Chapter 2

Environments of History: Biological Dimensions of Historical Archaeology

Stephen A. Mrozowski

Introduction

When Europeans began their global diaspora in the 15th century they set in motion a process of transformation that would help shape the modern world. First as explorers and then as colonists, Europeans were in some ways oblivious to their own power. Beyond what they carried in the way of knowledge or technology, these instruments of imperial design brought with them an army of biological agents who silently began their own colonizing efforts. Once contact between once-separated hemispheres became regular, changes were set in motion that included the introduction of Old World pathogens that often had a devastating impact on indigenous populations. Introduced plant and animal species changed the character of regional floral and faunal communities, as did the hunting, trapping, and fishing activities of colonial settlers. Reverse trends were also set in motion as New World crops and animals were introduced into areas such as Africa, Australia, New Zealand, and Europe. These too would have a transformative effect on the environments of these continents and their populations.

The scope of these events has been examined by scholars such as Eric Wolf (1982), Alfred Crosby (1986), and Jared Diamond (1999), but each has taken a very different approach to the subject. Wolf sought to present an antidote to the Eurocentric histories of the modern era presented by scholars such as Immanuel Wallerstein (1974) by focusing on the populations of the areas being colonized (Wolf 1982:22–23). Crosby aimed to examine the biological dimensions of colonial expansion, in particular the movement of plants and animal species across the globe. Diamond took the more ambitious – and controversial – approach of trying to explain human history as the product of accident and environmental determinism. Not surprisingly, many social scientists felt Diamond's majestic goals, while laudable, perpetuated a vision of the modern world dominated by the destiny of Western

It is difficult to criticize the breadth of Diamond's project; however, lost within its ambition is any notion of the events as they actually unfolded or the experiences of the individuals who were willing or unwilling participants. These remain the goals of a historical archaeology that seeks to understand the biological and cultural dimensions of the events that have shaped the modern world. For much of its history, the field of historical archaeology has focused primarily on the cultural side of this equation. The chief reason has been the dominance of paradigms that have stressed the central importance of material culture analysis while demonstrating little if any interest in the environment (e.g., Deetz 1977; Leone et al. 1987; Schuyler 1999). This chapter presents an alternative vision that situates the work of biologically-oriented historical archaeologists within a non-dualist, anti-essentialist epistemology. It also demonstrates how the results of this kind of research have contributed to a deeper understanding of the biological dimensions of processes such as colonization, urbanization, and industrialization.

Epistemology and the Environment

As historical archaeology has evolved as a discipline, one of its most enduring features has been a focus on material culture studies (Beaudry 1996; Hall 2000; Paynter 2000). The longevity and productivity of this approach speaks for itself. However, one of the drawbacks to its success has been to limit the growth of alternative or complementary approaches. In his classic study, *In Small Things Forgotten*, the late James Deetz made explicit reference to his views concerning the environment and the role of the natural sciences in historical archaeology:

> This lessened dependency on the natural sciences is but a reflection of the role played by the natural world in the history of human development. The earlier in time one goes, the more directly and intimately tied to their environment. . . . As culture became more complex, our removal from the natural world increased. Since Historical Archaeology treats only the past few hundred years of our multimillion year history, it follows that this last, brief time would find us at our greatest remove. (Deetz 1977:22)

Deetz's lack of interest in the environment seems to stem from his use of a structuralist paradigm that was grounded in a dualist epistemology that saw nature and culture as separate realities (Mrozowski 1996).

Similar issues influenced the work of critical theorists in archaeology who viewed ecological explanations as the product of positivist and reductionist epistemologies (e.g., Leone et al. 1987). Within the broader discipline of anthropology, the tension between positivist and critical epistemologies resulted in some departments breaking apart along biological and cultural lines (Soper 1996). These concerns led some to construct new, more dialectical epistemologies that reject dualist assumptions – especially the nature/culture divide (Benton 1996; Descola and Pálsson 1996; Escobar 1999; Goodman and Leatherman 2001; O'Connor 1998), while recognizing that assumptions such as these are deeply embedded in the historical consciousness of Western society (see Teich et al. 1997).

To date, these epistemological debates have had only limited impact on the practice of historical archaeology (but see Mrozowski 1996, 1999a), yet they hold great promise for constructing a theoretical framework that helps to transcend the biological/cultural divide. Questions surrounding the essentialism of nature are particularly relevant in this regard because they can cloud the dialectical relationship shared by biology and culture and its inherent ambiguities (McGuire 2002:129; Mrozowski 1996:465–467). The anti-essentialist epistemology espoused by Arturo Escobar, for example, combines a culturally and historically contingent view of nature with that of nature as a "biophysical reality" (Escobar 1999:1–2). By accepting this multidimensional view of nature, historical archaeologists can more productively integrate the environment into their research. The beginnings of this process are already evident in more sophisticated studies of foodways and agricultural practices, examinations of the biological impact of colonization on the composition of human, faunal, and floral communities across the globe; and the growth of urban and industrial landscapes. Although these studies have varied widely in scale and substance, most have been framed by one of three larger historical processes: colonization, urbanization, and industrialization.

Early Colonial Encounters

As dramatic and culturally destabilizing as early encounters undoubtedly must have been, even before colonization began there were environmental processes at work that would shape the course of some early colonial encounters. Well before the establishment of permanent colonies, European-borne diseases such as smallpox had a devastating impact on the indigenous populations of the New World, Africa, and Australia (Campbell 2002; Diamond 1999:77–78; Larsen 2002). The influence of disease was also felt by the European traders and explorers whose endeavors were greatly hampered by African and Asian diseases such as malaria (Diamond 1999:77–80, 210–212). With no preexisting immunity to many European pathogens, the speed and effectiveness of some diseases – often resulting in 95 percent mortality rates – had a particularly lethal effect among the Native populations of North America (e.g., Dobyns 1991; Perttula 1991). Campbell describes similar circumstances in Australia where European diseases withered Aboriginal populations even in the most remote sections of the country (Campbell 2002). The results were not universal, however. For some, the impacts were ruinous, while others may have experienced improved health in changed contexts (Larsen 2002:144).

