 4–6.

84. Ibid., 144–45.

85. Ibid., 264.

86. Ibid., 13.

87. Ibid., 185.

88. Ibid., 217.

89. Ibid., 197.

90. On this issue, see especially Joseph Ben-David, *The Scientist's Role in Society: A Comparative Study* (Chicago: University of Chicago Press, 1984), chap. 7, 108–38. Although it is certainly true that German natural scientists continued to view themselves as underfunded and underappreciated relative to humanists throughout the first half of the nineteenth century-see, for example, Kurt Bayertz, "Spreading the Spirit of Science: Social Determinants of the Popularization of Science in Nineteenth Century Germany," in Terry Shinn and Richard Whitley, eds., *Expository Science: Forms and Functions of Popularization* (Dordrecht: D. Reidel Publishing Co., 1985), 212–17–English, French, and American scientists looked on with envy from about 1825 to the end of the century. Arleen Tuchman has documented the growth of a research orientation and research support at Heidelberg in *Science, Medicine, and the State in Germany: The Case of Baden, 1815–1871* (New York: Oxford University Press, 1993).

91. Fichte, *Addresses to the German Nation,* 223–24.

92. Ibid., 227.

93. G. W. F. Hegel, *Reason in History: A General Introduction to the Philosophy of History,* trans. Robert S. Hartman (Indianapolis: Bobbs-Merrill, 1953; from the 1837 German original), 87.

94. Ibid., 53.

95. Ibid., 46–47.

96. Leopold von Ranke, "Analecta," *Historische Zeitschrift* 244 (1887), cited by Rudolph Vierhaus in "Historiography between Science and Art," in George Iggers and James M. Powell, eds., *Leoplod von Ranke and the Shaping of the Historical Discipline* (Syracuse: Syracuse University Press, 1990), 61.

97. Cited by Friedrich Jager and Jorn Rusen, *Geschichte des Historismus* (Munich: C. H. Beck, 1992), 83.

98. Roger Smith, *The Norton History of the Human Sciences* (New York: W. W. Norton Co., 1997), 386.

Chapter 5: The Rise of Materialisms and the Reshaping of Religion and Politics

1. See, for example, Donald Rohr, *The Origins of Social Liberalism in Germany* (Chicago: University of Chicago Press, 1963), passim. Karl Heinrich Brueggemann, who had studied law at Bonn and Heidelberg, was actually sentenced to death for his leadership at the Hambach Festival; but cooler heads prevailed and his sentence was first commuted to life in prison before he was released after eight years (see Rohr, *Origins of Social Liberalism in Germany,* 99).

2. See Karl Hill, ed., *The Management of Scientists* (Boston: Beacon Press, 1964), essay by Everett Mendelsohn.

3. See Rohr, *Origins of Social Liberalism in Germany,* 16, 38–40.

4. On the centrality of natural theology to seventeenth- and eighteenth-century religious discourse, see John Hedley Brooke, *Science and Religion, Some Historical Perspectives* (Cambridge: Cambridge University Press, 1991), esp. chaps. 4–6.

5. Cited from Norman Kemp Smith, ed., *Immanuel Kant's Critique of Pure Reason* (New York: St. Martin's Press, 1965), 528–29.

6. G. W. F. Hegel, "Preface," in H. F. W. Hinrich, *Religion in Its Internal Relation to*

logical Traditions of the Nineteenth Century (Cambridge, Mass.: Harvard University Press, 1992), 37.

7. My comments on Hegel and Strauss are based largely on Frederick Gregory, *Nature Lost,* chap. 3.

8. Cited in Gregory, *Nature Lost,* 80.

9. See Gregory, *Nature Lost,* 88–111, on Strauss's turn to Darwinism.

10. Gregory, *Nature Lost,* 81.

11. Cited in Eugene Kamenka, *The Philosophy of Ludwig Feuerbach* (New York: Praeger Publishers, 1969), 15.

12. See Ludwig Feuerbach, *Thoughts on Death and Immortality* (Berkeley: University of California Press, 1980), 89.

13. Ibid., 17.

14. Cited in Frederick Gregory, *Scientific Materialism in Nineteenth Century Germany* (Dordrecht: D. Reidel, 1977), 16.

15. Cited in Kamenka, *Philosophy of Ludwig Feuerbach,* 158, n. 26.

16. Cited in Gregory, *Scientific Materialism,* 19.

17. Ludwig Feuerbach, *The Essence of Christianity,* trans. Marian Evans (George Eliot) (London: Kegan Paul Trench and Tubner, 1854), viii.

18. Feuerbach, *Essence of Christianity,* 270.

19. Ibid., xi.

20. Cited in Kamenka, *Philosophy of Ludwig Feuerbach,* 17.

21. Cited in ibid., 16.

22. Cited in Gregory, *Scientific Materialism,* 24.

23. See ibid., 61, 64.

24. See ibid., 100–104.

25. See ibid., 213.

26. See ibid., 41, on the philosophical neutrality of most German scientists.

27. The central role played by Say's work in the Germanies is being explored currently by Keith Tribe, and was mentioned in his "Classicism before Neo-Classicism: Political Economy between Natural Law and Historicism," a paper presented at a conference on "Science and the Social Sciences in the Late Eighteenth and Early Nineteenth Centuries," May 30–31, 1997, at the Clark Library, UCLA, arranged by Theodore M. Porter and Dorothy Ross.

