

Weber and the Environment: Classical Foundations for a Postexemptionalist Sociology¹

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In the last two decades classical sociology, notably Marx, has been mined for environmental insights in the attempt to surmount the “human exemptionalism” of post–Second World War sociology. Weber, however, has remained an enigma in this respect. This article addresses Weber’s approach to the environment, including its significance for his interpretive-causal framework and his understanding of capitalism. For Weber, sociological meanings were often anchored in biophysical realities, including climate change, resource consumption, and energy scarcity, while environmental influences were refracted in complex ways within cultural reproduction. His work thus constitutes a crucial key to constructing a meaningful postexemptionalist sociology.

ENVIRONMENTAL SOCIOLOGY AND THE ENIGMA OF WEBER

Environmental sociologists have long seen ecological issues as consigned to the wilderness within sociological thought. In the first two decades following its organization as a field in the late 1970s, environmental sociology was largely defined by a persistent critique of sociology as a whole for its “aversion to the natural environment” (Buttel et al. 2002, p. 5). In

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the most influential expression of this by Catton and Dunlap (1978, 1980; Dunlap and Catton 1979, 1994), the dominant post-Second World War sociological tradition was seen as having embraced a human-exemptionalist paradigm, in which human beings in technologically advanced societies were considered exempt from natural-environmental influences. An unfortunate consequence of the dominance of this human-exemptionalist paradigm, they argued, was the relative impermeability of mainstream sociology to serious environmental concerns. This led to a call for a new environmental paradigm (now sometimes referred to as the “postexemptionalist paradigm”) denying such human-exemptionalist notions (Antonio 2009, p. 33).²

These environmental criticisms of late 20th-century mainstream sociology were often carried over, though much more ambivalently, to the classics themselves. Environmental sociologists saw sociology as a discipline having been organized around the “‘social facts’ injunction” (Buttel 2002, p. 38), identified with Durkheim (1982, p. 50) in particular, which had systematically cordoned off the realm of the social from that of the biophysical—in an attempt to distinguish sociology from biology and psychology. Weber similarly had criticized social evolutionism for its elevation of biological metaphors to the level of sociological concepts, warning against drawing crude social analogues with natural evolution (Weber [1914–20] 1968, p. 40; 1949, pp. 25–26, 86). Likewise Marx’s sharp critique of Malthus (Marx and Engels 1954) was frequently seen as a rejection of biophysical influences. Classical sociologists were thus often viewed as having systematically excluded biophysical issues from their core concerns. Environmental sociologists were therefore estranged not only from 20th-century sociology but also to a considerable extent from the founding traditions of the discipline.

Today there are signs that environmental sociology’s long period in the wilderness may be coming to a close. Not only have environmental issues been gaining considerable currency in various fields within sociology, such as world-systems theory, critical theory, cultural sociology, and so on (Buttel et al. 2002, pp. 13–15), but they have increasingly been acknowledged within sociology as a whole over the last decade, with prominent

² In this article the term “environment,” unless otherwise indicated, refers to that domain of reality which consists of or is directly related to the natural environment. The term “nature,” when used in this general sense, likewise refers to the realm of biophysical existence. The complexity of these terms guarantees that their meanings are somewhat fluid and change with the given context. There is no pure “Nature,” since nature or the environment, as we know it, is everywhere affected by human actions. “Environmental sociology” is meant to designate the subfield of sociology concerned with the interrelation between environment and society.

articles in the leading general sociological journals (e.g., Foster 1999; York, Rosa, and Dietz 2003; Hooks and Smith 2004; Jorgenson and Clark 2009; Rudel 2009; Grant et al. 2010). More significantly for the theoretical development of the field, perhaps, environmental sociologists have been engaged since the late 1990s in reconceptualizing the foundations of sociology to take into account green issues, attempting to construct, in this way, a postexemptionalist sociology. Marx and Durkheim in particular, and, in a much more limited and indirect way, Weber, have been reexamined for evidence of the environmental aspects of their thought.

The most decisive break in this respect arose in relation to Marx. Beginning in the 1990s a systematic reconsideration of Marx's environmental contribution has been under way, centered in sociology (O'Connor 1998; Burkett 1999; Foster 1999; Moore 2000; Dickens 2004; Foster, Clark, and York 2010). At the same time, the controversy over whether Durkheim's sociological approach created a theoretical blind spot with respect to the environment has led to important discussions of the ecological nexus of his work—focusing on how his modified evolutionism contributed to the development of human ecology (Järviöskö 1996; Buttel 2002; Catton 2002; Rosa and Richter 2008).

Yet Weber's work, in contrast, has remained an enigma within environmental sociology. West (1975) first systematically and positively assessed Weber's work from an environmental-sociological standpoint in a dissertation written in the mid-1970s. A book chapter by West (1985) based on his thesis appeared a decade later. But West's writings in this area (and particularly his dissertation), composed before the organization of environmental sociology as a field, are almost completely unknown (rare citations to West [1985] appear in Buttel [2002] and Murphy [2002]; while there are no citations at all to West [1975] by environmental sociologists—other than West himself—publishing in English up to the present).³

³ Using Web of Science and GoogleScholar we were able to ascertain that West's dissertation (West 1975) has been cited as of 2010 in English by someone other than himself only once—and in an article unrelated to environmental sociology. West's book chapter based on his dissertation has been cited (beyond his own work) in a total of four books and four articles—with only three citations (one in an article) occurring prior to 2000. The reason for the relative obscurity of West's work on Weber's environmental thought undoubtedly had to do with the fact that it preceded the organization of environmental sociology as a field. West's dissertation included two main chapters on Weber's ecological contributions, focusing on his historical-comparative works on religion (*Ancient Judaism*, *The Religion of China*, and *The Religion of India*) and on *The General Economic History* and also taking into account some crucial methodological issues. Our own analysis, although influenced by West's dissertation, attempts to approach these issues with more breadth and depth, relying on a much broader range of Weber's contributions, and aims at a larger synthesis.

Currently, the most prominent work related to Weber and the environment is that of Murphy (1994, 1997, 2002), who has provided a neo-Weberian approach to environmental sociology. However, this neo-Weberian perspective was itself predicated on the critical view that “the relation between social action and the processes of nature” was something that “Weber himself did not examine in any detail” (Murphy 1994, p. x).⁴

Weber has thus attained an enigmatic, even paradoxical, status within environmental sociology. On the one hand, it has been argued by leading environmental sociologists that “Weber’s relation to environmental sociology is the least controversial or problematic of the legacies of the ‘big three’” (Buttel et al. 2002, p. 8). On the other hand, these same thinkers went on to contend in the very same piece that Weberian contributions (including those of Weber himself) to the development of environmental sociology have been “relatively invisible.”

Indeed, claims that “Weber had little to say about the natural environment *per se*” (Blaut 1993, p. 83) are commonplace within the literature. “Max Weber,” Buttel (1986, p. 342) observed, “is almost never thought of as an ecological theorist.” “Of the classical trinity,” Goldblatt (1996, p. 3) contended, “Weber’s work conducts the most limited engagement with the natural world.” Benton (1991, p. 12) went so far as to declare that the very “oppositions between action and behaviour, meaning and cause, interpretation and explanation” that characterize Weber’s interpretive sociology have imposed “an impenetrable barrier to any project for a comprehensively naturalistic (i.e., biologically rooted) approach to the human sciences.” Benton and Redclift (1994, p. 5) declared that Weber’s sociological theory was characterized throughout by “space-time indifference,” making it immune to environmental influences.

Others have argued that, for the more interpretive strand of sociological thought emanating from Weber in particular, “the reality of a situation” lies “in the definition attached to it by the participating actors,” with the implication that “the physical properties of the situation” might be “ignored” (Choldin 1978, p. 353). Based on this, Dunlap (2002, pp. 332–34) stated that while “the Durkheimian antireductionist legacy suggested that

⁴ In a more recent essay, Murphy (2002, p. 74) has modified this earlier position—now claiming that embedded within Weber is an “ecological materialism.” In support of this he cites West’s (1985, p. 216) statement that “Weber’s ecological analysis emphasized the interactive role of geography, climate, natural resources, and the material aspects of technology in the structure and change in historical social structures.” Murphy does not follow up on this, however, and refers later in the same chapter to Weber’s “oversimplified view” of the relation between nature and mind as “characteristic of sociology, leading it to neglect the role of nature” (Murphy 2002, p. 80).

the physical environment *should* be ignored . . . the Weberian legacy suggested that it *could* be ignored.”⁵

Yet, for all of this, Weber’s broad contribution to environmental thought is not to be denied. In West’s argument (1985, p. 216), “Weber did not self-consciously develop an explicit ecology theory or perspective. But a comprehensive analysis of the role of ecological factors is implicit in [his] historical and comparative studies . . . [which] provide rich contributions to a sociological human ecology.” Robert J. Antonio (2009, p. 4) recently declared: “Although Weber was no ecologist, he grasped the tension between capitalist growth and the environment.” In his new biography of Weber, Joachim Radkau referred at one point to Weber’s “social ecology” (Radkau 2009, p. 443).

Given the comparative neglect of Weber’s environmental contributions within environmental sociology, it is ironic that probably the best-known statement by a sociologist referring to environmental factors is to be found in his famous declaration in *The Protestant Ethic and the Spirit of Capitalism*: “This [modern economic] order is now bound to the technical and economic conditions of machine production which today determine the lives of all the individuals who are born into this mechanism . . . with irresistible force. Perhaps it will so determine them until the last ton of fossil fuel is burnt” (Weber [1905/20] 1930, p. 181, translation slightly altered; Bell 1998, pp. 150–51).⁶ One could of course view this as a mere rhetorical flourish, unrelated to any substantive concern with the environment. Yet both the existence of “natural limits” on production and the “heedless consumption of natural resources,” particularly “coal and ore,” were important themes in his overall *Weltanschauung* (Weber 1946, pp. 364–66). Another concern of Weber’s was the robbing of the soil (*Raubbau*; see Weber [1907–8] 2005a, p. 147). Indeed, his critical view of naturalism/positivism did not prevent him from stating that “it is entirely proper” for sociology as a discipline “to take into account the physical and chemical balance sheets” of energy and natural resources (Weber [1909] 1984, p. 50). Within ecological economics Weber’s contributions to the sociology of energy are well recognized (Martinez-Alier 1987, pp. 183–92), though this has only rarely penetrated into sociology itself (for an exception, see Foster [1999, p. 370]). Perhaps the most startling indication of Weber’s environmental perspicacity, from today’s perspective, was his emphasis

⁵ In making such statements, however, Dunlap has professed himself agnostic on whether such criticisms are directly applicable to Weber and Durkheim themselves, though certainly pertaining to the traditions to which they gave rise (Dunlap 2002, p. 341).

⁶ Although employing the Parsons 1930 translation of *The Protestant Ethic* here and throughout this article, we have altered this passage slightly in conformity with Kalberg’s 2009 translation (Weber [1905/20] 2009, p. 157) to refer, as Weber did, to “fossil fuel” (Kalberg) as opposed to “fossilized coal” (Parsons).

in *Economy and Society* and elsewhere on adaptation to “climatic changes” as of crucial importance in the history of human development (Weber 1968, p. 70).

Nevertheless, understanding the role that environmental factors played in Weber’s thought constitutes a considerable conceptual challenge for sociological theory (and environmental sociology in particular). Although Weber, “unlike his contemporary, Durkheim,” Albrow (1990, p. 146) remarked, “had no reluctance to admit the causal significance of non-social factors for social processes,” the way in which this fits into his interpretive sociology and theory of rationalization still remained to be explained. As Albrow (1987, p. 182) stated with respect to Weber’s concept of rationality: “Population trends, resource limitations, health factors . . . all provide either the boundaries or the material for rational action but are outside the prescriptive rules of rationality.” From this perspective, then, the key to applying a Weberian approach to biophysical conditions appears to be understanding how “rationality and irrationality are locked in a dialectical embrace” (Albrow 1987, p. 182). Before Weber’s environmental insights can be addressed directly it is therefore necessary to explain the theoretical status of environmental factors within his interpretive sociology and causal analytics.

What emerges from such an investigation, we will contend, is a much wider conception of the systematic character and richness of Weber’s *verstehende Soziologie*—including the complex causal analysis associated with Weber’s overall approach to comparative-historical change (Kalberg 1994, pp. 69–70, 81, 148–49).⁷ Weber’s sociology can be seen as striving constantly for a balance between causes and interpretation, biophysical dynamics and meanings, nature’s constructions and society’s constructions, the material and the cultural. Perhaps nothing so clearly illustrates the complex, interactive character of Weber’s thinking than the attention he devotes to environmental influences and how they are refracted within cultural forms.

Indeed, environmental discussions play a large, though far from determining, role in Weber’s comparative-historical analysis of why societies came to differ from one another and, specifically, in his analysis of the

⁷ An underlying assumption of this article is that Weber’s interpretive sociology as encompassed in his concept of *Verstehen* has to be extended to encompass the more complex analysis of causal analytics revealed in his substantive works—if the significance of his environmental contributions is to be understood. As Kalberg (1994, p. 81) states: “In his [Weber’s] substantive texts, causal explanations are not provided alone by the central notion of *Verstehen*.” Thus, it is in Weber’s comparative-historical works that one is most likely to discover the complex interaction between the ideal-type as hypothesis-forming generalization and the manifold causalities revealed in the historical process (Ringer 1997, pp. 72–80).

origins and development of capitalism. A key element in the rise of industrial capitalism, he makes clear, was the discovery of the process of coking coal, without which industrialism in the modern sense would have been virtually impossible. Weber's analysis of the environmental conditions of capitalism, in fact, places heavy emphasis on the energy-intensive and fossil-fuel-intensive nature of the system, which could eventually place limitations, he suggested, on its further development. Weber was thus perhaps the first thinker to underscore the way in which a particular energy regime both enabled and constrained the development of capitalism. Indeed, Weber depicted capitalism at various points in his work as a major driver of environmental change, with notable repercussions for the future of society.

WEBER'S INTERPRETIVE/CAUSAL SOCIOLOGY AND THE ENVIRONMENT

Although environmental conditions often seem to stand outside Weber's sociology, operating as external parameters, a more accurate way of characterizing his approach in this respect, as West (1975) observed, would be in terms of significant environmental-social interactions. What needs to be explained, however, is how this was integrated both with the interpretive structure and the causal analytics of Weber's theoretical methodology.

In "Some Categories of Interpretive Sociology," Weber ([1913] 1981, p. 153) usefully observed: "The relevance for interpretive sociology of processes devoid of subjective 'meaning' [such as environmental factors]. . . lies exclusively in their role as 'conditions' and 'consequences' toward which meaningful action is oriented, just as climatic or botanical conditions are relevant for economic theory." However, once such environmental conditions and consequences have entered into human history and are no longer "devoid of subjective meaning," they are no longer mere external causes and consequences but become a part of cultural life. Structures of meaning and causal connections create a complex intellectual framework in which significant natural-environmental events are "anchored" in cultural-historical processes.

Thus in one of his principal methodological works, *Roscher and Knies*, Weber ([1903-5] 1975, pp. 107-8) sought to account for the interrelationship of physical-environmental factors and the complexes of causality and meaning that characterize social life, using the example of the Black Death/bubonic plague. "Was the meaning of the Black Death for social history," he rhetorically asked, "'contained' in the bacteria and the other causes of infection?" The answer was obviously no. What made the Black

Death socially meaningful was that it contributed to “historically *significant* consequences anchored in our ‘cultural values’” (Weber 1975, p. 105).