Historical archaeologists, often working in collaboration with environmental scientists, are beginning to uncover evidence of other preexisting biological conditions that influenced the trajectory of early colonial ventures. One example comes from the work of Stahle and Cleveland and their colleagues at the University of Arkansas tree-ring laboratory. Their research both at Santa Elena in South Carolina

(Anderson et al. 1995) and at Jamestown, Virginia (Stahle et al. 1998) provide compelling examples of the way history can be rewritten with an eye toward environmental contexts (see Figure 13.1). Historians of Jamestown have long focused their attention not so much on why the colony failed, but rather on why the English who landed in Virginia were so ill-prepared for what they encountered (Morgan 1971). Why did so many die so quickly and so easily? Why did relations with the local Native Americans turn violent so fast? Answers to both of these questions have been found in the least likely source, in the climatic record sealed in the tree-rings of bald cypress trees of Virginia and South Carolina. The study of these tree-rings revealed a recent climatic record punctuated by two periods of deep drought. The first appears to have coincided with the abandonment of portions of the Savannah River Valley during the late prehistoric period (Anderson et al. 1995:258–286). These same conditions may have also contributed to increased tension between Native groups in the area and the Spanish settlers of Santa Elena who eventually abandoned the colony (Anderson et al. 1995:266–268).

A second period of extended drought took place just prior to the arrival of the English at Jamestown. Again, Stahle et al. (1998) found evidence of extreme drought between 1606 and 1612 that was second only to a similar period of dry conditions between 1208 and 1215. The English colonists of Jamestown arrived in the driest conditions seen in the region for 800 years (Stahle et al. 1998:566). Along with the brackish conditions that extreme weather like this fostered, it also made the establishment of crops difficult and helped with spread of disease. Disease may have also played a major role in the demise of the Roanoke Colony prior to the settling of Jamestown. Mires (1994) suggests that European colonists may have infected the local Native populations with influenza. The spread of a new disease may have triggered local Native groups to seek revenge on the small colony, leading to its destruction (Mires 1994:30–38). Their perceived connection between the arrival of the Europeans on their shores with the appearance and rapid spread of the disease was essentially correct. When viewed within the context of an intercultural encounter, the lack of biological understanding on the part of both groups resulted in an instability that would become a hallmark of colonialism itself (see Moussette 2003).

The research carried out at Jamestown and Roanoke point to the manner in which environmental and biological information often reveals critical, but previously undocumented, facets of early colonial histories. Although drawn from a much later context, the analysis of lake sediments from New South Wales, Australia, may be helping to rewrite the early colonial history of this area. In a series of publications, Gale, Haworth, and their colleagues have examined the lake sediments from Guyra in New South Wales (Gale and Haworth 2002; Haworth et al. 1999). Through a combination of sedimentary and palynological analyses, Gale and Haworth have found evidence of rapid filling rates that they believe resulted from European occupation decades before the documented settlement of this part of New South Wales in 1830. A key component to their analysis is the use of lead 210 (^{210}Pb) dating that allows specialists to construct high resolution, tightly dated chronologies from stratified sediments (Haworth et al. 1999: 52–54).

In this instance, a well-dated chronology of lake bottom deposits suggests that soil erosion during the documented period of colonial expansion (1836–61) resulted in a fifty-fold increase in the sediment rate (Gale and Haworth 2002:129). Pollen analysis of lake sediments also indicates changes in local vegetation that also may have contributed to higher erosion rates (Gale and Haworth 2002:131). The authors ascribe the vegetation changes and increased erosion to land clearance, the introduction of livestock into the region, and an overall change in drainage patterns resulting from human activity in the 30-year period (1806–36) prior to the area's documented settlement. Gale and Haworth suggest that this earlier erosion likely did not result from the activities of the Aboriginal populations of the area and should therefore be attributed to undocumented colonists, such as squatters or escaped convicts, who were already pushing past the limits of settlement (Gale and Haworth 2002:129) and may have even carried diseases that eventually spread well into the interior of the continent (e.g., Campbell 2002).

Biological Impacts of Colonization

As the studies discussed above attest, environmental conditions could both shape the character of colonial encounter, as revealed at Jamestown, and be shaped by them, as the case from New South Wales demonstrates. Historical archaeology also has the potential to document changes wrought by colonial expansion and trade on biotic communities. The trade in furs and their lengthy popularity in Europe resulted in large-scale, hierarchical operations led by French, Dutch, English, and Russian colonial agents that devastated populations of beaver, otter, and other small fur-bearing mammals in colonized areas. Studies conducted by historical archaeologists reveal the complexities of this trade and the scale of its impact.

Hamilton's studies (1996, 2000) of the Canadian fur trade illustrate the multifaceted character of the enterprise and the link that existed between symbolic behavior and its biological implications. In this case, company hierarchies were visible not in the foods being consumed, but rather in the manner in which the food waste was discarded almost exclusively around enlisted men's quarters (Hamilton 2000:262–263). The efficiencies of such enterprises and the symbolic structures that reproduced them were a lethal combination that resulted in a steady supply of animal pelts as long as popularity continued, which it did well into the 19th century.

Russian colonial efforts in Alaska and California studied by Kent Lightfoot and his students revolved around the trade in furs (Lightfoot 2003). Here, as in Canada, pressure on local animal populations – in this case otter – resulted in the constant movement southward of the colonial enterprise. As they moved south, Russian colonists carried with them Native men that they had pressed into service. With the establishment of new communities such as that at Fort Ross in California, these

Native men often joined with local Native women to comprise the multicultural households that were common in these settlements (see Figure 14.1). The scope of the fur trade would eventually result in limited returns due to overexploitation of the fur resource.