28. Cited in Arleen Tuchman, *Science, Medicine, and the State in Germany: The Case of Baden, 1815–1871* (New York: Oxford University Press, 1993), 8. Tuchman's introductory chapter summarizes beautifully the case for a utilitarian emphasis on science emerging from liberal civil servants, though she does not see the cameralist curriculum as particularly important.

29. Cited in Tuchman, *Science, Medicine, and the State in Germany,* 11.

30. Ibid.

31. Cited in Gregory, *Scientific Materialism,* 105.

32. Ludwig Büchner, *Force and Matter: or, Principles of the Natural Order of the Universe. With a System of Morality Based Thereon,* Translated from the Fifteenth German Edition, Reprinted from the Fourth English Edition (New York: Peter Eckler Publishing Co., 1920), vii–viii.

33. Ibid., vi.

34. Ibid., 51.

35. Ibid., 7.

36. Ibid., 8.

37. Ibid., 46–47. There is no good historical evidence to believe the truth of this claim. Gnostic religions were much more hostile to matter in the ancient world than was Christianity.

38. Ibid., 52

39. Ibid.

40. Ibid., 57.

41. Ibid., 76.

42. Ibid., 77–78.

43. Ibid., 77.

44. Ibid., 85–86.

45. Ibid., 101.

46. Ibid., 173–74.

47. Ibid., 175–76.

48. Ibid., 205.

49. Ibid., see especially 214, 222–23.

50. Ibid., see 219–20.

51. See Gregory, *Scientific Materialism,* 120.

52. Büchner, *Force and Matter,* 238.

53. Ibid., 253.

54. Ibid., 244.

55. Cited in Ernest Jones, *The Life and Work of Sigmund Freud* (Garden City, N.J.: Doubleday and Co., 1961), 30.

56. See William Coleman, *Biology in the Nineteenth Century: Problems of Form, Function, and Transformation* (New York: Wiley, 1971), 150–54.

57. Hermann von Helmholtz, "Address Delivered August 2, 1877, on the Anniversary of the Foundation of the Institute for Education of Army Surgeons," in *Science and Culture: Popular and Philosophical Essays,* edited and with an introduction by David Cahan (Chicago: University of Chicago Press, 1995), 321.

58. Hermann von Helmholtz, "Über das Verhaltnis der Naturwissenschaften zur Gesammtheit der Wissenschaften," in *Vortrage und Reden,* 3 vols. (Braunscheig: F. Vieweg and Sohn, 1896–1903), 1:180–81, cited in Timothy Lenoir, *Instituting Science: The Cultural Production of Scientific Disciplines* (Stanford: Stanford University Press, 1997), 89.

59. Selection reprinted in Roland Stromberg, ed., *Realism, Naturalism, and Symbolism: Modes of Thought and Expression in Europe, 1848–1914* (New York: Harper and Row, 1968), 29–30.

60. Lenoir, *Instituting Science,* 77, 79.

61. Hermann von Helmholtz, "Autobiographical Sketch," in Cahan, ed., *Science and Culture,* 387.

62. Ibid., 391.

63. Virtually the entire story of Du Bois-Reymond told below comes from Lenoir, *Instituting Science,* chap. 4, "Social Interests and the Organic Physics of 1847," 75–95.

64. Cited in Lenoir, *Instituting Science,* 81.

65. Cited in ibid., 90.

66. Cited in ibid., 92.

67. On the role of dialectical materialism in Soviet science, see Loren Graham, *Science and Philosophy in the Soviet Union* (New York: Alfred Knopf, 1972).

68. Friedrich Engels, *Anti-Duhring* (Moscow: Progress Press, 1959), 16–17.

69. Cited in Sir Isaiah Berlin, *Karl Marx,* 4th ed. (New York: Oxford University Press, 1996), 87.

70. See Berlin, *Karl Marx,* 80.

71. See V. I. Lenin, *Karl Marx: A Brief Biographical Sketch with an Exposition of Marxism,* in *Collected Works,* 4th ed., vol. 21 (Moscow: Foreign Languages Publishing House, 1964), 50.

72. Both Karl Marx's father and his first philosophy teacher in Berlin, Edward Jans, are identified as Saint-Simonian followers by Ionescu in *Political Thought of Saint-Simon,* 25.

73. See Frank Manuel, *A Requiem for Karl Marx* (Cambridge, Mass.: Harvard University Press, 1995), 10–11.

74. See ibid., 12–13.

75. Karl Marx and Friedrich Engels, *Marx-Engels Collected Works in English* (London: Lawrence and Wishart, 1970), 5:247.