Drawing on the views of the influential German psychologist and philosopher Wilhelm Wundt, Weber insisted that the cultural reproduction of environmental events included “new properties” not reducible to the environmental conditions in which they were anchored (Weber 1975, p. 105).⁸ As Weber put it, “the *meaning* we ascribe to phenomena [environmental or otherwise]—that is, the relations which we establish between these phenomena and ‘values’—is a logically incongruous and heterogeneous factor which cannot be ‘deduced’ from the ‘constitutive elements’ of the event in question.” The chief significance of the Black Death for the cultural domain lay not in the “discovery of laws, e.g. bacteriological laws,” but rather the way “we ascribe historical ‘meaning’” to it as an event (Weber 1975, pp. 107–8, 141–42).

In order to make this methodological point clear, Weber referred a number of times, in both *Roscher and Knies* and *Economy and Society* to “the incursion of the Dollart [Dollard]” in the medieval and early modern Netherlands (near the Dutch-German border)—with storm floods leading to breaks in the sea defenses, massive loss of life and land, and the migrations that resulted from this. The cultural results, he insisted, were not “‘contained’ in the geological and meteorological causes which produced this phenomenon.” Rather such geological and meteorological events (like the bacteriological event represented by the Black Death) end up “anchoring” cultural history, insofar as they enter into human action and meaning (Weber 1975, pp. 107–8, 157; [1914–20] 1947, pp. 93–94; 1968, p. 7; Lambert 1971, pp. 84–87; Elvin 1984, p. 380).⁹ What Weber

⁸ Weber (1975, pp. 107–18) developed some of his key ideas in this respect in relation to Wundt’s psychology. But he rejected what he called the “metaphysical belief” and “apologetic” that led Wundt to promote a “belief in ‘progress’” in which “the culture of humanity” was seen as positively advancing “into the indefinite future.” See Wundt (1916, p. 10). On Wundt’s ideas in relation to sociology, see Martindale (1960, pp. 294–97).

⁹ It is perhaps illustrative of the relative neglect by sociologists of Weber’s environmental observations that, while he refers to the incursion of the Dollard (the flooding of the Ems, the overwhelming of the dikes, and the expansion of the Dollard basin) in a number of his works, including *Economy and Society*, the editorial treatment of this in published versions of his work is confused. The Parsons edition of Weber (1947, p. 93) refers to the incursion as occurring “at the beginning of the twelfth century,” while in the first complete English edition of *Economy and Society* (Weber 1968, p. 7) the date 1277 is added. Although the floods appeared over the late medieval and early modern periods, with one in 1287 leading to the loss of 50,000 lives (sometimes thought of as the date of the incursion of the Dollard) the storm flood probably most responsible for forming the Dollard basin occurred in the 15th century. The Dollard reached its fullest extent in the early 16th century (Lambert 1971, pp. 84–86; Haartsen and Marrewijk 2001).

called “the discursive nature of our knowledge” of the social, cultural, and historical sciences is thus not infrequently attached to environmental events, which become part of the content of the cultural realm, incorporated into “the causal explanation of cultural-historical ‘facts’” (Weber 1949, p. 94; see also Weber 1975, p. 142).

Another way of looking at this is in terms of Weber’s use of the concept of “refraction,” in which interests (material or otherwise) are seen as being refracted within cognitive culture (Weber [1916–17] 1958, p. 337; West 1975, pp. 19–20).¹⁰ The importance of “refraction” (or a “refractive effect”) as a concept in understanding Weber’s methodology was emphasized by Warner (1970, pp. 81–82, 85–86) and Smelser and Warner (1976, pp. 107, 133); while West (1975, pp. 19–20) applied it directly to Weber’s analysis of environmental-cultural linkages. As Smelser and Warner (1976, p. 133) indicated, “refraction suggests the contingent or switching function of ideas that was of great importance to Weber.” In this way, they associated it with Weber’s famous metaphor of the “switchman,” whereby ideas “switch” the route taken (altering the original direction derived from other more elemental forces) and thus end up becoming forces in themselves (Weber 1946, p. 280).

Here we use the concept of refraction in a somewhat different but related way, in order to indicate the manner in which environmental causes are refracted through a cultural lens. What were originally material-environmental influences assume an altered form (are refracted or bent as in light) and take on new content within the realm of cultural meanings and social interaction.

For example, in *Ancient Judaism*, Weber argued that due to harsh environmental conditions, Bedouins and semi-nomads were caught in a “selective struggle for existence,” which favored certain cultural forms. Their lives revolved around camel breeding and control of oases and trade routes. This outcome was thus refracted in a complex way within cultural (including religious and political) institutions (Weber [1919] 1952, p. 80; see also Weber 1968, p. 40; 1958, p. 337; 1949, p. 187; Ringer 1997, pp. 68–74).

This whole understanding of the cognitive refraction of environmental causes/interests within the cultural prism of a historical society thus constitutes the primary conceptual basis for Weber’s approach to the environmental-cultural nexus. “The forces of nature become an intellectual

¹⁰ Weber (1958, p. 337) wrote in *The Religion of India* that the “drive for gain” in India was “lacking in precisely that which was decisive for the economics of the Occident: the *refraction* and rational immersion of the drive character of economic striving and its accompaniments in a system of rational, inner worldly ethic of behavior, e.g., the ‘inner-worldly’ asceticism of Protestantism in the West” (italics added).

problem,” Weber wrote, “as soon as they are no longer part of the immediate environment”—that is, as soon as they are viewed at a distance, through a process of objectification (Weber 1968, p. 1178). In this way significant aspects of the environment become intellectualized and part of the cultural domain and are given specific historical meaning but only through the objectification of nature itself.

It was perfectly rational from an environmental perspective, Weber ([1911] 1978, p. 390) suggested, to seek to ascertain “which specific concrete elements in the particular cultural phenomena are determined by climate or similar geographical factors.” Weber had no doubt that environmental factors had a causal impact on human culture and vice versa. As Kalberg states, “Weber viewed *geography* [environment] as not only capable of setting distinct parameters to social actions—ones that, moreover, could remain effective over long periods of time—but also as itself constituting a causal force” (Kalberg 1994, pp. 69–70). Yet, equally important to Weber was how such environmental factors, if they came to bear on a culture, were then refracted in complex ways within the culture itself.

The complex, interpenetrating causality here, with environment and culture seen as mutually determining, was crucial to Weber’s overall perspective—as was his emphasis on the confrontation of reason (interpretation) and reality (empirical causes). Sociology, he stressed, was not to be conceived as an “empirical science of concrete *reality*,” but rather as the “confrontation of empirical reality with the ideal-type” (Weber 1949, pp. 72, 110). It was therefore both interpretive and causal-analytic. Perhaps nowhere else is this complex framework of Weber’s thought more evident than in his understanding of the environmental-cultural interface.

The epistemological sophistication of Weber’s treatment of the environment can be seen in his extraordinarily nuanced analysis of the concept of “nature” in his *Critique of Stammer*. “In ordinary discourse,” Weber writes:

The word “nature” is used in several ways. (1) Sometimes it refers to “inanimate” nature. (2) Or sometimes it refers both to “inanimate” nature and to all “organic” phenomena that are not distinctively human. (3) Or sometimes it refers to both these objects and, in addition, to those organic characteristics of a “vegetative” or “animal” sort which men and animals share. . . . In each of these three senses . . . nature is invariably conceived as a complex of certain kinds of *objects*, a complex that is distinguished from another complex of *objects* which have different properties. (Weber [1907] 1977, p. 96)

Based on such close scrutiny of the concept, Weber insisted on the fundamental “ambiguity of the concept of ‘nature’” (Weber 1977, p. 97). However, the theoretical import of this ambiguity led not, in his view, to the rejection of the concept itself, if properly handled, but rather to the

rejection of “naturalistic” or positivistic attempts to cordon off “nature” from society. What he objected to especially was the attempt to construct “an absolutely strict and mutually exclusive conceptual distinction between the objects ‘nature’ and ‘social life’” (Weber 1977, pp. 95–96).

Weber dealt with the complexity and ambiguity of nature in *The Religion of India*, where he wrote: “Before the cosmos of nature we think: it must still—be it to the analyzing thinker, be it to the observer contemplating the total picture and its beauty—have some sort of ‘last word’ to say as to its ‘significance.’ . . . Whether there is such a ‘last word’ as to the meaning of nature is a metaphysical indeterminable” (Weber 1958, p. 340). In other words, the overriding significance of nature was not to be doubted. But the cognitive domain mediated its cultural impact. Here Weber expressed his epistemological sophistication, in neo-Kantian terms. Nature in its pure state, or the realm of the noumena (the Kantian thing in itself), was unknown and unknowable; nevertheless, human sense perception allowed us to explore empirical phenomena as mediated by the categories of the understanding and human reason.¹¹

Steeped as he was in neo-Kantian epistemology, Weber (1977, p. 91) saw the “conflation of laws of nature and ‘categories’” (of understanding) as philosophically naïve. Nevertheless, this did not exclude realism of a more crucial kind. Nature was both something external to society (first nature), and in that sense not entirely knowable—that is, in its pure form as “the thing in itself,” independent of human cognitive powers. At the same time it was part of society/culture (second nature), where it was interwoven with cultural meanings. Here nature becomes truly part of the human world. As Weber put it, “the outside world which is relevant for economic theory may in the particular case be ‘nature’ (in the sense of ordinary language [i.e., first nature]) or it may be ‘social environment’ [second nature]” (Weber [1908] 1975, p. 31). Second nature was a hybrid, “man-made product” interpenetrating with society (Weber [1908] 1976, p. 84).

Weber’s insistence that what are often taken to be the impermeable barriers between the biophysical/natural and cultural/sociological realms governing human action are actually quite porous is made explicit in his *Critique of Stammer* through the example of Robinson Crusoe as depicted in Defoe’s novel. Weber objected to Stammer’s contention that the actions of Robinson Crusoe on his island, since they were carried out by an isolated individual in relation to his environment, were merely “natural” and “technical” and thus could be relegated to the realm of natural science

¹¹ On neo-Kantianism and Weber’s complex relation to it, see Martindale (1960, pp. 220–66, 376–83).

rather than social science. Rather, for Weber the constellation of causes governing what Crusoe did on his island was both environmental and social, while the meanings attached to the environment were social and thus belonged to the domain of sociology. Thus, Weber pointed out that if Robinson Crusoe, concerned with the “reforestation” of his island, were to choose to make certain “marks” on trees, this is a social meaning (the legacy of the society from which he came) that reflects the complex interpenetration of environmental and social causes. It thus lies within the social realm, as well as being related to factors outside of it—that is, ecological conditions (Weber 1977, pp. 100–104, 110–11; Ringer 1997, p. 99).

Weber’s interpretive approach, combined with what Kalberg (1994, p. 148) has called his “radical multicausality,” formed the basis of his interpretive-causal approach to environmental issues—that is, the contingent anchoring of the cultural in the biophysical, so often revealed in his comparative-historical study of society. This complex cultural refraction of environmental causes within social meaning/interpretation and multicausality is evident to varying degrees in all of his major comparative-historical works: *The Agrarian Sociology of Ancient Civilizations*, *Ancient Judaism*, *The Religion of China*, *The Religion of India*, *The Protestant Ethic and the Spirit of Capitalism*, and *The General Economic History*. It is also present at certain points in *Economy and Society*.

In line with what we take to be the general thrust of Weber’s environmental-sociological contributions, it is possible to designate two broad, comparative ideal-typical social epochs, corresponding to different phases of history/modernization: (1) traditional-organic and (2) rational-inorganic. Thus, the analysis of Weber’s chief environmental insights in what follows will be divided into two parts, reflecting these two phases of cultural-material development. For Weber, the traditional-organic phase can be seen as encompassing a wide variety of pre-industrial-capitalist societies; while the rational-inorganic phase is associated with the rise of industrial capitalism. As we shall see in the following discussion, it is the reliance on “inorganic” sources of energy (fossil fuels), along with energy-intensive and high-resource consumption, that, for Weber, distinguishes the environmental context of industrial capitalism. In this conception, capitalism, in fact, emerges as the major driver not only of the rational-inorganic phases of development but also of growing natural-resource constraints.

THE TRADITIONAL-ORGANIC ERA IN HUMAN HISTORY: THE ENVIRONMENT AND NONINDUSTRIAL SOCIETY

The ideal-typical distinction between the traditional-organic period in world history, governed by natural cycles, and the rational-inorganic world, in which the “organic cycle of simple peasant existence” no longer dominates human awareness, was a thread running throughout Weber’s work (Weber 1968, p. 607; 1946, p. 346). He saw the “rational systematization” (and disenchantment) of the “total life pattern” as antithetical to “the lot of peasants,” which was “so strongly tied to nature, so dependent on organic processes and natural events” (Weber 1968, pp. 468, 607).

These observations on the dissolution of traditional-organic life were closely linked to the notion that rational industrial capitalism depended on “substituting inorganic raw materials and means of production for organic raw materials and labor forces” (Weber 1946, pp. 364–66). Such liberation from natural limits was, however, only possible under specific historical conditions that would not persist.

Given that Weber saw the role of environmental factors taking on quite different meaning for society in the traditional-organic and rational-inorganic (or nonindustrial and industrial) eras, his historical inquiries were divided into these two periods—conceived as ideal-typical generalizations intended to guide our inquiries into empirical history. In terms of his major substantive historical works this means that such studies as *Ancient Judaism*, *The Religion of China*, *The Religion of India*, and *The Agrarian Sociology of Ancient Civilizations*, as well as most of the first three parts of the *General Economic History* relate primarily to society at a time when traditional-organic relations were, in his view, predominant; while the later parts of *The General Economic History* and *The Protestant Ethic and the Spirit of Capitalism* belong to the rational-inorganic era.

In relation to the traditional-organic era, Weber thus explores a wide variety of environmental-cultural relations, including the effect of climate on religion in Palestine; the role of hydraulic bureaucracies in Mesopotamia, Egypt, and China; the effects of rain-fed agriculture in Europe; and the deforestation associated with early industrialization (and the smelting of iron with charcoal) primarily in Britain. In relation to the rational-inorganic era, he discusses the “fateful unity” of coal and iron; the robbery of the land by capitalist agriculture; the destruction of the organic cycle of life; the sociology of energy; and the rationalization and “disenchantment of the world”—all of which were to be exemplified by the United States.

Ancient Judaism and Climatic Conditions

Weber's comparative approach to environmental-cultural interactions is most explicit in his *Ancient Judaism*, which offers what Radkau (2009, p. 443) has called a "social ecology of the Jewish religion." This work begins with a consideration of general historical and climatic conditions. For Weber Palestine and the surrounding regions offered a laboratory with respect to environment-cultural relations. Ancient Palestine in the period from the settlement of Israel to the Division of the Monarchy (from approximately the 13th to the 10th centuries BCE)—lay precariously between the two great civilizations of Mesopotamia and Egypt, both of which intruded on its history. The nearness to Egypt raised the question as to why Egyptian culture had not penetrated more deeply into Judaic beliefs. Weber explained this as mainly due to "profound differences in natural environmental conditions" underlying the social orders. "The Egyptian corvée state, developing out of the necessity of water regulation and the construction works of the kings" was seen by the "inhabitants of Palestine as a profoundly alien way of life." Thus the separation of the two realms was "based on natural and social differences." Just as ancient Egyptian culture was the refractive effect of the environmental conditions of the Nile, cultural life in ancient Palestine was the refractive effect of rain-fed agriculture and stock breeding (Weber 1952, pp. 5–8).