Similar evidence of overexploitation comes from South Africa, where first Dutch and subsequently English colonial efforts would have a profound impact on Native peoples and the landscape in this area (Hall 2000:57–60). One example comes from the site of Oudepost I, located along the Churchhaven Peninsula at the Cape (see Figure 12.1). Faunal remains speak to the efficiency of European technology, in this case rifle and shot (Schrire 1995:107), in the hunting of a wide variety of species of birds. In summarizing the results of her research at Oudepost I, Carmel Schrire provides an eloquent description of the impact Dutch colonial efforts would have on the land and the native Khoihhoi of South Africa:

> The bottom line, then, is that the Oudepost bones illustrate in detailed material terms one aspect of the colonial grab of native resources in this newly invaded land. Extrapolating beyond this post to the long chain of other posts and farms along the frontier, we may envisage in very specific terms, how the new settlers cut a broad swathe through the wild food base, swamping the old Khoikhoi pattern of small persistent cull with a sudden vigorous onslaught. (Schrire 1995:107)

Schrire's description captures the essence of what archaeology can bring to the study of colonization: not only evidence of broad patterns of behavior, but the flavor of those actions. The scale of the results and their comprehensibility on a human scale contribute to images of colonialism that give texture to our understanding of the process.

In the same way that Russian colonization resulted in the displacement of human populations in North America, bioarchaeological evidence from South Africa indicates similar demographic processes at work. Stable isotope analysis of the skeletal remains from a mass grave associated with Fort Knokke near Cape Town identified many as slaves (see Figure 12.1). Based upon a combination of dietary reconstruction and documentary evidence, it appears that the graves contain slaves who were being transshipped from Mozambique to Brazil (Cox and Sealy 1997: 220–221). Stable isotope analysis also assisted in reconstructing the life history of a single individual found beneath the floor of a slave lodge at the 18th-century estate of Vergelegen located east of Cape Town (Sealy et al. 1993). Skeletal and stable isotope analysis revealed the woman's earlier home was rich in tropical plants (Sealy et al. 1993:86–89). Whether she came from West Africa, Malaysia, or India remains unclear, although all are possibilities. Her story, limited though it may be, nevertheless speaks to the details and experiences of the lives of those who were willing or unwilling participants in the broader colonial drama.

The intricacies of the colonial process are also revealed in the movement of plant and animal species across the globe. Reitz (1992) has argued, for example, that the ability of colonial populations to successfully adapt Old World species to new environments was a key element in the sustainability of early settlements (see also Reitz

and McEwan 1995; Deagan 1996:368). Evidence that some Old World species of cattle fared better in the southern portions of North America and the Caribbean comes from the work of Reitz and Ruff (1994). In some instances, the introduction of Old World breeds had deleterious effects on the local environment. Bowen has discussed the way that herding practices employed by Chesapeake farmers during the 17th century – the herding of livestock first in forests and then in fields – contributed to the degradation of local soils (Bowen 1999:363–365), a pattern similar to that seen by Gale and Haworth in Australia (2002).

The impact of colonial ventures was also felt in the Old World. The most notable examples revolve around the incorporation of crops such as maize, tobacco, potatoes, and a wide variety of other species into the diets of Europeans (Diamond 1999), Africans (Alpern 1992:24–31), and later colonial ventures in places such as Australia (Diamond 1999:319). One of the more interesting examples of New World crops affecting European populations comes from Mays' work (1999) on the history of sugar production. Drawing on a variety of sources and analyses, his research not only confirmed a dramatic rise in the incidence of dental caries during the medieval period, but also indicated an equally significant increase during the 19th century when technological changes in sugar production led to a dramatic lowering of prices. The result was a noticeable drop in dental health among sugar consumers in Britain (Mays 1999:338), a pattern that was probably experienced on a global scale.

Food in Colonial Contexts

The impact of sugar on the diets of Europeans provides a vivid example of the importance of food as a measure of cultural transformation, a fact well substantiated by the foodways studies carried out by historical archaeologists in a variety of colonial contexts. Historical archaeologists working in Spanish colonial contexts have carried out numerous studies that examine the interaction of Spanish, Native American, and African-American food practices. Reitz and Scarry's research has shown that Spanish colonists relied heavily upon locally available foods in constructing a diet that combined Native American and Spanish foods and practices (Reitz 1992; Scarry and Reitz 1990:350–352; see also Deagan 2003). One of Scarry and Reitz's more interesting conclusions was that frustrations over unmet expectations among Spanish colonists may have stemmed from their inability to reproduce European foodways in the New World to the extent they wished. Despite the success of some Old World plants and animals in the New World, Spanish reliance on local species may have contributed to the perception that colonists lived a deprived existence (Scarry and Reitz 1990:352).

Similar observations about Spanish colonial settlements have been made by both deFrance (2003) working in Bolivia and Trigg (2004) working in New Mexico. DeFrance examined the faunal remains from two sites located in the community of Tarapaya, a wealthy enclave outside the large urban center of Potosí (see Figure 11.1) (deFrance 2003:117). Tarapaya was a favored area for the wealthier Spaniards wishing to escape the more urbanized Potosí (deFrance 2003:107). The dietary

preferences of these elites reflect their desire to reconstruct Iberian cuisine. Although New World species were incorporated into the diet, the dominance of domesticated animals such as sheep and goats – well adapted to higher elevations – and cattle points to the importance of these European species in the food practices of the Spanish colonists of Bolivia.

Trigg's study examines an area of secondary colonization involving a population that had been predominately born in the New World. This difference clearly played a role in their dietary practices and their own perceptions of acceptable cuisine. In the same manner that colonists of Florida, the Caribbean, and Bolivia appear to have placed a premium on Spanish cuisine, the later colonists of New Mexico already had experience with New World plants and animals (Trigg 2004:241). The substitution of staple grains such as wheat and maize served as a measure of identity rather than meat as had been the case in Spain and other parts of New Spain (Trigg 2004:240–241).