76. Karl Marx, *Early Writings* (London: Penguin Books, 1974), appendix, 425–26.

77. Karl Marx, *The German Ideology, Collected Works* 5:77–78.

78. See Olson, *Science Deified and Science Defied* 2, chaps. 5 and 6, 191–283, passim.

79. Cited in Ionescu, *Political Thought of Saint-Simon,* 24.

80. Berlin, *Karl Marx,* 15.

81. Marx and Engels, *Collected Works* 1:88.

82. Karl Marx, *The Holy Family, Collected Works* 4:128.

83. Reprinted in Marx, Engels, Lenin, *On Dialectical Materialism* (Moscow: Progress Publishers, 1977), 59.

84. Ibid.

85. From Engels, *Dialectics of Nature,* reprinted in Marx, Engels, Lenin, *On Dialectical Materialism,* 117.

86. From *Dialectics of Nature,* reprinted in Marx, Engels, Lenin, *On Dialectical Materialism,* 122.

87. From *Anti-Duhring,* reprinted in Marx, Engels, Lenin, *On Dialectical Materialism,* 82–84.

88. Cited in *Anti-Duhring,* reprinted in Marx, Engels, Lenin, *On Dialectical Materialism,* 86.

89. Engels, *Anti-Duhring,* in Marx, Engels, Lenin, *On Dialectical Materialism,* 86.

90. Published as an appendix to Friedrich Engels, *Ludwig Feuerbach and the Outcome of Classical German Philosophy* (New York: International Publishers, 1941; from 1888 German original), 84.

91. In Engels, *Ludwig Feuerbach,* 83.

92. In Engels, *Dialectics of Nature,* reprinted in Marx, Engels, Lenin, *On Dialectical Materialism,* 108.

93. Cited in Michael E. DeGolyer, "Science and Society, Justice and Equality: An Historical Approach to Marx" (Ph.D. diss., Claremont Graduate School, 1985), 128.

94. See Olson, *Science Deified and Science Defied* 2:201–2.

95. See ibid., 216–17.

96. Karl Marx, *Capital,* vol. 1 (London: Penguin Books, 1976), 181–82.

97. From Karl Marx and Friedrich Engels, *The German Ideology,* selections reprinted in Eugene Kamenka, *The Portable Karl Marx* (New York: Penguin Books, 1983), 177–78.

98. Marx, *Capital* 1:799.

99. Ibid., 477–79.

100. Karl Marx, *The Communist Manifesto,* in Kamenka, *Portable Karl Marx,* 203–4.

101. Ibid., 225.

102. Ibid., 235.

103. See especially part 5 of Karl Mannheim, *Ideology and Utopia* (New York: Harcourt Brace and World, 1936).

104. See Helena Sheehan, *Marxism and the Philosophy of Science: A Critical History* (Atlantic Highlands, N.J.: Humanities Press, 1985), for a survey of the complex tradition of Marxist philosophy of science, beginning with the dialectical materialism of Engels.

Chapter 6: Early Victorian Culture: Public Science and Political Science

1. For the contemporary critiques of the Royal Society and the paucity of government support for science, See Charles Babbage, *Reflections on the Decline of Science in England* (London: B. Fellowes, 1830), esp. 50–200, and David Brewster, Gerard Moll et al., *Debates on the Decline of Science* (New York: Arno Press, 1975).

2. On the founding of the British Association for the Advancement of Science, see Susan Faye Cannon, *Science in Culture: The Early Victorian Period* (New York: Science History Publications, 1978), 167–224.

3. In addition to a plethora of specialized studies, I would recommend David Knight, *The Age of Science* (Oxford: Basil Blackwell, 1986), Susan Faye Cannon, *Science in Culture: The Early Victorian Period,* and above all, the venerable but amazingly valuable first two volumes of John Theodore Merz, *A History of European Thought in the Nineteenth Century* (London: Blackwood, 1904), esp. vol. 1:226–301.

4. See Olson, *Science Deified and Science Defied* 2, chap. 8, 316–44.

5. See, for example, Robert Fox, "Science, Industry, and the Social Order in Mulhouse, 1798–1871," *British Journal for the History of Science* 17 (1984): 127–68; Arnold Thackray, "Natural Knowledge in Cultural Context: The Manchester Model," *American Historical Review* 79 (1974): 672–709; and Jack Morrell, "*Wissenschaft* in Worstedopolis: Public Science in Bradford, 1800–1850," *British Journal for the History of Science* 18 (1985): 1–23. Morrell describes a case in which a Literary and Philosophical Society oriented toward manufacturing interests folded for lack of support after a very brief existence in 1808–10.

6. For a list of such societies founded between 1812 and 1842, see Thomas Kelly, *A History of Adult Education in Great Britain* (Liverpool: Liverpool University Press, 1962), 113.

7. See Richard Olson, *Science and Religion, 1450–1900: From Copernicus to Darwin* (Westport, Conn.: Greenwood Press, 2004), 83–110.

8. See Olson, *Science Deified and Science Defied* 2, chap. 3.

9. See Robert Kargon, *Science in Victorian Manchester: Enterprise and Expertise* (Baltimore: Johns Hopkins University Press, 1977), 5–14.

10. Installments of the Library of Useful Knowledge came out biweekly in thirty-two-page pamphlets with double columns in small print for six pence each. Brougham's