Palestine itself afforded "important climatically-determined contrasts in economic opportunities" (Weber 1952, p. 8). These varied from fairly settled or semi-settled peasant agriculture and stock breeding of goats, sheep, and cattle on the mountain slopes and plains to the nomadic existence characteristic of Bedouin tribes in the marginal and desert lands to the east and south. Given that irrigation-based agriculture was limited, peasant farmers, and even more so herders who engaged in stock breeding in the mountainous areas, were dependent on rainfall, which varied dramatically, seasonally and annually. The entire region was prone to numerous natural depredations, including violent storms, which eroded the sandy soil, and droughts. During droughts, herders purchased grain from Egypt or were forced to migrate. Life was therefore, in Weber's words, "meteorologically precarious" (Weber 1952, pp. 8–10; see also Weber 1976, pp. 134–35; Bendix 1960, pp. 219–22; West 1975, pp. 77–79). He so much identified the social, cultural, and economic developments of the tribes of Israel with the land from which they sprang that when describing the eventual coalition of peasants and herdsman against urban patricians he wrote: "With slight inaccuracy one might say: it was the struggle of the mountain against the plain" (Weber 1952, p. 54).

Climatic variance also created sharp cultural differences between the Hebrew tribes and the surrounding Bedouins, located mainly to the south

and east, where the “sterile desert . . . has been and is a place of horror and demons” (Weber 1952, p. 8). “Naturally given contrasts in economic conditions,” he observed, “have always found expression in differences of the social and economic structure.” The desert Bedouins, as distinct “from the settled Arab,” were nomadic “tent-communities,” without any kind of real state organization, engaged in camel breeding and occupying oases and caravan routes (Weber 1952, pp. 8–13; Bendix 1960, p. 219).

Environmental factors within Palestine and the surrounding regions were refracted in Judaic religious doctrines, which showed strong evidence of the natural conditions in which they arose. To illustrate some of the religious implications, Weber contrasted Yahweh with the god Baal (standing in fact for numerous local deities). Like the “Babylonian god, Bel, Lord of the Fertile Soil,” the Palestinian Baal was a fertility god attached to the earth—“lord of the land, of all of its fruits” (Weber 1952, pp. 154–55). Juxtaposed to this, Yahweh, worshipped by the Jews, was primarily a god from afar—a “rain god,” a god of thunderstorms, and a “war god.” Yahweh showed his “sovereign might and greatness in the events of nature.” Indeed, “he was originally a god of the great catastrophes of nature.” The biblical stories of military victory, such as the parting of the Red Sea and the devastation of the Egyptian armies, were viewed by Weber as likely emanating from natural catastrophes (ebb-tide, volcano, etc.) which were then refracted in particular religious beliefs: in Yahweh as a god of wrath. “This historically [and climatically] determined peculiarity of God [Yahweh]” was “fraught with consequences [extending] into times when the early Christian doctrine of natural law emerged” (Weber 1952, pp. 124, 128–33; see also Weber 1968, p. 449; [1915] 1951, pp. 21, 23; Bendix 1960, pp. 229–30).

Although there are places in *Ancient Judaism*, as Radkau (2009, pp. 441–42) has noted, that appear to point to a kind of “ecological determinism,” the predominant notion is that “natural conditions do not determine forms of human life but contain several different opportunities: instead of ecological determinism, then, a possibilism that corresponds to our present state of knowledge.”

Hydraulic Bureaucracy

The best known, but also most controversial, of Weber’s treatments of environment-culture interactions is his discussion of hydraulic civilizations in Asia. Weber drew on a set of prevailing theses on “Oriental Despotism,” the Asian mode of production, and hydraulic society. Although such notions were central to much of 19th- and early 20th-century

European thought, particularly Marx, Weber, and Karl Wittfogel (1956, 1957), they are largely rejected today.¹²

The idea that the dependence of Asian agriculture on the construction and regulation of navigable canals and irrigation systems led to extensive public works and systems of centralized, state-bureaucratic power was first suggested by Adam Smith ([1776] 1937, pp. 646, 789–90) and John Stuart Mill ([1848] 1904, p. 8) and adopted by Marx in June 1853, in an article for the *New York Tribune*:

Climate and territorial conditions, especially the vast tracts of desert, extending from the Sahara, through Arabia, Persia, India and Tartary, to the most elevated Asiatic highlands, constituted artificial irrigation by canals and waterworks [as] the basis of Oriental agriculture. As in Egypt and India, inundations are used for fertilizing the soil of Mesopotamia, Persia, etc. . . . Hence an economical function devolved upon all Asiatic Governments, the function of providing public works. This artificial fertilization of the soil, dependent on a Central Government, and immediately decaying with the neglect of irrigation and drainage, explains the otherwise strange fact that we now find whole territories barren and desert that were once brilliantly cultivated, as Palmyra, Petra, the ruins in Yemen, and large provinces of Egypt, Persia and Hindustan. (Marx and Engels 1972, p. 37)

Marx was later to expand this interpretation in the *Grundrisse, Capital*, and his *Ethnological Notebooks* into a larger theory of the “Asiatic mode of production”—a term, however, that he used only one time in 1859 (Marx [1859] 1970, p. 21; O’Leary 1989, pp. 82, 104). In *Capital* Marx briefly discussed the role of irrigation in “the domination of the priests as the directors of agriculture” and the way in which this was related to the development of astronomy and the management of agricultural systems (Marx [1867] 1976, pp. 649–50). In *Anti-Dühring* Engels ([1876–78] 1969, p. 215) returned to the original hydraulic civilization notion, which, except for this brief mention in *Capital*, had been deemphasized by Marx for 20 years (Anderson 1974, p. 482). Lawrence Krader (1975, pp. 286–96) has conceptually divided Marx and Engels’s treatment of the Asian mode into 24 separate elements, with the hydraulic civilization element as only one of these. It is clear that the central purpose of the concept of the Asian mode of production in Marx’s theory was to provide a comparative-historical explanation for why capitalism had not developed in Asia as

¹² Marx’s concept of the Asian mode of production was derived primarily from earlier views developed by classical political economists associated with colonial policy such as Adam Smith, James Mill, John Stuart Mill, and Richard Jones. The two Mills were employees of the British East India Company. Jones was Malthus’s successor as professor of political economy at the East India College. See Mill (1904, pp. 105–6, 255), Wittfogel ([1929] 1985, p. 38), Winch (1965, pp. 163–64), Anderson (1974, pp. 464–72), and Krader (1975, pp. 5–7, 183).

in Europe. In doing so he ended up focusing primarily on the issue of the village community as opposed to hydraulics (Melotti 1977, pp. 8–21).¹³

But for some later social theorists the hydraulic civilization argument was to loom particularly large: most notably in the writings of Weber and Wittfogel. It was Wittfogel, going beyond both Marx and Weber, as Krader (1975, p. 115) has noted, who “made the hydraulic interpretation of the Oriental society into the central one,” leading to a “hypostatization of water control” in what amounted to an environmentally determinist argument. Today scholars have abandoned this view as based on faulty Eurocentric preconceptions.¹⁴

Weber’s own approach to the analysis of Asian societies, though not beyond reproach from the present-day standpoint, was complex, multi-causal, and based on varied sources. Nevertheless, central to much of his analysis was the development of what he called “‘hydraulic’ bureaucracy” (sometimes referred to as “irrigation bureaucracy”), which he incorporated as a central component in his overall comparative cultural interpretation (Weber 1968, p. 198; [1919–20] 2003, p. 57). Here Weber focused on the need in Mesopotamia, Egypt, China, and Ceylon (and to a lesser extent India)—viewed as great river civilizations existing within arid or semi-arid climates—for extensive engineering works related to irrigation, canals, dams, and dikes. This led in turn to state bureaucracies and royal power (Love 2000, p. 175). For Weber most ancient civilizations, particularly in the East, were “riparian in character” (Weber 2003, pp. 97–98).

The most obvious, and at first sight perplexing, feature in Weber’s claims about hydraulic bureaucracy in Asia is the seemingly strong causal determinacy of many of his statements. Thus he claimed that, in Mesopotamia, Egypt, and much of China, irrigation was an absolute “necessity” imposed by an arid or semiarid environment, a question of winning land back from the desert. The “Mesopotamian and Egyptian subject,” Weber (1976, p. 106; 1968, pp. 971–72, 1091; 1951, pp. 20–21) noted, “hardly knew rain.” The lack of rainfall led directly to a bureaucratic state with irrigation as its “prerequisite” (Weber 1951, p. 20). In *Economy and Society* he wrote: “The *necessity* of river regulation and an irrigation policy in the Near East and Egypt, and to a lesser degree also in China, *caused* the development of royal bureaucracies” (Weber 1968, p. 1261; italics

¹³ Weber’s (1958) argument in *The Religion of India* focuses too on the village community rather than hydraulics, showing some similarity to the later Marx in this respect.

¹⁴ On contemporary criticisms of the Asiatic mode and the hydraulic civilization hypotheses, see Anderson (1974, p. 548), Chandra (1981, pp. 14, 47), Mann (1986, pp. 94–98), and Blaut (1993, pp. 80–90). Nevertheless, strong traces of such views, particularly with respect to the hydraulics argument, can still be found in the literature (e.g., Jones 1987, p. 8).

added).¹⁵ Elsewhere in the same work he asserted: “In Mesopotamia irrigation was *the sole source* of the absolute power of the monarch” (Weber 1968, p. 449; italics added). In *The Religion of China*, he was equally emphatic: “Political subjection to princely power was *determined by river control* [in China] in the manner of Egypt and the Middle East” (Weber 1951, p. 64, italics added). In *The Religion of India* he insisted that Ceylon’s “kingship [was] *based upon* a magnificent irrigation system” (Weber 1958, p. 257; italics added). Such statements raised the issue of what Radkau (2009, p. 82) has called the “paradoxical ecological determinism” that occasionally seemed to appear in Weber’s writing.

However, despite such strong, deterministic-sounding statements—which showed the causal importance he placed on these environmental factors—it would be a serious mistake if one were to interpret him as a rigid thinker in this respect. Weber should not be confused, as some have done (e.g., Blaut 2000, pp. 21–24), with Wittfogel. For Weber, as we have seen, environmental causes never gave rise to a simple determinism in which an environmental event is adequate to produce a particular cultural result. Rather such material causes were refracted in complex ways within a given culture. Hence, the somewhat exaggerated statements on the role of environmental factors in the development of state formation in Asia arose not from determinism as such but, rather, from the comparative-historical perspective underlying his studies in the sociology of religion. Contrasting ideal types were being drawn between two different forms of civilizational rationality, attributable in part to varying environmental influences, distinguishing Asia, where rainfall was sparse and irrigation necessary, and Europe (and Palestine), where rain-fed agriculture was common. Thus Weber compared the “relatively individualist activity of clearing virgin forest” in the rain-fed agriculture of Europe to the state-dominated building of irrigation canals in Mesopotamia, Egypt, central and southern China, and Ceylon (Weber 1976, p. 84). Despite deterministic-sounding statements with respect to hydraulic civilizations, there is no doubt—particularly if entire texts are examined—that Weber’s understanding of the complex chain of cultural meanings through which such conditions were refracted was a multicausal one.

¹⁵ In relation to China, Elvin (1984, p. 386) indicates that Weber was wrong in his notion of a hydraulic state. “Except for some important large scale operations that mostly appeared rather late, the greater part of irrigation and flood defense was maintained by collectivities as opposed to supervision and the adjudication of disputes. Doubts about Weber’s position here are questions of balance and nuance.”

European Rain-Fed Agriculture, Forest Clearances, and Landholdings

In Weber's comparative-historical conception of European development such key geographical factors as the "position of the Mediterranean as an inland sea, and the abundant interconnections through the rivers, [clearly] favored . . . the development of international commerce" and mercantilist development in Europe, as opposed to the "decisively inland commerce" of China and India. Nevertheless, industrial development in Europe was to occur not on the seacoasts but in the interior regions, once cleared of forests. "Capitalism in the west," he wrote, "was born in the industrial cities of the interior, not in the cities which were centers of sea trade" (Weber 2003, p. 354). In Weber's overall comparative-historical perspective on East versus West, "the rationalization of the irrigation economy in the ancient Orient" was anchored in the state-patrimonial bureaucracy. "By contrast, acquisition of new land through the clearing of forests in Northern Europe favored the manorial system and therefore feudalism" (Weber 1968, p. 1091).

As in John Locke's ([1690] 1952, p. 17) theory of property, the clearing and cultivation of the earth converted it into landholdings. Thus Weber (1968, p. 132) defined "land" as opposed to the earth or soil as a social artifact created "by virtue of clearing or irrigation." For the "oriental economy—China, Asia Minor, Egypt,—irrigation husbandry became dominant, while in the west where settlements resulted from the clearing of land, forestry sets the type" (Weber 2003, p. 56). Forest clearings to increase cultivable land therefore constitute an integral part of Weber's theory of agricultural and community development.

In discussing the role of forest clearings in generating the "economic milieu" (Weber 1946, p. 379) of Germanic agricultural development, Weber explained that land settlement in the Germanic region took the village form. These villages were associated with a very large tract of land called the "mark," which included wood and wasteland as commons. There was a head official of the mark, usually preempted by the king or lord, and a "wood court" representing those that originally had equal land allotments associated with the various communities (Weber 2003, p. 9; see also Engels [1882] 1978).

The rise of the manor and seigniorial property increased demand for servile labor to further land appropriation through forest clearings. The lords of the manors "regularly appropriated to themselves the common mark and often the common pasture" (Weber 2003, pp. 66, 71). The great Peasant War in Germany, beginning in 1525, was waged against this usurpation, with the peasants demanding free access to woodlands and pasture. These, however, "could not be granted as the land had become

too scarce, and fatal deforestation would have resulted as in Sicily" (Weber 2003, p. 72).

As markets emerged for agricultural goods, and the commercial interests of the bourgeoisie developed, the manor system, which was "originally directed toward using dependent land and dependent labor force to support an upper class life," gave way to the two forms of plantation and estate (Weber 2003, p. 79). "With the dissolution of the manors and of the remains of the earlier agrarian communism through consolidation, separation, etc. private property in land" was established, and much of the population permanently dislocated. This transformation of the countryside "was bound up with the development of industry and trade" (Weber 2003, p. 111). These changes associated with nascent capitalist development "disrupted the 'natural' rhythms of pre-modern means of production and consumption in the traditional household" (Turner 1991, p. xxiv). Co-operative village agriculture (the old German "mark"), "bound to place, time and organic means of work" was completely dissolved, as the epoch of wood gave way to the age of iron and coal, associated with the transition to industrial capitalism (Weber 1946, p. 368).

Deforestation: From the Epoch of Wood to the Age of Iron

For Weber, a revolutionary transformation in the role of forests, setting off a deep-seated ecological crisis, played a critical role in the transition to industrial capitalism. In the precapitalist period, land was cleared primarily to advance agriculture or enlarge the landholdings of the lord. Now suddenly forests and the land in general were sites of accelerated resource extraction necessary to feed industry. "Capitalism," Weber (1946, p. 367) wrote, "extracts produce from the land, from the mines, foundries, and machine industries."