The adoption of Old World plants and animals by Native groups in the New World provides another example of dietary changes brought about during colonialism. At Rancho Santa Cruz, a small hamlet outside the village of Chihuitán in Oaxaca, Mexico (see Figure 11.1), Zeitlin and Thomas found that local Native populations increasingly incorporated European domesticated animals into their diet during the 17th and 18th centuries, while continuing other cultural practices such as the use of stone tools (Zeitlin and Thomas 1997:15–16). Similar results have been discovered at Rancho Petaluma in California (see Figure 14.1), where Native dietary practices reflected the growing influence of Spanish and Mexican-Californian foods at the same time that stone tool use and production continued (Silliman 2004:156–166).

Evidence of adaptation and change has framed the study of foodways practices among historical archaeologists working in other colonial contexts. For example, Janowitz (1993:20–21) has found evidence of a joining of Native American and Dutch dietary practices in New Amsterdam (see also Cantwell and Wall 2001: 177–180). Maize became a dietary mainstay as did local wild game and fish; however, this did not result in a shift in the practice of food preparation. Instead the evidence points to the incorporation of new foods into a relatively stable, culturally consistent foodways system (Janowitz 1993:20–21). Comparable conclusions were reached by Scott (1996) in her comparisons of French and English colonists living in Michigan during the 18th century. She found that where frontier conditions had a homogenizing effect on food availability, subtle evidence of ethnic differences were detectable (Scott 1996:353). Cheek (1999) provides still another facet to this picture by identifying regional differences in foodways practices among the English colonists of the Chesapeake, Philadelphia, and New York that resulted from a combination of economic and environmental factors.

One group who faced the continuing challenge of adapting to new social and environmental realities were enslaved Africans. In Spanish colonial contexts in Florida and the Caribbean, strong evidence exists that African, Native American, and European cultural traditions combined in what were often multicultural households (Deagan 2003; see also Armstrong 1999). This combination was also visible within freed African communities such as Fort Mose in Florida (Deagan and Landers 1999; Reitz 1994).

Research in the American South has confirmed that hunting, foraging, stealing, and producing small crops all comprised part of the economic strategies employed by African-American slaves (Edwards-Ingram 1999; McKee 1999). Larry McKee (1988, 1999) has argued that the various strategies employed by enslaved Africans to feed themselves were an important part of their identity. Hunting, stealing, and trading all provided enslaved Africans with some control over these elements of their daily practice. Across the Atlantic in South Africa, Martin Hall (1992) has used a similar argument to interpret the dietary remains found beneath the floor of a grain storage building in the large fortress known as the Castle in Cape Town. In this instance, both composition and body elements represented in the faunal assemblages of slaves and white officers reveal differences that are similar to those seen on plantations in the American South (Hall 1992:392).

The biological dimensions of colonial expansion reveal the intricacies and texture of this global event. The various examples outlined above point to the intersection of cultural and biological forces in shaping the colonial experience. In many instances the success or failure of colonial ventures – such as those at Jamestown, Roanoke, Florida, California, and South America – hinged on the ability of Europeans to adapt to new environments or to survive the reaction of Native populations to diseases brought by the newcomers. These studies also demonstrate the need to view nature dialectically as both physical reality and perceived reality (Escobar 1999; Mrozowski 1996, 1999b). Despite the adaptation of Old World species to New World conditions or the adoption of New World species into the diets of Spanish colonists in Florida, the Caribbean, Bolivia, and New Mexico, perceptions of success were still measured by comparisons with Iberian life. Ultimately success rested on the ability of Europeans, indigenous populations, and Africans to construct new realities expressed perhaps most clearly in the appearance of new foodways practices. There were, of course, other keys to the stabilization and eventual flourishing of modern society out of colonial beginnings across the globe, including both the establishment of cities and the eventual spread of industrial technology.

Urbanization

The establishment of urban communities in the New World, South Africa, Asia, Australia, and New Zealand served as a pivotal event in the growth of a world economic order borne of colonial beginnings. In virtually every case, the founding of these cities resulted in the transformation of environments and the production of urban space. Other processes at work, such as the growth of urban foodways, would have a tremendous impact on surrounding biotic communities (e.g., Rothschild and Balkwill 1993) and the development of regional market systems (Cantwell and Wall 2001; Cheek 1999; Landon 1996). However, for the purposes of this chapter, I have chosen to focus primarily on the production and use of space and its environmental implications

The production of urban space often resulted in dramatic changes that historical archaeologists have been able to read through environmental archaeology. In a colonial city such as Boston, Massachusetts, the establishment of a new landscape resulted in the appearance of new plant communities (Mrozowski 1987). The alteration of existing environments was an essential first step in the construction of cities throughout the colonial era. The production of urban space took a similar path in other colonial cities including New York (Cantwell and Wall 2001:227–231; Rothschild 1990), Buenos Aires, Argentina (Schávelson 1999:153–161), Quebec (Auger and Moss 2001), St. Augustine, Florida (Deagan 2003), Cape Town, South Africa (Hall 2000) and Sydney, Australia (Karskens 2003:42). Even in those instances where planning played a strong role in early urban development – such as in Buenos Aires (see Figure 11.1) (Schávelson 1999:153–159) and New York (see Figure 13.1) (Cantwell and Wall 2001:188–195) – the use of space for everything from food production to waste and water management often fostered a crucible for disease.

Examining changing notions of health and sanitation is one component of the broader study of urban environments that also includes the analysis of soils recovered from urban privies (Bain 1998; Geismar 1993; Reinhard 1992). The study of human and animal parasite remains, for example, has focused on the reconstruction of environmental conditions and the manner in which social differences such as class were expressed in patterns of disease (Bain 2000; Mrozowski 1991, 1996; Reinhard et al. 1986). While parasite infection was a reality for virtually everyone living in modern cities, differences in the degree of infection or access to possible medical treatments do appear to represent markers of differential status, in particular along class lines (Mrozowski 1996, 1999a).