The mercantilist period in the 16th, 17th, and early 18th centuries saw rapid deforestation in Europe, and particularly in Britain, where the smelting of iron with charcoal intensified demand for wood. This was the great ecological crisis that occurred at the very moment that Europe was on the verge of an industrial revolution. As Weber (2003, p. 304) put it: "Until the 18th century the [iron smelting] technique was determined by the fact that smelting and all preparation of iron was done with charcoal. The deforestation of England resulted. . . . Everywhere [where industrialization was taking place] the destruction of the forests brought the industrial development to a standstill at a certain point," threatening the nascent industrial take-off. "However energetic landowners and farmers might be in afforestation," historian T. S. Ashton (1951, p. 17) was later to write, "they could hardly hope to keep pace with this development: in Malthusian language, though the supply of charcoal might at best increase

in arithmetical proportion, the needs of industry increased in geometrical proportion.”

In early industrial England, verses were sung celebrating John Wilkinson, a pioneer in the new coked iron and steel: “That the wood of old England would fail, did appear, / And tough iron was scarce because charcoal was dear, / by puddling and stamping he cured the evil, / So the Swedes and Russians may go to the devil” (Radkau 2008, p. 149). The last line refers to the imports of wood in the 18th century to supply charcoal for the iron mills in England prior to the introduction of the process for smelting iron with coal. In France as well as England protests against the overtaxing of forests in response to the demands of ironworks arose (Radkau 2008, p. 149). So serious, Engels indicated, was the shortage of wood for charcoal in the 18th century until the means of smelting iron with coal became widespread, that the English were forced when the environmental crisis peaked to “obtain all their wrought iron from abroad” (Marx and Engels 1975, 3:484).¹⁶

Energy analyst and historian Vaclav Smil (2008, p. 191) has recently explained the severity of the charcoal-smelting crisis facing the nascent industry in the period of charcoal-based iron smelting:

During the early eighteenth century a single English blast furnace, working from October to May, produced 300 t[ons] of pig iron. With as little as 8 kg of charcoal per kilogram of iron and 5 kg of wood per kilogram of charcoal, it needed some 12,000 t[ons] of wood. . . . In 1720 60 British furnaces produced about 17,000, t[ons] of pig iron, requiring about 680,000 t[ons] of trees. Forging added another 150,000 t[ons], for a total of some 830,000 t[ons] of charcoaling wood. . . . Already in 1548 anguished inhabitants of Sussex

¹⁶ Another sign of the failure of Weber scholars to take the environmental aspects of his analysis seriously is the following sentence, containing a major error, in his *General Economic History*: “The smelting of iron with coal instead of charcoal first begins to be typical in the 16th century, thus establishing the fateful union of iron and coal” (Weber 2003, p. 191). The sentence should clearly have said: “begins to be typical in the late 18th century.” The process of smelting iron with coal was not invented by Andrew Darby until 1709 (although historians still debate whether it was first developed by Dud Dudley in the 17th century, and then the method was lost). It did not become typical until late in the 18th century (in 1788 the number of charcoal furnaces in England and Wales had finally fallen to 24, as compared to coal furnaces which had by then reached 53; Gale 1969, p. 29; see also Lord 1966, pp. 23–24). Indeed, not only was Weber himself well aware of the fact that the smelting of iron with coal was only introduced in the 18th century (he provides 1740 as the date of its first introduction), but he also made this a central part of his argument elsewhere in his *General Economic History*, as indicated in the text above. This curious error might be attributable to the fact that his *General Economic History* was compiled from very scattered notes of his lectures, left behind by Weber and kept by his students (Käsler 1988, p. 48). But it is also an indication of the general neglect by sociologists of the environmental aspect of his thought that this contradiction in the text as it has come down to us has apparently gone unnoticed.

wondered how many towns would decay if the iron mills and furnaces were allowed to continue (people would have no wood to build houses, watermills, wheels, barrels, and hundreds of other necessities), and they asked the king to close down many of the mills. . . . Widespread European deforestation was to a large degree a matter of horseshoes, nails, axes (and mail shirts and guns).

Too late to save England's forests, coked coal was introduced in the smelting process in the early 18th century, becoming widespread in England only late in the century. "Germany," Weber remarked, "was [only] saved from this fate [deforestation] by the circumstance that in the 17th and 18th centuries it was untouched by capitalist development" (Weber 2003, p. 304).

For Weber the discovery of the process for smelting iron with coal constituted what he called the "fateful union of iron and coal," without which, in his view, the industrial revolution was scarcely conceivable. Indeed, "the victory" of the industrial revolution, he emphasized, "was decided by coal and iron," in particular the "coking of coal . . . and the use of coke in blast furnace operation" (Weber 2003, pp. 191, 304–5). The dramatic introduction of a coal-smelting process for iron anchored the industrial revolution in particular environmental-technological conditions, in which coal was king. Today historians concur with Weber regarding the limits of charcoal-based iron smelting, the crisis this posed for nascent industry, and the dire consequences if it had persisted: "An impossible amount of woodland would have been needed if iron producers had continued to use charcoal by the year 1850" (Whited et al. 2005, p. 94). "The forest [land in British isles]—or what was left of it—was saved only by coal, a fuel more suitable for industry than charcoal" (Bechmann 1990, p. 154). For Weber the shift from charcoal smelting to coke smelting represented a critical historical turning point, without which the emergence of industrial capitalism and the rational-inorganic phase of development would have been blocked.

THE RATIONAL-INORGANIC ERA IN HUMAN HISTORY: THE AGE OF COAL, IRON, AND INDUSTRIAL CAPITALISM

Weber's best-known definition of modern capitalism is the one provided in his 1920 "Prefatory Remarks" to his *Sociology of Religion*. There he wrote:

We will define a capitalistic economic action as one which rests on the expectation of profit by the utilization of opportunities for exchange, that is on (formally) peaceful chances of profit. . . . In modern times the Occident has developed . . . a very different form of capitalism which has appeared nowhere else: the rational capitalistic organization of (formally) free labour. . . .

Rational industrial organization, attuned to a regular market . . . is not, however, the only peculiarity of Western capitalism. The modern rational organization of the capitalistic enterprise would not have been possible without two other important factors in its development: the separation of business from the household, which completely dominates modern economic life, and closely connected with it, rational book-keeping. (Weber 1930, pp. 17–22)

Weber thus treated capitalism (along with modern bureaucracy) as representing the fullest development of formal rationality or rationalization. This was consistent with his argument in *The Protestant Ethic and the Spirit of Capitalism*. In his *General Economic History* Weber, however, went somewhat further, providing what Collins (1986, p. 20) has called his “full theory of capitalism as a historical dynamic.” Hence, environmental factors enter in at a causal level, with the rational organization of the modern industrial enterprise anchored in environmental-technological conditions.

Modern industrial capitalism, associated with machine development and rational calculation, was, according to Weber’s description of it in *The General Economic History*, anchored in “the age of iron,” which was just as much the age of coal, “the most valuable and most crucial of all products peculiar to the western world” (Weber 2003, pp. 190–91). Since coal was viewed as an inorganic or nonrenewable form of energy, modern capitalism was, in Weber’s conception, an age dependent on “substituting inorganic” for “organic” materials/energy (Weber 1946, pp. 364, 368). A similar observation on the shift to “inorganic energies” from an earlier reliance on human and animal (or physiological) energy was made by Weber’s contemporary, the German chemist and energetics theorist, Wilhelm Ostwald (1907, p. 512; Stokes 1995, p. 136). Weber’s central distinction here between “traditional-organic” and “rational-inorganic” phases in the development of energy was to be elaborated upon decades later in the United States by Mumford (1934), who differentiated between the “ecotechnic” and “paleotechnic” phases of civilization. More recently, Collins (1986, p. 78) has referred to this transformation from the traditional-organic to the rational-inorganic—as presented in Weber’s analysis of historical development—in terms of the shift, at the time of the industrial revolution, from “agrarian to inanimate-energy-based technologies.”

Today this change, highlighted by Weber, is commonly described as the shift from biomass to fossil fuels as the primary form of energy. In the world at large, 1,000 million metric tons of biomass were consumed as fuel in 1800, as opposed to 10 million metric tons of coal. By Weber’s day, in 1900, 1,400 million metric tons of biomass were consumed globally but coal consumption rose to 1,000 million metric tons, and oil had made its appearance, accounting for 20 million metric tons (McNeill 2000, p.

14). Industrial development has come to be identified with this shift to “inorganic” materials/energy in the form of coal and petroleum. In Weber’s view, this broad transformation paralleled the development of modern, rational chemistry, represented by Justus von Liebig, and its introduction of new synthetic chemicals (Weber 2003, p. 306).

Coal was seen as crucial to the rise of industrial capitalism, in the eyes of 19th- and early 20th-century observers, not simply because of its role in powering industry through steam engines—though its importance in that respect was indisputable—but even more so because coked coal was the basis of blast furnace technology for the smelting of iron. In 1869 coal consumption by the iron and steel industries in Britain was greater than the combined coal consumption of both general manufactures and railroads (Jevons [1865] 1965, pp. 138–39; Hobsbawm 1969, pp. 70–71).

In Weber’s conception coal was more important and indispensable than even the revolutionary technologies that it made possible. Rather than seeing coal as the basis of the steam engine, with the latter as the object, he dramatically turned this on its head: arguing that the steam engine, used first in mining, “made it possible to produce the amount of coal necessary for modern industry.” For Weber, even the railroad, “the most revolutionary instrumentality known to industry,” was a manifestation of “the age of iron” and coal (Weber 2003, pp. 297, 304–6).

So significant was coal for the rise of industrial capitalism in Weber’s view that it entered into his comparative-historical interpretation of world civilizations. Anthracite coal, he noted, was used in ancient times in China. Yet, he argued (in ways that later would open him to charges of Eurocentrism) that its further use was hindered by the prevalence “of a superstructure [in Chinese society] of magically ‘rational’ science,” consisting of such beliefs as geomancy or earth divination. Mining was thought to “incense the spirits” while smoke from burning coal “magically invested whole areas. . . . The magic stereotyping of technology and economics, anchored in this belief . . . completely precluded the advent of indigenous modern enterprises in communication and industry” in China. The barrier to the critical rise of king coal in China as opposed to Europe was therefore a product of the former’s lack of demagification/disenchantment. “To overcome this stupendous barrier” to industrialization in China, Weber claimed, “occidental high capitalism had to sit in the saddle aided by the mandarins who invested tremendous fortunes in railroad capital” (Weber 1951, p. 199; Lough 2006, p. 81; Radkau 2008, pp. 106–7).

The burning of fossilized coal in blast furnaces, and its use as a means to steam power, therefore constituted, for Weber, a major transformation in human society, liberating it from its traditional relation to nature and providing a crucial environmental precondition for the rise of industrial capitalism. As he wrote in his *General Economic History*:

In the first place, coal and iron released technology and productive possibilities from the limitations of the qualities inherent in organic materials; from this time forward industry was no longer dependent upon animal power or plant growth. Through a process of exhaustive exploitation, fossil fuel, and by its aid iron ore, were brought up to the light of day, and by means of both men achieved the possibility of extending production to a degree which would have previously been beyond the bounds of the conceivable. Thus iron became the most important factor in the development of capitalism; what would have happened to this system or to Europe in the absence of this development [made practical by the introduction of coked coal in iron smelting] we do not know. (Weber 2003, p. 305)

For Weber, “the mechanization of the production process through the steam engine liberated production from the organic limitations of human labor.” The “*relative* energetic significance of human energy” for production was thereby diminished (Weber 2003, pp. 305–6; see also Weber 1984, p. 39). This was accompanied, in an increasingly industrialized agriculture, by the accelerated “liberation of the peasants” from the land and the dissolution of the organic relation to the earth (Weber 2003, pp. 92, 96). In the age of industrial capitalism, Weber declared, the machine is no longer “the servant of the man,” but rather “the inverse relation holds” (Weber 2003, p. 302).

It is a characteristic feature of Weber’s complex theory of human-environmental interactions that, in contrast to those who were to adopt the crude human-exemptionalist notion that humanity had conquered nature and history by means of fossil fuels, iron, and machinery, he was to reveal the deeper alienation and instability in these same processes. Not only did he repeatedly emphasize, as we shall see, that human beings were becoming “servants to machines,” he also recognized the resource limitations of an industrial capitalism increasingly dependent on fossil fuels and the rapid consumption of natural resources.

At the same time, Weber managed to elude the simplistic, quasi-Malthusian notion that the development of modern industrial capitalism was to be explained primarily by the effects of population growth. “It is a widespread error,” he contended,

that the increase of population is to be included as a really crucial agent in the evolution of western capitalism. In opposition to this view, Karl Marx made the assertion that every economic epoch has its own law of population, and although this proposition is untenable in so general a form, it is justified in the present case. . . . The growth of population in Europe did indeed favor the development of capitalism, to the extent that in a small population the system would have been unable to secure the necessary labor force, but in itself it never called forth that development. (Weber 2003, p. 352)

Weber hammered home this point by arguing that China in the same

period (the 18th and 19th centuries) saw “a population growth of at least equal extent [to that of the West]—from 60 or 70 to 400 millions, allowing for the inevitable exaggerations.” This growth, however, took place in different strata, under a different system than the West, making “China the seat of a ‘swarming mass of small peasants.’” Because “capitalism went backward in China and not forward” in this period, the masses did not become a modern proletariat (Weber 2003, p. 352). From a theoretical standpoint, this meant that population growth was not an adequate cause of capitalist development. When it came to the environmental preconditions of capitalism, Weber thus emphasized energy and resources over population. Moreover, it was capitalism’s relentless consumption of energy and resources that was to constitute its main environmental constraint.

Raubbau and the Heedless Consumption of Natural Resources

Weber (1946, p. 369), more than most social theorists of his day, was acutely aware of what he called the “dissolving effects of capitalism”—both materially and culturally—on the previous organic relations with respect to land and resources. As a major contributor to rural sociology in Germany (see Honigsheim 2000), he recognized the importance of the disruption of the soil nutrient cycle, first described by Liebig and analyzed in social terms in Marx’s theory of metabolic rift (Foster 1999). Under conditions of modern agriculture, Weber argued, it was no longer adequate to assume that the “agricultural product” was the result of natural soil quality and the work of farmers, and nothing more. Rather, means of production such as “improved tools, modern buildings, or artificial fertilizer,” were increasingly necessary, independent of the farmer. Artificial fertilizers were essential in industrialized agriculture because “even the nutrients in the soil” were no longer “produced by the farmer with the aid of the gifts of nature within the natural soil, but far away in machine and tool factories, ‘potash mines,’ Thomas blast furnaces, fitters’ workshops, and the like,” and imported to the farm ([1905] 1995, p. 84). “Capitalism,” he argued, “shifts the imputation of the yield of agricultural land from the place of direct agricultural production to the workshops where the agricultural implements, artificial fertilizers, etc., are produced” (1968, p. 872). In the age of industrial capitalism—the age of coal, iron, and synthetic fertilizer—agriculture itself was industrialized, increasingly dominated by inorganic, inanimate forms of energy.

In the natural organic cycle, soil nutrients (chiefly nitrogen, phosphorus, and potassium) formed the basis of plant cultivation. However, as Liebig had pointed out beginning in the 1840s, with the growth of industrial capitalism and the shift of populations to the cities, soil nutrients were increasingly being shipped in the form of food and fiber to the urban

centers where they eventually became sources of pollution rather than being returned to the soil. As a result the soil was continually robbed of vital nutrients—what Liebig called earth robbery (*Raubbau*) or the robbery system (*Raubsystem*) (Brock 1997, pp. 177–78).

The primary limitation on cultivation in Europe in the 19th century was lack of nitrogen for fertilizer, followed by phosphorus shortages. When artificial sources for these two minerals were secured—and when the agricultural yield reached a certain level—potassium became a major constraint on agricultural productivity (in accordance with Liebig’s famous “law of the minimum”). Hence potassium was the last of the three great mineral fertilizers exploited. The Germany of Weber’s day played a leading role in addressing this natural limitation, beginning in the 1870s, with its potassium (or potash) mines. It was no accident therefore that potash mines were to be singled out by Weber as a prime example of the external sources of fertilizer essential to industrialized agriculture (Weber 1995, p. 84; Mazoyer and Roudart 2006, pp. 366–67).

The concept of *Raubbau* recurred numerous times in Weber’s work, playing a key role in his conception of the break from the organic conditions of existence. He saw such “land-robbing agriculture (‘*Raubbau*’),” as particularly characteristic of agriculture in the United States (as opposed to Europe), since the very abundance of “virgin soils” in the former made it possible for farmers, often in distressed circumstances, to use up the soil and move on (Weber 2005a, pp. 143, 147).

The slave plantation system in the antebellum South in the United States, he argued, was an extreme version of a soil “culture [that] was exploitative [*Raubbau*]. . . . The system required cheap land and the possibility of constantly bringing new land under tillage.” This contributed to the crisis of the slave-based plantation system and helped generate the conditions leading to the Civil War (Weber 2003, pp. 82–83). During his trip to Booker T. Washington’s Tuskegee Institute in 1904, Weber questioned the extreme exploitation of the land that characterized even the postbellum South, remarking that the farmers’ training was aimed at the “conquest of the soil” as “a definite ideal” (quoted in M. Weber [1926] 1975, p. 296).

Weber was also concerned with sustainability in relation to forests. He celebrated the German forests as a lasting treasure of German culture, having a role in the development of the German character, and argued for their preservation (Radkau 2009, p. 94). He compared the well-managed German forests, which were “nurtured with all the care that the highly developed technic of forestry has made possible” to the “primitive forestry conditions” that prevailed in the United States, where forests were simply cleared away in anticipation of their further exploitation (Weber 2005a, p. 139).

Although Germany was relatively rich in raw materials, with coal reserves that could, Weber suggested, outlast those of Britain by centuries, the former did not have the same advantage as Britain (and some parts of the United States) of coal and iron mines that were close together, facilitating industrialization. Key raw materials necessitated rational management in order to not “hasten unnecessarily the exhaustion of mines” (Weber [1907–8] 2005*b*, pp. 148–49, 155).

During his trip to the United States in September–November 1904, Weber provided a general historical view of natural resource constraints within modern capitalism and their relation to cultural development. He was invited along with other German social and natural scientists—the social scientists included Werner Sombart and Ernst Troeltsch, while the leading natural scientist was Ostwald—to present a paper at the Universal Exposition of the Congress of Arts and Science in St. Louis, commemorating the Louisiana Purchase (Davis 1904). Weber’s talk, presented in German to a small audience on September 21, 1904, dealt with the question of rural society and the overall social structure of capitalism in the United States and Germany (M. Weber 1975, pp. 290–91; Weber 1906; 1946, pp. 363–85; Radkau 2009, p. 226; Scaff 2011, pp. 60–66).¹⁷

What was most remarkable about Weber’s St. Louis presentation was his adoption of a line of argument that paralleled Frederick Jackson Turner’s (1921) frontier thesis (first introduced in 1893). Turner was famous for contending that with the closing of the frontier, U.S. society would come to resemble the more densely populated, class societies of Europe.¹⁸ Echoing this, Weber claimed that scarcity of land and natural resources would eventually impinge on capitalism in the United States, which would no longer have the outlets of free soil and boundless raw materials. As a result, the United States, which had hitherto been constrained primarily by the effects of racism and ethnocentrism, would increasingly come to resemble the older societies of Europe, where economically related class and status issues dominated. Thus Weber introduced his own environmentally nuanced interpretation of “American exceptionalism” ahead even of Sombart (Weber 1946, pp. 372, 383; Scaff 2011, pp. 60–66).

Like Turner (1921, p. 13), Weber was concerned not just with the disappearance of free land (or the frontier) but also with the depletion of

¹⁷ Sociologists generally have ignored the ecological implications of Weber’s 1904 presentation in St. Louis. But the same is not true of ecological economists. See Georgescu-Roegen (1971, p. 313).

¹⁸ Although Turner also presented a version of his thesis in St. Louis at the Universal Exposition in Chicago in 1904, there is no evidence that Weber attended or that the two scholars ever met. Nor is there any record of any direct influence of Turner’s ideas on Weber (Scaff 2005, p. 54; 2011, p. 54).

supplies of coal, iron ore, and other natural resources. “We must not forget,” Weber wrote, “that the boiling heat of modern capitalist culture is connected with the heedless consumption of natural resources, for which there are no substitutes. It is difficult to determine how long the present supply of coal and ore will last.” If the timeline governing the inevitable exhaustion of key raw materials was uncertain, the end of frontier land was on the immediate horizon. “The utilization of new farm lands will soon have reached an end in America; in Europe it no longer exists” (Weber 1946, p. 366).

It was this awareness of the overall problem of natural resources and energy under capitalism that was to form the environmental-sociological basis of Weber’s comparison of German and American rural life. After “all the free land has been exhausted,” the United States, he wrote, will eventually confront “increased density of population and rising land values” and “the so-called ‘law of decreasing productivity of the land.’” This would lead to higher rents and a sharpening of capitalist social relations and class divisions. Over a longer period, the inability continuously to revolutionize agriculture, by “substituting inorganic raw materials [fossil fuels] and mechanical means of production for organic raw materials and labor forces,” could also intensify social divisions. In short, “America will one day also experience the effects of such [social] factors—the effects of modern capitalism under conditions of completely settled old civilized countries.” With “the areas of free soil . . . now vanishing everywhere in the world” the distinction between old world and new would give way before the “dissolving effects of capitalism” (Weber 1946, pp. 364–85).

This fundamental perspective on ecological constraints was evident in many of Weber’s concrete observations during his 1904 trip to the United States. In the course of his travels he wrote of the pollution, filth, environmental degradation, and wasted resources. In the state of New York, the “natural beauty” of many of the sights was subject to “shameful disfigurement.” In Chicago, he noted, the pollution from the burning of “soft coal” was so severe that “one can see only three blocks ahead—everything is haze and smoke, the whole lake is covered in a huge pall of smoke from which the little steamers suddenly emerge and in which the sails of the ships putting out to sea quickly disappear.” The stockyards were characterized by endless filth and an “ocean of blood.’ . . . There one can follow the pig from the sty to the sausage and the can” (quoted in M. Weber 1975, pp. 284–87; Scaff 2011, pp. 40–43).

It was, however, Weber’s trip to Muskogee in Indian Territory, in present-day Oklahoma, that gave rise to his most powerful environmental indictments while in the United States. Three days after his presentation in St. Louis Weber announced in a letter to Georg Jellinek his plan to travel “*perhaps* to Oklahoma and Texas, instead of to [Theodore] Roo-

sevelt” for a White House reception (Scaff 2005, p. 55). Weber’s wife Marianne, who accompanied him to the United States, but not to Indian Territory because of what she called its “primitive” state, explained his motivations (while employing racial preconceptions which were not characteristic of Weber himself and which do not appear in his letters from Oklahoma): “Here it was still possible to observe the unarmed subjugation and absorption of an ‘inferior’ race by a ‘superior,’ more intelligent one, the transformation of Indian tribal property into private property, and the conquest of the virgin forest by the colonists” (M. Weber 1975, p. 291; Scaff 2005, p. 55).

Weber sent two letters to his mother from Muskogee, one of the main commercial centers in Indian Territory, containing detailed sociological descriptions of the conditions, including environmental relations. “In no other location in his correspondence does Weber have as much to say about ‘nature’ as in his Indian Territory commentaries” (Scaff 2005, p. 65). Much of Weber’s discussion focused on the fate of Indian Territory and the Indians themselves. He was concerned with how the privatization of Indian land was being imposed on the Five Civilized Tribes (Cherokee, Chickasaw, Choctaw, Creek, and Seminole) forcibly relocated to Oklahoma in the 1830s via the Trail of Tears—and on some 20 other tribes that had at various times been removed to the area of present-day Oklahoma. Weber was equally caught up, however, in the related issues of environmental change. Comparing what he saw to romantic conceptions of wilderness in James Fenimore Cooper’s *Leatherstocking* tales and Ludwig Ganghofer’s *The Silence of the Forest* (the peak of German sylvan romanticism), Weber proclaimed, with evident misgivings, that soon “the last remnant of ‘romanticism’ will be gone” (Weber [1904] 1988, p. 136). In a dramatic description that encompasses both the tragedy of the Indians and the rise of the oil fields, he wrote:

Nowhere else does the old Indian romanticism [*Indianerpoesie*] blend with the most modern capitalistic culture as much as it does here right now. The newly built railroad from Tulsa to McAlester first runs along the Canadian river for an hour through veritable virgin forest [*Urwald*], although one must not imagine it [*sich vorstellen*] as the “Silence in the Forest” with huge tree trunks. . . . The large rivers, like the Canadian River, have the most Leatherstocking romanticism [*Poesie*]. They are in an utterly wild state. . . . But the virgin forest’s hour has struck even here. . . . [In occasional clearings] the bases of the trees had been smeared with tar and ignited. They are dying off, stretching their pale smoky fingers into the air in a confused tangle. . . . And suddenly it begins to smell like petroleum: one sees the tall Eiffel Tower–like structure of the drilling holes, right in the middle of the forest, and comes to a “town.” (Scaff 2011, p. 91; see also Weber 1988, p. 134)

The first oil wells in the vicinity of Muskogee had appeared only the year before but already dominated the environment, creating a booming,

camp-like atmosphere. Weber wrote of the constant “stench of the petroleum and the fumes” and the “primitive state” of the streets, “usually doused with petroleum twice each summer to prevent dust and smelling accordingly.” He mentioned in both letters that the more romantic aspects of this world were fast passing away and constituted a true loss: “This is a more ‘civilized’ place than Chicago. It would be quite wrong to believe that one can behave as one wishes. . . . Too bad; in a year this place will look like Oklahoma (City), that is, like any other American city. With almost lightning speed everything that stands in the way of capitalistic culture is being crushed” (Weber 1988, pp. 134–35; Scaff 2011, pp. 73–97).

Weber’s letters from Indian Territory reveal his enormous ability to integrate causal analysis at an empirical level, taking into account environmental changes, with his larger interpretive vision of capitalist cultural development. In fact, Weber’s account here of “the lightning speed” in which all that “stands in the way of capitalistic culture” is simply “crushed” (with reference in particular to the environment and Native Americans) reads like a precursor to the “treadmill of production” perspective of contemporary environmental sociology (e.g., Schnaiberg 1980, pp. 227–31). Nowhere else perhaps does Weber point so forcefully to capitalism as a driving force for environmental change.

THE SOCIOLOGY OF ENERGY

Weber’s emphasis on the energy-intensive, fossil-fuel-dependent, and high-resource-consumption character of capitalism led to intensive studies in the economics and sociology of energy. Although his work in this area is celebrated by ecological economists, it is little known to sociologists. Yet without an understanding of Weber’s approach to the sociology of energy it is impossible to comprehend fully his theoretical rendition of the way in which capitalism, as a specific cultural formation, is anchored in environmental conditions.

During his journey to the United States in 1904 Weber became well acquainted with Ostwald. Besides being a leading chemist, Ostwald was especially well known for his advocacy of energetics as the key to a universal theory of culture. In St. Louis Ostwald presented a paper—quite likely with Weber in attendance—on the methodology of science in which he advanced the Comtian view of a hierarchy of sciences, with the three great divisions of mathematics (theory of order; theory of numbers, or arithmetic; theory of space, or geometry), energetics (mechanics, physics, and chemistry), and biology (physiology, psychology, and sociology). “Mathematics, energetics, and biology,” he wrote, “therefore embrace, the

totality of the sciences,” with sociology as the final, most epiphenomenal of the sciences (Ostwald 1906, pp. 339–40). Such views were anathema to Weber and led to his critique of Ostwald’s energetics and conception of science five years later, in 1909, the same year that Ostwald received the Nobel Prize in chemistry.

In 1909 Ostwald published *Energetic Foundations of a Science of Culture*, which sought to establish the energetic bases of all culture. In this context, he addressed issues of energy scarcity/abundance; the application of energy concepts to all aspects of life, including psychology, language, and so on; and the issue of the Comtian hierarchy of the sciences as seen from the standpoint of energetics. A key part of his analysis was his chapter “Raw Energy.” Here he attacked prevailing views of energy scarcity, claiming that given “the enormous capital from the energy of the sun” humanity was at present making “use of only a disappearingly small portion—much like the rich child who inherited a fortune but is not capable of using more than it spends for nutrition, clothing and shelter.” The various untapped sources of energy, even taking into account entropy, were “so extraordinarily great,” he observed, “that we do not need to worry about the exhaustion of fossil fuels. In the few centuries that separate us from this event” the different forms of solar energy could easily fill the gap—before “the legacy [of fossil fuel] is completely exhausted” (Ostwald 1909, pp. 44–50).¹⁹

Ostwald emphasized that human beings were then using the sun’s available energy, mainly by two means: first, “planting [*Bestockung*] of a part of the land with fields, meadows, and forests, and through the use of plants raised there for chemical storage. A second, and presently much smaller part, rests on the use of the water quantities raised by the sun’s rays that pour down from the mountains for the driving of mechanical motors” (Ostwald 1909, p. 44). At the time Ostwald was writing, the latter capture of energy mainly took the form of water mills, while hydroelectric power was only just coming into use. Ostwald insisted that the main means for expanding energy availability was through the construction of hydroelectric power facilities using the recent developments in electrical transmission to transfer this energy to more distant locales and constructing large dams or “gigantic reservoirs” to ensure that this energy was stored and available on a nonseasonal basis. Dependence on fossil fuels and energy scarcity could be a thing of the past. “In terms of the utilization of energy,” he wrote, “humanity remains thoroughly stuck in childhood. The used part of the annual intake is still in comparison to the entire supply so extremely small that the danger of it not being sufficient later

¹⁹ Translation of Ostwald in this and the following paragraphs in this article is by Joseph Fracchia.

does not at all exist" (Ostwald 1909, pp. 44–50). Not only was it possible to have a "more complete capture of the energy stream," but also "through the improvement of the efficiency of the process of the transformation of the already captured raw energies" it was possible to achieve more with less. Indeed, it was "not improbable that in the future humanity might even find its pleasure in leading a comfortable life with a lesser consumption of energy and will consider the gluttonous consumption of raw energy in contemporary life to be a blamable barbarism" (Ostwald 1909, pp. 44–50).