Tracing the establishment and growth of urban environments is also possible through the analysis of insect and faunal remains. Alison Bain (1998, 2000) has pioneered the study of urban insect communities from archaeological contexts in the New World. Her work has focused on the use of insect assemblages to examine environmental changes resulting from colonization at the micro- and macro-scales. Insect remains offer the extra bonus of being relatively unambiguous signatures of environmental change. Nan Rothschild and her colleagues working in New York have used zooarchaeological data to study impact of urbanization on animal communities (Rothschild 1989; Rothschild and Balkwill 1993). Research of this kind not only supplies evidence of how rapidly biotic communities can change, but it also provides a complement to studies of urban foodways by suggesting links between the loss of habitat and declining percentages of wild foods in the diets of city dwellers (Cantwell and Wall 2001:177–205; Cheek 1999; Landon 1996).

Cities played a central role in the development of colonial societies and the capitalist economies that fueled their growth. The landscapes of these early cities were a rich mosaic of shared spaces that gave rise to ecologies closely linked to the social relations of production and commerce. With the growth of mechanized industry and industrial capitalism, new cities emerged while older communities were often transformed. These changes spawned new land use practices and their attendant ecologies that were themselves expressions of new, more hierarchical social structures.

Industrialization

With the coming of mechanized industry, the face of urbanization changed profoundly. The growth of industrial cities in Europe and North America (and later Japan) represents a watershed in human history. Like colonization, industrialization altered the global landscape and continues to shape the modern and postmodern worlds. There is an ecology to this industry that has been a mainstay of industrial archaeology in Britain (Alfrey and Clark 1993:31–59; Palmer and Neaverson 1998:17–32), North America (Hardesty 1988, 1998, 1999; Shackel 1996), and Australia (Jack and Cremin 1994). The work at Ironbridge Gorge in Shropshire, often referred to as the cradle of the Industrial Revolution, represents an archaeology that explores the nexus of environmental and social variables in shaping the history of the region (Alfrey and Clark 1993:11–59). Such an approach is essential given the power of industry to transform nature into a seemingly unending stream of material commodities. This transformative power shaped both urban and rural landscapes and often spawned the growth of bustling cities and towns where cattle or sheep had once pastured (e.g., Jack and Cremin 1994:96–107; Mrozowski et al. 1996). In other instances, industry led to the recasting of older cities as new residential and land use patterns accompanied the establishment of factories and the housing needed for their workers.

Donald Hardesty (1998; see also Hardesty and Fowler 2001) has been one of the more innovative voices in the field when it comes to the study of industry. For him, the environment is a critical factor in constructing an archaeology of the modern world:

> An environmentally focused historical archaeology of the modern world falls somewhere between the short time span and high resolution studies of ecologists working in today's world and the long time span and low resolution studies of our archaeological colleagues interested in the more ancient past. The archaeological record of the modern world is an unsurpassed source of information about human–environmental interplay within a middle range time span. (Hardesty 1999:51)

Hardesty's comments are significant not solely because of his concerns for the environment, but also because he recognizes the importance of middle-range scale issues, both spatially and temporally. It is also clear that a global historical archaeology needs to be concerned not just with the past, but with the future as well (Hardesty 2001). These are ambitious goals, but evidence abounds that historical archaeologists have already begun to construct an archaeology of industry that examines more than just technology and technological change.

Many of the earliest industrial enterprises were established in rural settings. Although the growth of

urbanization on a global scale, it was the countryside that first felt the hand of its transformative powers. At Ironbridge in England, the direction and pace of industrial development can be read in a changing landscape of factories, canals, mines, and housing (Alfrey and Clark 1993:145–168). At Lithgow in New South Wales, Australia, the presence of ores in an otherwise rural area led to the establishment of a steel town that would have all of the hallmarks of an urban, industrial community. Constructed on either side of the railroad line that would connect it to Australia's commercial centers, Lithgow now stands as a quiet monument to industrial development rather than the noisy, smoke-draped place it had once been. Jack and Cremin note that the poor living and working condition in Lithgow had always been a source of turmoil for the many who toiled in the community (Jack and Cremin 1994:123).

The mining of ores and precious metals occupied a central place in industrial development well before the advent of factory-based industry. Mining for silver and gold was an important part of the Spanish colonial effort during the 16th and 17th centuries (e.g., deFrance 2003), as it was in places such as South Africa (Behrens 2004), Australia (Jack and Cremin 1994:59–77), and the American West (Hardesty 1988, 1998). Hardesty's (1998, 2001) innovative research has focused on the growth of industrial landscapes as well as the long-term impact industry has had on the environment writ large. Historical archaeologists working in the western United States have continued to develop this focus on mining and other forms of rural industry. For instance, Gillespie and Farrell's study of mining camps in Arizona revealed that companies took steps to meet the newly established state standards for housing and sanitation (Gillespie and Farrell 2002:59–68).

Legislation to promote better standards of living and hygiene for workers such as that discussed by Gillespie and Farrell (2002) grew directly out of concerns for worker well-being that first emerged in the industrial cities of Europe, the United States, and Australia during the 19th century. The interdisciplinary investigations of the Boott Cotton Mills (Mrozowski et al. 1996) and subsequent research in Lowell, Massachusetts (Mrozowski 1999a) have explored the growth of that city's urban environment as part of a broader examination of the social and biological consequences of industrialization (see Figure 13.1). Among the results of this research has been evidence of rodent infestations in company boarding houses and the presence of lead in the soils surrounding the Boott boarding house yards (Mrozowski et al. 1996:53). Medical research illustrates just how dangerous even a slightly elevated lead level can be, particularly for children, if exposed to lead-laden soils, drinking water traveling through deteriorating lead pipes, or paint (Canfield et al. 2003; Rogan and Ware 2003:1515–1516). Lead data from yards used by workers of the Boott and Lawrence manufacturing companies far exceeded the 10 milligrams per deciliter of blood threshold which can cause intellectual impairment (Canfield et al. 2003; Rogan and Ware 2003) as well as delay puberty in girls (Selevan et al. 2003). The results from Lowell can be easily extrapolated to other 19th-century cities where overcrowding and poor sanitation could result in the spread of disease. The creation of slums and densely populated areas in cities across the globe (see Mayne and Murray 2001) all resulted in conditions that were highly conducive to the spread of disease.