Ostwald's views are significant in today's context both because of their emphasis on solar energy as the energy of the future and because of the ironic counterpart to that—his contention that energy was superabundant to human society and if harnessed properly could lead to endless economic expansion. His work arose out of a long tradition, going back to Herbert Spencer, which, in the words of Rosa, Machlis, and Keating (1988, p. 150), claimed that "the ability to harness more and more energy to production lay at the foundation of the evolution of societies." For Ostwald, according to the above analysts, "the greater the coefficient of useful energy obtained (in the transformation) the greater a society's progress" (Rosa et al. 1988, p. 151).

Weber reacted strongly to Ostwald's argument, declaring in a letter in May 1909 that he "'dreaded' Ostwald's 'energetic sociology'" (Radkau 2009, p. 273). This led to a full-blown critique in the form of an extensive review of Ostwald's book, which Weber (1984) entitled "'Energetic' Theory of Culture." Although Weber's critique of Ostwald is known as one of his most important methodological papers and is frequently referred to in Weber studies, sociologists (e.g., Ringer 1997, pp. 53–56) have treated it almost entirely in terms of a critique of Comtian-style positivism and hierarchy of the sciences, while ignoring for the most part Weber's strong engagement with energetics. This contrasts sharply with the response of ecological economists, who draw extensively on Weber's critique of Ostwald (e.g., Martinez-Alier 1987, pp. 183–92; Stokes 1995, p. 138).

Weber's critique of energetics was remarkable as the work of an economic sociologist who challenged the views of a Nobel Prize-winning chemist on his own ground: thermodynamics. Adopting a perspective that we would now call ecological economics, Weber displayed a startling grasp of issues related to natural science and energy specifically. In general he objected that the "positivist" project of Ostwald was "influenced . . . by the (supposedly) 'exact' sociological method derived from the work of Comte and Quetelet," nurtured at Ernest Solvay's institute. This led Ostwald to the crude (and indeed absurd) reduction of all revolutions in culture to energetics.

Weber's objection to Ostwald's views, however, went beyond questions

of methodology and extended to Ostwald's treatment of energy itself. For Weber, Ostwald's account of the potentially unlimited supply of energy emanating from the sun, which human beings had not yet tapped fully, was questionable if taken to the extreme of denying resource scarcity. Economics, after all, was "bound up with the application of *scarce* material means" (Weber 1949, pp. 64–65), including limited natural resources. Weber thus strongly questioned Ostwald's claim that a "squandering of our inheritance' [with respect to energy and natural resources] seems totally unthinkable" (Weber 1984, p. 37). Not only was Weber extremely skeptical about the end of dependence on fossil fuel, but he argued—anticipating in this respect the founder of modern ecological economics Georgescu-Roegen (1971)—that the entropy law could be seen as applying to essential raw materials as well as energy as such, so that the squandering, for example, of iron ore and copper, could prove crucial in limiting production and enforcing conditions of scarcity (Martinez-Alier 1987, p. 185). Thus Ostwald's views of energetic abundance were naïve in that "the indispensable chemical and form-energy of every substance used for production, transmission, and utilization of the most important energies that are used is *equally* irretrievably dissipated. This, after all, is the case with all free energy according to the law of entropy" (Weber 1984, p. 38).

Ostwald's expectations of the elimination of energy scarcity were further compromised, according to Weber, by his failure to take into account the "energy ladder," representing different qualities and compositions of energy, which were bound in various ways to space and time. In opposition to this, Weber argued that even if there were such a thing as a "*perpetuum mobile*"—and if free energy were theoretically available at a given rate and no cost—still constraints on energy use (scarcity) would disappear only if the energy were available in (1) the appropriate form, (2) everywhere, (3) at every time and in each time differential, (4) in unlimited quantity, and (5) in the appropriate direction for the desired effect. In other words, even if Ostwald's notion of the expansion of technological "apparatuses" to capture energy from the sun appeared theoretically to make energy superabundant, real constraints of space and time in relation to production would still inevitably apply (Weber 1984, p. 41; Martinez-Alier 1987, pp. 190–91).

In terms of the energetics of production, Weber pointed out that Ostwald was mistaken in assuming that the absolute importance of human energy in production was decreasing and that human energy was less thermodynamically efficient than other forms of energy used in production, such as the electric dynamo. As Weber (1984, p. 38) put it, "it is . . . completely wrong to say that 'advanced' culture . . . is identical with an absolute [as opposed to relative] *diminution* of the use of *human* energy." With respect to the efficiency of human energy, Weber stated that if it

were possible to compute all of the energy components (kinetic, chemical, and other forms of energy) that went into machine weaving of textiles (including dissipated energy) and compare that to human weaving it would be found that the latter was more thermodynamically efficient (though more expensive in terms of *economic* unit costs).

Indeed, basing himself on thermodynamic/physiological studies conducted since the late 19th century, Weber explained that “the ‘primitive’ tool that man is given by nature, the human muscle” has greater thermodynamic efficiency “for the utilization of the energy set free through the biochemical oxidation process than the best generator can ever attain” (Weber 1984, pp. 38–40). As Martinez-Alier (1987, p. 187) points out, “steam engines, at the time Weber was writing, had efficiencies as low as five percent, whilst the human body can convert food energy into work with an efficiency on the order of twenty percent, as has been known since the 1860s.”

Such elementary truths, Weber argued, completely destroyed Ostwald’s attempts to generate an energy theory of value. “Even a dilettante like Ostwald could ultimately see that the relationship between need and cost simply cannot be defined ‘energetically’ and this is so even when one makes allowances for his totally worthless discussion of the economic concept of value” (Weber 1984, p. 48).²⁰

Weber’s sensitivity to environmental issues reflected his critique of one-sided notions of progress under capitalism. His intense dislike of Ostwald’s views was engendered not simply by Ostwald as a personification of positivism, but even more as a personification of a crude productivism. For Weber, Ostwald’s ultimate failing was his inability to recognize that there were other possible forms of social action and meaning beyond productivist ones. As Weber stated elsewhere in a discussion of technology: “How else could a chemist of Ostwald’s importance hold exclusively technological ideals of life and view all cultural development as a process of saving energy if his whole science were really not exclusively dependent on the requirements and the progress of modern technology in our factories, and through this . . . to the utmost extent on capitalist-economic conditions?” (Weber [1910] 2005, p. 31).

Ostwald’s energetics, Weber contended, were rooted in the economic drives of capitalism. For this reason, he pointedly raised the issue of Sombart’s critique of the Reuleauxian concept of technology in which Sombart claimed technology had moved from a situation in which the instrument was the servant of the human being to one in which the human being is the servant of the machine (Weber 1984, p. 38; Hessen [1931]

²⁰ For a similar critique of an energetic theory of value to that of Weber’s, see Engels in Marx and Engels (1975, 25:586–87).

1971, p. 197; Martinez-Alier 1987, p. 186). Likewise, Weber (1984, p. 56) went on in his critique of Ostwald to attack what he called a “fanaticism for ‘productivity’” (directed specifically at Solvay). In Ostwald’s case, Weber saw this, as we have seen, as tied to “capitalist economic conditions” (2005, p. 31). The crime of thinkers like Ostwald, Solvay, and Comte was to promote in the crudest positivistic, productivist manner possible the heedless consumption of resources and energy associated with rationalized industrial capitalism and its “disenchantment of the world.”

The Disenchantment of the World

If rationalization was the defining theme in Weber’s view of modernity, his notion of “the disenchantment of the world” (*Entzauberung der Welt*—literally “demagification of the world”) constituted an important, if somewhat controversial, element in his critique of a rationalized modernity (Gerth and Mills 1946, p. 51; Scaff 1989, p. 224; Schroeder 1995, pp. 227–28). “The absence of the gods, the ‘disappearance of the sacred,’” was presented by Weber, according to Lukács ([1955] 1991, p. 112), “as the real physiognomy of our times, which is necessary to accept as a historical inevitability but which invokes in us an infinite melancholia and a profound nostalgia for the good times when there was ‘science of the true, good and beautiful,’ when there were ‘sacred things.’”

In the work of later critical theorists, such as Horkheimer and Adorno (1972, pp. 3–8), the concept of “disenchantment” not only became the means of questioning “the dialectic of enlightenment” but also stood for the contradictions inherent in the human “conquest of nature.” It is not surprising therefore, as Murphy (1994, p. 32) noted, that Weber’s concept of the disenchantment of the world is often seen as having deep ecological implications (e.g., Berman 1981; Bookchin 1995).

Most analysts of disenchantment in Weber’s thought have approached it from a purely cultural angle, seeing it as a kind of mirror image of the growth of calculation, formal rationalization, and the disappearance of magic—all factors that he emphasizes in defining the concept. Yet some commentators (e.g., Iggers 1982, p. 60; Gibson 2009, pp. 15–16) have recognized that it is also connected to his references, at the end of *The Protestant Ethic*, to an iron cage (steel casing) and to the eventual burning up of fossil fuels (as the inorganic substance of modern mechanization). Still others have noted that there is a direct relation between Weber’s concept of the disenchantment of the world and his allusions to the loss of connection to “organic life” (Cohen 1981, p. xxvi; see also Martindale and Riedel 1958, p. xxi; Koch 2006, pp. 121–23).

Weber first employed his notion of “the disenchantment of the world” in 1913 in “Some Categories of Interpretive Sociology” (Weber 1981, p.

155; Schluchter 1989, p. 417), using it thereafter in numerous works. He made a point of inserting it into the final edition of *The Protestant Ethic and the Spirit of Capitalism*, published 15 years after the original.²¹ There he gave the disenchantment process a millennia-long timeline. Thus he referred to the “great historic process in the development of religions, the elimination of magic from the world [*Entzauberung der Welt*] which had begun with the old Hebrew prophets, and in conjunction with Hellenistic scientific thought, had repudiated all magical means to salvation as superstition and sin” (Weber 1930, p. 105).

Within German Romantic literature and philosophy it was Friedrich Schiller in the 18th century who most powerfully conveyed this sense of disenchantment in his poem “The Gods of Greece”: “Insensible of her maker’s glory / Like the dead stroke of the pendulum / She slavishly obeys the law of gravity / A Nature shorn of the divine [*Die entgötterte Natur*]” (Schiller 1902, p. 75; translation according to Taylor [2007, p. 317]). Where the gods previously held sway, there was now only the insensible law of gravity.

For Weber—as he indicated in *The Protestant Ethic* with regard to the concept of “rationalization”—the notion of the disenchantment of the world was to be viewed as “an historical concept” that covered “a world of different things” and thus carried contradictions within itself (Weber 1930, p. 78). Weber employed this “historical concept” in two main, overlapping senses: (a) a narrower technical meaning of *demagification*, related principally to his comparative-historical sociology of religion; and (b) a broader, more philosophical concept associated with the German Romantic tradition, embodying the loss of connection with nature as a realm of meaning, that is, as a process of *disenchantment*. It is the latter, more philosophical sense of the term that has sometimes been seen as constituting the central element—the negative aspect of rationalization—in Weber’s critique of modernity.²²

²¹ On the addition of the concept of the “disenchantment of the world” to the final, 1920 edition of Weber’s original 1905 work, compare the last edition of Weber’s treatise (Weber 1930, p. 105) and Talcott Parsons’s note to this on pp. 221–22, to the first edition of Weber’s treatise recently translated by Peter Baehr and Gordon C. Wells (Weber [1905] 2002, p. 74).

²² It is ironic that Kalberg, in opposition to many other Weber scholars, denied the historical and dialectical complexity of Weber’s concept of the disenchantment of the world, in his classic article on the polymorphous nature of Weber’s concept of rationalization. In Kalberg’s view, the use of the term “disenchantment,” as opposed to “demagification,” in English translations was simply an error that conjured “up images of the romanticist’s yearning for the *Gemeinschaft*” of “an earlier ‘simpler world’” and thus “has not the slightest relationship to Weber’s usage of *Entzauberung*” (Kalberg 1980, p. 1146). This is clearly contradicted, however, by the close connection between Weber’s term and Schiller’s and by Weber’s critical use of the concept with respect

The logic of the broad tendency to rationalization/disenchantment in Western capitalism was tied, in Weber's tragic conception, to the exhaustion of fossil fuels, which would constrain cultural development. Although environmental forces do not seem to affect directly Weber's discussion in *The Protestant Ethic and the Spirit of Capitalism*, the illusion of a culture entirely free of such constraints, as Roth (1979, pp. 192–93) cogently observed, is broken at the end of the work when Weber explains: "We must [now] worry about what will happen when 'the last ton of fossil fuel has been used up.' . . . Suddenly we may find ourselves in a position in which Weber's *apprehensions*" with respect to the environment and "material constraints" are activated and the whole "evanescent superstructure" becomes "powerless before the geographic, demographic, and economic substructures of long duration."

In *The Protestant Ethic* Weber stressed, in line with Sombart, that the technical-rational expansion of the "productivity of labor" had "relieved" the production process "from its dependence on the natural organic limitations of the human individual" (Weber 1930, p. 75). Here was embodied a powerful ecological critique, which was to be developed further in *Economy and Society*, of Taylorism or "scientific management," which he depicted as a process in which "the individual is shorn of the natural rhythm as determined by his organism" (Weber 1968, p. 1156). For Sombart, writing of the ecologically destructive aspects of formally rational capitalism: "Modern culture has alienated us from nature, has put a layer of asphalt between ourselves and nature so that nature can at best be merely an object of aesthetic enjoyment" (Sombart quoted in Scaff [1989, p. 205]). The "rationalization and intellectualization" of modern society, Weber wrote in a similar fashion in *Economy and Society*, "parallel the loss of the immediate relationship to the palpable and vital realities of nature, because the work is done largely within the house and is removed from the organically determined quest for food" (Weber 1968, p. 1178).

Recognition of Weber's sensitivity to environmental changes and their refracted effect on culture can therefore help attune us more fully to the significance of his master theme of rationalization/disenchantment. For Weber, the demise of the traditional-organic world of preindustrial capitalist society and its replacement with a rational-inorganic one of modern capitalism was an overarching frame characterizing his thought. The coupling of the traditional with the organic, and the formally rational with the mechanical and inorganic, appeared repeatedly in his works. Embedded within this was a deep critique of any unilinear notion of progress.

to modernity. Thus he explicitly raised the issue of disenchantment, in works like "Science as a Vocation" as representing "the fate of our times" (Weber 1946, p. 155).

WEBER AND THE CLASSICAL FOUNDATIONS FOR
POSTEXEMPTIONALIST SOCIOLOGY

The foregoing analysis brings us back to two critical questions raised at the beginning of this article: (1) How do we account for the fact that leading environmental sociologists have characterized Weber's environmental contributions as "relatively invisible" (Buttel et al. 2002, p. 8)? And (2) what do Weber's insights into the environment and society teach us with regard to the needed transformation of environmental sociology and sociology as a whole—in our postexemptionalist age, symbolized by global warming, when we realize all too fully the dangers of the human degradation of the environment?

The Question of the "Invisibility" of the Environment in Weber

How are we to account for the invisibility of Weber's consideration of the natural environment in the eyes of so many sociologists? One possible explanation lies in the fact that the two masterworks that receive the most attention from Weber scholars and sociologists in general—*The Protestant Ethic and the Spirit of Capitalism* and *Economy and Society*—appear at first sight to be completely detached from environmental questions.

In the case of *The Protestant Ethic* we have already seen that this detachment (which at first sight seems to conform to Dunlap's [2002, pp. 332–34] contention that the environment "could" be ignored in the Weberian tradition) was based on very special assumptions. The reference to the using up of fossil fuels at the end of his treatise underscores Weber's key assumption, presented in his *General Economic History*, that in industrial society coal, viewed as an inorganic material, had temporarily detached society from organic materials (a view that merged with his notion that rationalization had detached society from the cultural basis of organic life). Given Weber's passionate denunciation in 1904 (while he was working on *The Protestant Ethic*) of the reckless wasting of natural resources in the United States—and his Turner-like thesis on the same occasion, which suggested that environmental scarcity would come back to haunt the country, placing it in a more European context once the conquest of nature could no longer substitute for the conflict between classes—it is clear that the environment always constituted a background condition in his analysis (Weber 1930, p. 181).

However, this same argument might be seen as less applicable to *Economy and Society*, which was not principally a historical work but, rather, a grand theoretical-taxonomic treatise aimed at providing a master framework, or set of ideal-typical patterns and domains, for analyzing society. Although Weber made, as we have seen, important environmental state-

ments in this treatise, mentioning such factors as climate change, at no point does the environment enter into the basic structure and organization of *Economy and Society* itself. As a result, some have argued that this is clear evidence of the relative unimportance of environmental influences in Weber's thought (see Goldblatt 1996, p. 3).

This conclusion is directly refuted, however, by the wider context in which *Economy and Society* was written and of which it was a part. *Economy and Society* was part of a larger, multivolume work *Grundriss für Sozialökonomik (Outline of Social Economics)* of which Weber was the editor. It thus entailed a certain division of labor. As Roth (1979, p. 173) pointed out, there were three distinct parts in the *Outline of Social Economics* that dealt with "Economy and . . .": (1) 'Economy and Nature'; (2) 'Economy and Technology'; and (3) 'Economy and Society.'" It was Weber's self-assigned task to write the third part. "In the section on 'economy and nature' Alfred Hettner contributed 'The Geographic Conditions of the Human Economy,' a systematic treatise on the surface of the earth, the coasts, the mountains and seas, the quality of the land, crops and animals, and the climate, concluding with an historical overview of 'The Geographic Course of Economic Culture.'"²³ Since this was part of a larger, multivolume work supervised by Weber as editor (in which he wrote the concluding part) Roth (1979, p. 174) came to the conclusion that there was "no basic difference" in the theoretical importance accorded to environmental-geographical factors between the geographically oriented world-systems theorist Fernand Braudel and Weber—a fact corroborated by Weber's many discussions of environmental influences in his more historical writings. Here, again, the "relative invisibility" of Weber's environmental discussions remarked upon by some environmental sociologists is explained by looking at the overall context of Weber's work. Both *The Protestant Ethic and the Spirit of Capitalism* and *Economy and Society* can be seen as belonging to a general Weberian perspective in which environmental causes and environmental-cultural relations were significant. The natural environment, for Weber, constrains and channels social development, while also enabling it, in a complex process of cultural refraction.

²³ Hettner was best known for his methodological writings on geography, which overlapped with Weber's general perspective. "Both nature and man," he wrote, "are intrinsic to the particular character of the [geographical] areas, and indeed in such intimate union that they cannot be separated from each other" (Hettner quoted in Hartshorne [1959, pp. 50–51]). Robert Park, who was to develop the human ecology approach to urban sociology in the United States, completed his Ph.D. dissertation at Heidelberg under Hettner and Wilhelm Wideband.

Weber and Postexemptionalist Sociology

If mainstream sociology, even in our time, has had difficulty incorporating environmental issues into its canon and still often exhibits a human exemptionalism where environmental conditions are concerned—seeing them as unimportant or outside the proper domain of sociology—Weber offers us one lesson after another on how a postexemptionalist sociology might be developed. His treatment of environmental causes that were significant for human society stretched from climate change, natural disasters, natural resource exhaustion, and soil robbery (*Rabbau*) to deforestation, fossil fuel exhaustion, pollution, and the passing away of the relatively pristine nature-society relations in Indian Territory. His analysis of the sociology of energy, in which he challenged the ideas of the world's leading scientific exponent of energetics, was among the most advanced in his time. His recognition of ecological crisis, in the context of the rapid deforestation in Europe resulting from charcoal smelting, constituted an important contribution to the history of environmental development in relation to the industrial revolution. The complex interface between such analysis of environmental causes and Weber's interpretive sociology helps us to understand more fully his central, comparative-historical theme of the transformation from traditional-organic to rational-inorganic society. His critique of one-dimensional, capitalist notions of progress, so evident in his environmental analyses, lays bare the crude assumptions of postwar human-exemptionalist analysis. Above all, an understanding of how environment and culture interpenetrated through a complex process of cultural refraction, which gave added cultural meaning to environmental events, is crucial to understanding the wider dimensions and scope of Weber's thought.

The theoretical approach Weber introduced opens the way to a more powerful sociological vision that is anchored in biophysical realities and better suited to the examination of environmental questions. Indeed, there are times when his environmental observations seem startlingly prescient. "It is impossible to infer from the . . . natural environment alone," Weber (1968, p. 70) cautioned in *Economy and Society*, how peoples, even at a given level of technological development, will adjust. In the face of "such factors as climatic changes, inroads of sand [desertification] or deforestation . . . human groups have adapted themselves in widely different ways," depending on numerous causal factors and "structures of interests."²⁴ Today with climate change (not to mention desertification and

²⁴ In the 19th century it was common to describe desertification processes in terms of "inroads of sand." Thus in *The Book of Nature* John Mason Good (1831, p. 72) wrote: "The most extraordinary inroads of sand storms and sand floods are, perhaps, those

deforestation) constituting a dominant global reality, Weber's sophisticated outlook, which addressed human economic and cultural adaptation to climatic changes, is especially relevant. We once again are faced, due to global warming, with conditions that he described (in relation to the ancient Middle East) as "meteorologically precarious" (Weber 1952, p. 10). His profound insights into the anchoring of culture in environmental conditions (and on the effects of culture on the environment) can be used to explore these issues more fully.

The natural environment, for Weber, is refracted through a cultural lens, which gives it social meaning, but these meanings are complex and are as likely (or more so) to constitute an iron cage as a definite way forward. Weber's nonteleological perspective is definitely at odds with the outlook of today's ecological modernization theorists, who see solutions to ecological problems in terms of a further stage in the modernization process (sometimes called "reflexive modernity"), and sometime seek to present their views of ecological reform as a further development on Weber (e.g., Beck 1994, pp. 6–7; Buttel 2000, pp. 63–64; Cohen 2000, p. 100; Mol and Sonnenfeld 2000, pp. 21–22). What might be called Weber's "refracted materiality" represents a critical perspective that denies to modernization any simple, harmonious reflexivity. While ecological modernization theorists suggest that capitalism can finally exempt itself, if not from environmental influences, at least from their main constraints on development, through a more reflexive modernity, Weber's outlook is clearly immune to all such exemptionist notions.

For Weber the mismatch of today's cultural norms and environmental realities—as evidenced by the 2004 tsunami in the Indian Ocean, which perversely killed many thousands of people due to a lack of adequate societal recognition and preparation for such an eventuality—would have come as no surprise. As he implied in relation to the Dollard incursion, the inability of humanity to protect itself in the face of environmental disasters has long been part of our cultural history and constitutes a domain of meaning, even if a negative one. Likewise Weber's example of the Black Death as a pandemic carrying significant social meanings demonstrates his concern with environmental crises capable of challenging whole societies. It is easy to see the relation between his references to the Black Death and the HIV/AIDS pandemic today.

which have taken place in the Libyan Desert and in Lower Egypt. M. Denon informs us, in his travels over this part of the world, that the summits of the ruins of ancient cities buried under mountains of drifted sands still appear externally." Since Weber in the sentence quoted in the text is referring to environmental factors that had extraordinary effects on civilization there is little doubt that he is describing the desertification process with this region of the world in mind.

The most important discovery with regard to Weber's environmental analysis uncovered here is the extent to which it entered into his critique of modern, rational-inorganic capitalism—its origins, development, and (perhaps) decline. Weber's work was notable for its understanding of historical capitalism as energy intensive and resource dependent and its foreshadowing of the contradictions that this posed for the system. On a number of occasions he questioned the permanence of machine capitalism on this basis. His concern with energy and resource scarcity led him to refer in his critique of Ostwald to the "fanaticism for 'productivity'" and productivism brought on by "capitalist economic conditions" (1984, p. 56). His understanding of the destruction of the soil (*Rabbau*) overlapped with Marx's theory of the metabolic rift. During his tour of Indian Territory, Weber (1988, pp. 134–35) noted with respect to capitalism's effect on the environment and the lives of Native Americans that "with almost lightning speed everything that stands in the way of capitalistic culture is being crushed." This evoked a view similar to contemporary treadmill of production theory in environmental sociology—but one that was even more forceful in emphasizing the role of capitalism as a driver of environmental change. For Weber it was essential to recognize "the dissolving effects of [rational-inorganic] capitalism" with respect both to the pre-existing natural environment and traditional-organic societies (Weber 1946, pp. 364–85).

Nor could such change be seen, as in the case of Wundt, as simple progress: the displacement of "the peoples of nature" by the peoples of history, in the inevitable "progression" of the latter (Wundt [1912] 1916, pp. 10, 510–12). Rather, as Weber (1975, p. 118) emphasized in his critique of Wundt, one should reject any such "metaphysical . . . belief in 'progress.'"

In Weber we thus find some of the strongest classical foundations for the construction of a postexemptionalist sociology, one in which culture is seen as anchored in material existence and environmental causes generate important, refracted effects on the world of social meaning. It is possible on the basis of his work, and that of other classical theorists (notably Marx), to "bring nature back in"—constructing a sociology fully equipped to address the human-environmental challenges of the 21st century.

REFERENCES

- Albrow, Martin. 1987. "The Application of the Weberian Concept of Rationalization to Contemporary Conditions." Pp. 164–82 in *Max Weber, Rationality and Modernity*, edited by Scott Lash and Sam Whimster. London: Allen & Unwin.
- . 1990. *Max Weber's Construction of Social Theory*. New York: St. Martin's Press.
- Anderson, Perry. 1974. *Lineages of the Absolutist State*. London: New Left Books.
- Antonio, Robert J. 2009. "Climate Change, the Resource Crunch, and the Global Growth Imperative." *Current Perspectives in Social Theory* 26:3–73.
- Ashton, T. S. 1951. *Iron and Steel in the Industrial Revolution*. Manchester: Manchester University Press.
- Bechmann, Roland. 1990. *Trees and Man*. New York: Paragon House.
- Beck, Ulrich. 1994. "The Reinvention of Politics." Pp. 6–7 in *Reflexive Modernization*, by Ulrich Beck, Anthony Giddens, and Scott Lash. Cambridge: Polity.
- Bell, Michael Mayerfeld. 1998. *An Invitation to Environmental Sociology*. Thousand Oaks, CA: Sage Publications.
- Bendix, Reinhard. 1960. *Max Weber: An Intellectual Portrait*. Garden City, N.Y.: Doubleday.
- Benton, Ted. 1991. "Biology and Social Science." *Sociology* 25 (1): 1–29.
- Benton, Ted, and Michael Redclift. 1994. "Introduction." Pp. 1–27 in *Social Theory and the Global Environment*, edited by Michael Redclift and Ted Benton. New York: Routledge.
- Berman, Morris. 1981. *The Reenchantment of Nature*. Ithaca, N.Y.: Cornell University Press.
- Blaut, J. M. 1993. *The Colonizer's Model of the World*. New York: Guilford.
- . 2000. *Eight Eurocentric Historians*. New York: Guilford.
- Bookchin, Murray. 1995. *Re-enchanting Humanity*. New York: Cassell.
- Brock, William H. 1997. *Justus von Liebig*. Cambridge: Cambridge University Press.
- Burkett, Paul. 1999. *Marx and Nature*. New York: St. Martin's Press.
- Buttel, Frederick H. 1986. "Sociology and the Environment: The Winding Road toward Human Ecology." *International Social Science Journal* 38 (3): 337–56.
- . 2000. "Ecological Modernization as Social Theory." *Geoforum* 31:57–65.
- . 2002. "Environmental Sociology and the Classical Sociological Tradition." Pp. 35–50 in *Sociological Theory and the Environment: Classical Foundations and Contemporary Insights*, edited by Riley E. Dunlap, Frederick H. Buttel, Peter Dickens, and August Gijswijt. New York: Rowman & Littlefield.
- Buttel, Frederick H., Peter Dickens, Riley E. Dunlap, and August Gijswijt. 2002. "Sociological Theory and the Environment: An Overview and Introduction." Pp. 3–32 in *Sociological Theory and the Environment: Classical Foundations and Contemporary Insights*, edited by Riley E. Dunlap, Frederick H. Buttel, Peter Dickens, and August Gijswijt. New York: Rowman & Littlefield.
- Catton, William R. 2002. "Has the Durkheim Legacy Mised Sociology?" Pp. 90–115 in *Sociological Theory and the Environment: Classical Foundations and Contemporary Insights*, edited by Riley E. Dunlap, Frederick H. Buttel, Peter Dickens, and August Gijswijt. New York: Rowman & Littlefield.
- Catton, William R., Jr., and Riley E. Dunlap. 1978. "Environmental Sociology: A New Paradigm." *American Sociologist* 13:41–49.
- . 1980. "A New Ecological Paradigm for Post-exuberant Sociology." *American Behavioral Scientist* 24:15–47.
- Chandra, B. 1981. "Karl Marx, His Theories of Asian Society, and Colonial Rule." *Review* (Fernand Braudel Center) 5 (1): 13–91.
- Choldin, Harvey. 1978. "Social Life and the Physical Environment." Pp. 353–84 in