Conclusion and Future Directions

Over the past 20 years historical archaeologists have become increasingly interested in the role of environmental studies. As the numerous examples discussed here can attest, those studies are providing critical perspectives on the many changes wrought by colonization, urbanization, and industrialization. The biological dimensions of those changes are inseparable from the cultural forces that helped to shape these historical processes. In the Lowell case, for instance, it is easy to ponder whether the performance of immigrant children in school was affected by learning disabilities linked to lead poisoning. Joined with the other vagaries of poverty and prejudice, the picture that emerges is one that speaks to the pathologies of social inequality. Regardless of the context, the biological dimensions of living in densely populated urban communities contradict epistemologies that see culture and nature as separate realities (Descola and Pálsson 1996; Escobar 1999; Mrozowski 1996). One metaphor that works to illustrate the fallacy of dichotomous epistemologies is the body as environment (Butler 1993; Haraway 1991; Lowe 1995; see Meskell 1999). In cases where disease can be linked to poor sanitation, the body serves as an appropriate metaphor for characterizing the impact industry had on the well-being of working class communities. By placing the body into its broader environment, historical archaeologists can begin reconstructing the ecologies of capitalism and chronicle their change over time (Mrozowski in press). In so doing they provide a unique perspective on history of capitalism and its continuing influence in today's world and in the future.

By recognizing the dialectical relationship of nature as physical reality and nature as perceived reality, as Escobar has argued (1999), historical archaeologists can begin to deepen their understanding of the innumerable histories that have contributed to the evolution of the modern world. Those histories were often conditioned by biological factors such as the presence of disease, the need to adapt to novel environments, and the coming together of disparate populations in forming new communities. New directions in this regard are already visible. The work of people such as Stahle et al. (1998) at Jamestown point to the potential for making new discoveries that helps in rewriting colonial history. Similar results from New South Wales suggest other avenues of research for recasting the events that shaped Australia's colonial origins (Gale and Haworth 2002). Hardesty's work (2001, 2003) on issues of sustainability provides still another avenue for an environmentally-oriented historical archaeology. As new research is undertaken, comparative and more integrative approaches to colonialism, urbanization, and industrialization will be possible. Kealhofer's (1999) recent call for a more integrative approach to the study of landscape is one such example. Johanna Behrens' recent examination of the Modderfontein dynamite factory in South Africa drew upon case studies from North America to provide her study with greater global breadth

(Behrens 2004:350–366). The work of Grace Karskens (2003) in Sydney, Susan deFrance (2003) in Bolivia, and Heather Trigg (2004) in the American Southwest represent other examples of placing local experiences into a broader global context.

In October of 1897 an Aboriginal man in northern Australia was transported by police to a prison in the southern portion of the continent. Having never been in this part of Australia before, he found himself in a strange environment not inhabited by spirits with which he could communicate. He found the new place filled with *kartiya*, or non-aborigines, as well as plants and animals that were strange to him (Harrison 2002:260). Pieced together from written descriptions of prison life in late 19th-century Australia, this fictional narrative captures a first-hand account of colonization through the eyes of the colonized. Its description of a transformed world, populated by strange people, foreign plants and animals, and an unfamiliar spirit world, captures the texture of the colonial encounter. It is this texture, the lived experience, that demands a historical archaeology capable of constructing comparable images of past realities and the experiences of those who lived them.

REFERENCES

Alfrey, Judith, and Catherine Clark 1993 The Landscape of Industry: Patterns of Change in the Ironbridge Gorge. London: Routledge.

Alpern, Stanley 1992 The European Introduction of Crops into West Africa in Precolonial Times. History in Africa, 19:13–43.

Anderson, David G., David W. Stahle, and Malcolm K. Cleveland 1995 Paleoclimate and the Potential Food Reserves of Mississippian Societies: A Case Study from the Savannah River Valley. American Antiquity 60(2):258–286.

Armstrong, Douglas V. 1999 Archaeology and Ethnohistory of the Caribbean Plantation. *In* "I, Too, Am America": Archaeological Studies of African-American Life. Teresa Singleton, ed. Pp. 173–192, Charlottesville: University of Virginia Press.

Auger, Reginald, and William Moss 2001 The Archaeology of Physical and Social Transformation: High Times, Low Tides and Tourist floods on Quebec City's Waterfront. *In* The Archaeology of Urban Landscapes, Explorations in Slumland. Alan Mayne and Tim Murray, eds. Pp. 132–144. Cambridge: Cambridge University Press.

Bain, Alison 1998 A Seventeenth Century Beetle Fauna from Colonial Boston. Historical Archaeology 32(3):32–48.

—— 2000 Archaeoentomological and Archaeoparasitological Reconstructions at Îlot Hunt (CeEt-110): New Perspectives in Historical Archaeology (1850–1900). British Archaeological Reports, vol. S973. Oxford, Archaeopress.

Beaudry, Mary C. 1996 Reinventing Historical Archaeology. *In* Historical Archaeology and the Study of American Culture. Lu Ann De Cunzo and Bernard L. Herman, eds. Pp. 473–497. Knoxville: University of Tennessee Press.

Behrens, Joanna 2004 Navigating the Liminal: An Archaeological Perspective on South African Industrialization. *In* African Historical Archaeologies. Andrew M. Reid and Paul J. Lane, eds. Pp. 347–373. London: Kluwer.

Benton, Ted 1996 The Greening of Marxism. New York: Guilford.

Bowen, Joanne 1999 The Chesapeake Landscape and the Ecology of Animal Husbandry. *In* Old and New Worlds. Geoff Egan and Ronald L. Michael, eds. Pp. 358–367. Oxford: Oxbow.

Butler, Judith 1993 Bodies that Matter: On the Discursive Limits of Sex. New York: Routledge.

Campbell, Judy A. 2002 Invisible Invaders: Smallpox and Other Diseases in Aboriginal Australia. Melbourne: Melbourne University Press.

Canfield, Richard L., Charles R. Henderson, Jr., Deborah A. Cory-Slechta, Christopher Cox, Todd A. Jusko, and Bruce P. Lanphear 2003 Intellectual Impairment in Children with Blood Lead Concentrations below 10 μg per Deciliter. New England Journal of Medicine 348(16):1517–1526.

Cantwell, Anne-Marie, and Diana diZerega Wall 2001 Unearthing Gotham: The Archaeology of New York City. New Haven: Yale University Press.

Cheek, Charles D. 1999 An Evaluation of Regional Differences in Colonial English Foodways. *In* Old and New Worlds. Geoff Egan and Ronald L. Michael, eds. Pp. 349–357. Oxford: Oxbow.

Cox, Glenda, and Judith Sealy 1997 Investigating Identity and Life Histories: Isotope Analysis and Historical Documentation of Slave Skeletons Found on the Cape Town Foreshore, South Africa. International Journal of Historical Archaeology 1(3):207–224.

Crosby, Alfred W. 1986 Ecological Imperialism: The Biological Expansion of Europe, 900–1900. Cambridge: Cambridge University Press.

Deagan, Kathleen 1996 Environmental Archaeology and Historical Archaeology. *In* Case Studies in Environmental Archaeology. Elizabeth J. Reitz, Lee A. Newsom and Sylvia J. Scudder, eds. Pp. 359–376. New York: Plenum.

—— 2003 Colonial Origins and Colonial Transformations in Spanish America. Historical Archaeology 37(4):3–13.

Deagan, Kathleen A., and Jane Landers 1999 Fort Mosè: Earliest Free African-American Town in the United States. *In* "I, Too, Am America": Archaeological Studies of African-American Life. Teresa Singleton, ed. Pp. 261–282. Charlottesville: University of Virginia Press.

Deetz, James J. 1977 In Small Things Forgotten: The Archaeology of Early American Life. Garden City, NJ: Anchor Press.

deFrance, Susan D. 2003 Diet and Provisioning in the High Andes: A Spanish Colonial Settlement on the Outskirts of Potosí, Bolivia. International Journal of Historical Archaeology 7(2):99–125.

Descola, Philippe, and Gísli Pálsson, eds. 1996 Nature and Society: Anthropological Perspectives. London: Routledge.

Diamond, Jared 1999 Guns, Germs, and Steel: The Fates of Human Societies. New York: Norton.

Dobyns, Henry F. 1991 New Native World: Links between Demographic and Cultural Changes, Columbian Consequences, vol. 3, The Spanish Borderlands in Pan-American Perspective. David H. Thomas, ed. Pp. 541–559. Washington, DC: Smithsonian Institution Press.

Edwards-Ingram, Yvonne D. 1999 The Recent Archaeology of Enslaved Africans and African Americans. *In* Old and New Worlds. Geoff Egan and Ronald L. Michael, eds. pp 155–164. Oxford: Oxbow.

Escobar, Arturo 1999 Steps to an Anti-Essentialist Political Ecology. Current Anthropology 40(1):1–16.

Gale, S. J., and R. J. Haworth 2002 Beyond the Limits of Location: Human Environmental