- Handbook of Contemporary Urban Life*, edited by D. Street. San Francisco: Jossey-Bass.
- Cohen, Ira J. 1981. "Introduction." Pp. xv–lxxxiii in *General Economic History*, by Max Weber. New Brunswick, N.J.: Transaction Publishers.
- Cohen, Murray J. 2000. "Ecological Modernisation, Environmental Knowledge and National Character." Pp. 77–106 in *Ecological Modernisation around the World*, edited by Arthur P. J. Mol and David A. Sonnenfeld. London: Frank Cass.
- Collins, Randall. 1986. *Weberian Sociological Theory*. Cambridge: Cambridge University Press.
- Davis, W. M. Harper. 1904. "The International Congress of Arts and Science." *Popular Science Monthly* 60:5–32.
- Dickens, Peter. 2004. *Society and Nature*. Cambridge: Polity.
- Dunlap, Riley E. 2002. "Paradigms, Theories, and Environmental Sociology." Pp. 329–50 in *Sociological Theory and the Environment: Classical Foundations and Contemporary Insights*, edited by Riley E. Dunlap, Frederick H. Buttel, Peter Dickens, and August Gijswijt. New York: Rowman & Littlefield.
- Dunlap, Riley E., and William R. Catton, Jr. 1979. "Environmental Sociology." *Annual Review of Sociology* 5:243–73.
- . 1994. "Struggling with Human Exemptionalism: The Rise, Decline and Revitalization of Environmental Sociology." *American Sociologist* 25:5–30.
- Durkheim, Émile. 1982. *The Rules of Sociological Method*. New York: Free Press.
- Elvin, Mark. 1984. "Why China Failed to Create an Endogenous Industrial Capitalism: A Critique of Max Weber's Explanation." *Theory and Society* 13 (3): 379–91.
- Engels, Frederick. (1876–78) 1969. *Anti-Dühring*. Moscow: Progress Publishers.
- . (1882) 1978. "The Mark." Pp. 77–93 in *Socialism: Utopian and Scientific*. New York: International Publishers.
- Foster, John Bellamy. 1999. "Marx's Theory of Metabolic Rift: Classical Foundations for Environmental Sociology." *American Journal of Sociology* 105 (2): 366–401.
- Foster, John Bellamy, Brett Clark, and Richard York. 2010. *The Ecological Rift*. New York: Monthly Review Press.
- Gale, W. K. V. 1969. *Iron and Steel*. London: Longmans, Green.
- Georgescu-Roegen, Nicholas. 1971. *The Entropy Law and the Economic Process*. Cambridge, Mass.: Harvard University Press.
- Gerth, Hans, and C. Wright Mills. 1946. "Introduction." Pp. 3–74 in *From Max Weber*. New York: Oxford University Press.
- Gibson, James William. 2009. *A Reenchanted World*. New York: Holt.
- Goldblatt, David. 1996. *Social Theory and the Environment*. Boulder, Colo.: Westview Press.
- Good, John Mason. 1831. *The Book of Nature*. New York: J. & J. Harper.
- Grant, Don, Mary Nell Trautner, Liam Downey, and Lisa Thiebaud. 2010. "Bringing the Polluters Back In: Environmental Inequality and the Organization of Chemical Production." *American Sociological Review* 75:479–504.
- Haartsen, Adriaan, and Dré van Marrewijk. 2001. "The Dutch Wadden Sea Region." Pp. 225–56 in *Wadden Sea Ecosystem*, no. 12, Lancewad Report 2001, <http://waddensea-secretariat.org>.
- Hartshorne, Richard. 1959. *Perspectives on the Nature of Geography*. Chicago: Rand McNally.
- Hessen, Boris. (1931) 1971. "The Social and Economic Roots of Newton's 'Principia.'" Pp. 149–212 in *Science at the Crossroads*, by Nicholas Bukharin et al. London: Frank Cass.
- Hobsbawm, E. J. 1969. *Industry and Empire*. London: Penguin.
- Honigsheim, Paul. 2000. *The Unknown Max Weber*. New Brunswick, N.J.: Transaction Publishers.
- Hooks, Gregory, and Chad L. Smith. 2004. *American Sociological Review* 69:558–75.

- Horkheimer, Max, and Theodor Adorno. 1972. *The Dialectic of Enlightenment*. New York: Continuum.
- Iggers, George G. 1982. "The Idea of Progress in Historiography and Social Thought since the Enlightenment." Pp. 41–66 in *Progress and Its Discontents*, edited by Gabriel A. Almond, Marvin Chodorow, and Roy Harvey Pearce. Berkeley and Los Angeles: University of California Press.
- Järvikoski, Timo. 1996. "The Relation of Nature and Society in Marx and Durkheim." *Acta Sociologica* 39 (1): 73–86.
- Jevons, William Stanley. (1865) 1965. *The Coal Question*. New York: Augustus M. Kelley.
- Jones, Eric L. 1987. *The European Miracle*. Cambridge: Cambridge University Press.
- Jorgenson, Andrew K., and Brett Clark. 2009. "The Economy, Military and Ecologically Unequal Relationships in Comparative Perspective: A Panel Study of the Ecological Footprints of Nations, 1975–2000." *Social Problems* 56:621–46.
- Kalberg, Stephen. 1980. "Max Weber's Types of Rationality." *American Journal of Sociology* 85 (5): 1145–79.
- . 1994. *Max Weber's Comparative-Historical Sociology*. Chicago: University of Chicago Press.
- Käsler, Dirk. 1988. *Max Weber: An Introduction to His Life and Work*. Chicago: University of Chicago Press.
- Koch, Andrew M. 2006. *Romance and Reason: Ontological and Social Sources of Alienation in the Writings of Max Weber*. Lanham, Md.: Lexington Books.
- Krader, Lawrence. 1975. *The Asiatic Mode of Production*. Assen, Netherlands: Van Gorcum.
- Lambert, Audrey M. 1971. *The Making of the Dutch Landscape*. New York: Seminar Press.
- Locke, John. (1690) 1952. *The Second Treatise of Government*. Indianapolis: Bobbs-Merrill.
- Lord, John. 1966. *Capital and Steam Power, 1750–1800*. London: Frank Cass.
- Lough, Joseph W. H. 2006. *Weber and the Persistence of Religion*. London: Routledge.
- Love, John. 2000. "Max Weber's Orient." Pp. 172–99 in *The Cambridge Companion to Weber*. Cambridge: Cambridge University Press.
- Lukács, Georg. (1955) 1991. "Max Weber and German Sociology." Pp. 103–14 in *Max Weber: Critical Assessments*, vol. 1. Edited by Peter Hamilton. New York: Routledge.
- Mann, Michael. 1986. *The Sources of Social Power*, vol. 1. Cambridge: Cambridge University Press.
- Martindale, Don. 1960. *The Nature and Types of Sociological Theory*. Boston: Houghton Mifflin.
- Martindale, Don, and Johanne Riedel. 1958. "Introduction." Pp. xi–liii in Max Weber, *The Rational and Social Foundations of Music*, edited by Don Martindale, Johanne Riedel, and Gertrude Neuwirth. Carbondale: Southern Illinois University Press.
- Martinez-Alier, Juan. 1987. *Ecological Economics*. Oxford: Basil Blackwell.
- Marx, Karl. (1859) 1970. *A Contribution to a Critique of Political Economy*. Moscow: Progress Publishers.
- . (1867) 1976. *Capital*, vol. 1. London: Penguin.
- Marx, Karl, and Frederick Engels. 1954. *Marx and Engels on Malthus*. New York: International Publishers.
- . 1972. *On Colonialism*. New York: International Publishers.
- . 1975. *Collected Works*. New York: International Publishers.
- Mazoyer, Marcel, and Laurence Roudart. 2006. *A History of World Agriculture*. New York: Monthly Review Press.
- McNeill, J. R. 2000. *Something New under the Sun*. New York: W. W. Norton.
- Melotti, Umberto. 1977. *Marx and the Third World*. London: Macmillan.

- Mill, John Stuart. (1848) 1904. *Principles of Political Economy*. New York: Longmans, Green.
- Mol, Arthur P. J., and David A. Sonnenfeld. 2000. *Ecological Modernisation around the World*. London: Frank Cass.
- Moore, Jason W. 2000. "Environmental Crises and the Metabolic Rift in World-Historical Perspective." *Organization and Environment* 13 (2): 123–57.
- Mumford, Lewis. 1934. *Technics and Civilization*. New York: Harcourt, Brace.
- Murphy, Raymond. 1994. *Rationality and Nature*. Boulder, Colo.: Westview Press.
- . 1997. *Sociology and Nature*. Boulder, Colo.: Westview Press.
- . 2002. "Ecological Materialism and the Sociology of Max Weber." Pp. 73–89 in *Sociological Theory and the Environment: Classical Foundations and Contemporary Insights*, edited by Riley E. Dunlap, Frederick H. Buttel, Peter Dickens, and August Gijswijt. New York: Rowman & Littlefield.
- O'Connor, James. 1998. *Natural Causes*. New York: Guilford.
- O'Leary, Brendan. 1989. *The Asiatic Mode of Production*. Oxford: Basil Blackwell.
- Ostwald, Wilhelm. 1906. "On the Theory of Science." Pp. 333–52 in *Congress of Arts and Science, Universal Exposition, St. Louis, 1904*, vol. 1. Boston: Houghton Mifflin.
- . 1907. "The Modern Theory of Energetics." *Monist* 17 (4): 481–515.
- . 1909. *Energetische Grundlagen der Kulturwissenschaft* [Energetic foundations of a science of culture]. Leipzig: Dr. Werner Klinkhardt, Verlag.
- Radkau, Joachim. 2008. *Nature and Power*. Cambridge: Cambridge University Press.
- . 2009. *Max Weber: A Biography*. Cambridge: Polity.
- Ringer, Fritz. 1997. *Max Weber's Methodology*. Cambridge, Mass.: Harvard University Press.
- Rosa, Eugene A., Gary E. Machlis, and Kenneth M. Keating. 1988. "Energy and Society." *American Review of Sociology* 14:149–72.
- Rosa, Eugene A., and Lauren Richter. 2008. "Durkheim on the Environment: Ex Libris or Ex Cathedra?" *Organization and Environment* 21:182–87.
- Roth, Guenther. 1979. "Duration and Rationalization: Fernand Braudel and Max Weber." Pp. 166–93 in *Max Weber's Vision of History*. Berkeley and Los Angeles: University of California Press.
- Rudel, Thomas. 2009. "How Do People Transform Landscapes?" *American Journal of Sociology* 115 (1): 129–54.
- Scaff, Lawrence A. 1989. *Fleeing the Iron Cage*. Berkeley and Los Angeles: University of California Press.
- . 2005. "Remnants of Romanticism: Max Weber in Oklahoma." *Journal of Classical Sociology* 5 (1): 53–72.
- . 2011. *Max Weber in America*. Princeton, N.J.: Princeton University Press.
- Schiller, Friedrich. 1902. *The Poems of Schiller*. New York: Henry Holt.
- Schluchter, Wolfgang. 1989. *Rationalism, Religion, and Domination*. Berkeley and Los Angeles: University of California Press.
- Schnaiberg, Allan. 1980. *The Environment: From Surplus to Scarcity*. New York: Oxford University Press.
- Schroeder, Ralph. 1995. "Disenchantment and Its Discontents." *Sociological Review* 43 (2): 227–50.
- Smelser, Neil J., and R. Stephen Warner. 1976. *Sociological Theory*. Middletown, N.J.: General Learning Press.
- Smil, Vaclav. 2008. *Energy in Nature and Society*. Cambridge, Mass.: MIT Press.
- Smith, Adam. (1776) 1937. *An Inquiry into the Nature and Causes of the Wealth of Nations*. New York: Modern Library.
- Stokes, Kenneth. 1995. *Paradigm Lost*. Armonk, N.Y.: M. E. Sharpe.
- Taylor, Charles. 2007. *A Secular Age*. Cambridge, Mass.: Harvard University Press.
- Turner, Bryan S. 1991. "Preface to the New Edition." Pp. xxii–xxx in Max Weber, *From Max Weber*. London: Routledge.

American Journal of Sociology

- Turner, Frederick Jackson. 1921. *The Frontier in American History*. New York: Henry Holt.
- Warner, R. Stephen. 1970. "The Role of Religious Ideas and the Use of Models in Max Weber's Comparative Studies on Non-Capitalist Societies." *Journal of Economic History* 30 (1): 74–99.
- Weber, Marianne. (1926) 1975. *Max Weber: A Biography*. New York: John Wiley & Sons.
- Weber, Max. (1903–5) 1975. *Roscher and Knies*. New York: Free Press.
- . (1904) 1988. "A Letter from Indian Territory." *Free Inquiry in Creative Sociology* 16 (2): 133–36.
- . (1905/20) 1930. *The Protestant Ethic and the Spirit of Capitalism*. London: George Allen & Unwin.
- . (1905/20) 2009. *The Protestant Ethic and the Spirit of Capitalism with Other Writings on the Rise of the West*. London: George Allen & Unwin.
- . (1905) 1995. *The Russian Revolutions*. Ithaca, N.Y.: Cornell University Press.
- . (1905) 2002. *The Protestant Ethic and the "Spirit" of Capitalism and Other Writings*. London: Penguin.
- . 1906. "The Relations of the Rural Community to Other Branches of Social Science." Pp. 725–46 in *Congress of Arts and Science, Universal Exposition, St. Louis, 1904*, vol. 7. Boston: Houghton Mifflin.
- . (1907) 1977. *Critique of Stammler*. New York: Free Press.
- . (1907–8) 2005a. "German-Agriculture and Forestry." *Kölner Zeitschrift für Soziologie und Sozialpsychologie* 57 (1): 139–47.
- . (1907–8) 2005b. "German Industries." *Kölner Zeitschrift für Soziologie und Sozialpsychologie* 57 (1): 148–56.
- . (1908) 1975. "Marginal Utility Theory and 'The Fundamental Law of Psychophysics.'" *Social Science Quarterly* 56 (1): 21–36.
- . (1908) 1976. *The Agrarian Sociology of Ancient Civilizations*. London: Verso.
- . (1909) 1984. "'Energetic' Theories of Culture." *Mid-American Review of Sociology* 9 (2): 33–58.
- . (1910) 2005. "Remarks on Technology and Culture." *Theory, Culture and Society* 22 (4): 23–38.
- . (1911) 1978. "Sociology and Biology." Pp. 389–90 in *Weber: Selections in Translation*, edited by W. G. Runciman. Cambridge: Cambridge University Press.
- . (1913) 1981. "Some Categories of Interpretive Sociology." *Sociological Quarterly* 22 (Spring): 151–80.
- . (1914–20) 1947. *The Theory of Social and Economic Organization*. New York: Free Press.
- . (1914–20) 1968. *Economy and Society*. Berkeley: University of California Press.
- . (1915) 1951. *The Religion of China*. New York: Free Press.
- . (1916–17) 1958. *The Religion of India*. New York: Free Press.
- . (1919) 1952. *Ancient Judaism*. New York: Free Press.
- . (1919–20) 2003. *General Economic History*. Mineola, N.Y.: Dover.
- . 1946. *From Max Weber*. New York: Oxford University Press.
- . 1949. *The Methodology of the Social Sciences*. New York: Free Press.
- West, Patrick C. 1975. "Social Structure and Environment: A Weberian Approach to Human Ecological Analysis." Ph.D. dissertation. Yale University.
- . 1985. "Max Weber's Human Ecology of Historical Societies." Pp. 216–43 in *Theory of Liberty, Legitimacy and Power: New Directions in the Intellectual and Scientific Legacy of Max Weber*. Boston: Routledge & Kegan Paul.
- Whited, Tamara L., Jens F. Engels, Richard C. Hoffmann, Hilde Ibsen, and Wybren Versteegen. 2005. *Northern Europe: An Environmental History*. Santa Barbara, Calif.: ABC-CLIO.

- Winch, Donald. 1965. *Classical Political Economy and the Colonies*. Cambridge, Mass.: Harvard University Press.
- Wittfogel, Karl A. (1929) 1985. "Geopolitics, Geographical Materialism and Marxism." *Antipode* 17 (1): 21–72.
- . 1956. "The Hydraulic Civilizations." Pp. 152–64 in *Man's Role in Changing the Face of the Earth*, vol. 1. Edited by William L. Thomas, Jr. Chicago: University of Chicago Press.
- . 1957. *Oriental Despotism*. New Haven, Conn.: Yale University Press.
- Wundt, Wilhelm. (1912) 1916. *Elements of Folk Psychology*. New York: Macmillan.
- York, Richard, Eugene A. Rosa, and Thomas Dietz. 2003. "Footprints on the Earth: The Environmental Consequences of Modernity." *American Sociological Review* 68 (2): 279–300.