Disturbance prior to Official European Contact in Early Colonial Australia. Archaeology in Oceania 37:123–136.
Geismar, Joan H. 1993 Where is Night Soil? Thoughts on an Urban Privy. Historical Archaeology 27(2):57–70.
Gillespie, William. B., and Michael Farrell 2002 Work Camp Settlement Patterns: Landscape-Scale Comparisons of Two Mining Camps in Southeastern Arizona. Historical Archaeology 36(3):59–68.
Goodman, Alan H., and Thomas L. Leatherman, eds. 2001 Building a New Biocultural Synthesis, Political-Economic Perspectives on Human Biology. Ann Arbor: University of Michigan Press.
Hall, Martin 1992 Small Things and the Mobile, Conflictual Fusion of Power, Fear, and Desire. *In* The Art and Mystery of Historical Archaeology: Essays in Honor of James Deetz. Anne E. Yentsch and Mary C. Beaudry, eds. Pp. 373–399. Boca Raton: CRC Press.
—— 2000 Archaeology and the Modern World: Colonial Transcripts in South Africa and the Chesapeake. London: Routledge.
Hamilton, Scott 1996 Over-Hunting and Local Extinctions: Socio-Economic Implications of Fur Trade Subsistence. *In* Images of the Recent Past: Readings in Historical Archaeology. Charles E. Orser, ed. Pp. 416–435. Walnut Creek: AltaMira Press.
—— 2000 Dynamics of Social Complexity in Early Nineteenth-Century British Fur-Trade Posts. International Journal of Historical Archaeology 4(3):217–273.
Haraway, Donna 1991 Simians, Cyborgs and Women: The Reinvention of Nature. London: The Free Associate Press.
Hardesty, Donald L. 1988 The Archaeology of Mining and Miners. Special Publication Number 6. Ann Arbor: Society for Historical Archaeology.
—— 1998 Power and the Industrial Mining Community in the American West. *In* Social Approaches to an Industrial Past: The Anthropology and Archaeology of Mining. A. Bernard Knapp, Vincent C. Pigott, and Eugenia W. Herbert, eds. Pp. 81–96. London: Routledge Press.
—— 1999 Historical Archaeology in the Next Millennium: A Forum. Historical Archaeology 33(3):51–58.
—— 2001 Archaeology. *In* Our Fragile World: Challenges and Opportunities for Sustainable Development, vol. II. M. K. Tolba, ed. Pp. 1165–1181. Oxford: Eolss Publishers Co. Ltd.
—— 2003 Mining Rushes and Landscape Learning in the Modern World. *In* Colonization of Unfamiliar Landscapes: The Archaeology of Adaptation. M. Rockman and J. Steele, eds. Pp. 81–95. London: Routledge Press.
Hardesty, Donald L., and Donald D. Fowler 2001 Archaeology and Environmental Changes. *In* New Directions in Anthropology and Environment: Intersections. Carol. L. Crumley, A. E. van Deventer, and J. J. Fletcher, eds. Pp. 72–89. Walnut Creek: AltaMira Press.
Harrison, Rodney 2002 Archaeology and the Colonial Encounter: Kimberly Spearpoints, Cultural Identity and Masculinity in the North of Australia. Journal of Social Archaeology 2(3):352–377.
Haworth, R. J., S. J. Gale, S. A. Short, and H. Heijnis 1999 Land Use and Lake Sedimentation on the New England Tablelands of New South Wales, Australia. Australian Geographer 30(1):51–73.
Jack, Ian R., and Aedeen Cremin 1994 Australia's Age of Iron: History and Archaeology. Oxford: Oxford University Press.
Janowitz, Meta F. 1993 Indian Corn and Dutch Pots: Seventeenth Century Foodways in New Amsterdam/New York. Historical Archaeology 27(2):6–24.
Jarosz, Lucy 2003 A Human Geographer's Response to Guns, Germs, and Steel: The Case of Agrarian Development and Change in Madagascar. Antipode 35(4):823–828.
Karskens, Grace 2003 Revisiting the Worldview: That Archaeology of Convict Households in Sydney's Rocks Neighborhood. Historical Archaeology 37(1):34–55.
Kealhofer, Lisa 1999 Adding Content to Structure: Integrating Environment and Landscape. *In* Old and New Worlds. Geoff Egan and Ronald L. Michael, eds. Pp. 378–389 Oxford: Oxbow.
Landon, David B. 1996 Feeding Colonial Boston: A Zooarchaeological Study. Historical Archaeology 30.
Larsen, Clark S. 2002 Bioarchaeology: The Lives and Lifestyles of Past Peoples. Journal of Archaeological Research 10(2):119–166.
Leone, Mark, Parker B. Potter, and Paul A. Shackel 1987 Toward a Critical Archaeology. Current Anthropology 28(3):283–302.
Lightfoot, Kent 2003 Russian Colonization: The Implications of Mercantile Colonial Practices in the North Pacific. Historical Archaeology, 37(4):14–28.
Lowe, Donald M. 1995 The Body in Late Capitalist USA. Durham: University of North Carolina Press.
Mayne, Alan, and Tim Murray 2001 The Archaeology of Urban Landscapes, Explorations in Slumland. Cambridge: Cambridge University Press.
Mays, Simon 1999 The Study of Human Skeletal Remains from English Post Medieval Sites. *In* Old and New Worlds. Geoff Egan and Ronald L. Michael, eds. Pp. 331–341 Oxford: Oxbow.
McGuire, Randall 2002 A Marxist Archaeology. Clinton Corners: Percheron Press.
McKee, Larry 1988 Plantation Food Supply in Nineteenth Century Tidewater, Virginia. Ph.D. dissertation, Berkeley, Department of Anthropology.
—— 1999 Food Supply and Plantation Social Order: An Archaeological Perspective. *In* "I, Too, Am America": Archaeological Studies of African-American Life. Teresa Singleton, ed. Pp. 218–239. Charlottesville: University of Virginia Press.
Meskell, Lynn 1999 Archaeologies of Social Life. Oxford: Blackwell.
Mires, Peter B. 1994 Contact and Contagion: The Roanoke Colony and Influenza. Historical Archaeology 20:30–38.
Morgan, Edward S. 1971 The First American Boom: Virginia 1618–1630. William & Mary Quarterly 28(2):169–198.
Moussette, Marcel 2003 An Encounter in the Baroque Age: French and Amerindians in North America. Historical Archaeology 37(4):29–39.
Mrozowski, Stephen A. 1987 Exploring New England's Evolving Urban Landscape. *In* Living in Cities, Edward Staski, ed. Pp 1–9. Ann Arbor: Society for Historical Archaeology.
—— 1991 Landscapes of Inequality. *In* The Archaeology of Inequality. Randell H. McGuire and Robert Paynter, eds. Pp 79–101. Oxford: Basil Blackwell.
—— 1996 Nature, Society, and Culture: Theoretical Considerations in Historical Archaeology. *In* Historical Archaeology and the Study of American Culture. Lu Ann De Cunzo and Bernard L. Herman, eds. Pp. 447–472. Knoxville: University of Tennessee Press.
—— 1999a Interdisciplinary Perspectives on the Production of Urban Industrial Space. *In* Old and New Worlds. Geoff Egan and Ronald L. Michael, eds. Pp. 136–146. Oxford: Oxbow.
—— 1999b The Commodification of Nature. International Journal of Historical Archaeology, 3(3):153–166.
—— In press The Archaeology of Class in Urban America. Cambridge: Cambridge University Press.

Mrozowski, Stephen A., Grace H. Zeising, and Mary C. Beaudry 1996 Living on the Boott: Historical Archaeology at the Boott Cotton Mills, Lowell, Massachusetts. Amherst: University of Massachusetts Press.

O'Connor, James 1998 Natural Causes: Essays in Ecological Marxism. New York: Guilford.

Palmer, Marilyn and Peter Neaverson 1998 Industrial Archaeology Principles and Practice. London: Routledge.

Paynter, Robert 2000 Historical and Anthropological Archaeology: Forging Alliances. Journal of Archaeological Research 8(1):1–37.

Perttula, Timothy K. 1991 European Contact and Its Effects on Aboriginal Caddoan Population between A.D. 1520 and A.D. 1680. *In* Columbian Consequences, vol. 3: The Spanish Borderlands in Pan-American Perspective. David H. Thomas, ed., Pp. 501–518. Washington, DC: Smithsonian Institution Press.

Reinhard, Karl J. 1992 Parasitology as an Interpretive Tool in Archaeology. American Antiquity 57(2):231–245.

Reinhard, Karl. J., Stephen A Mrozowski, and Kathleen K. Orloski 1986 Privies, Pollen, Parasites and Seeds: A Biological Nexus in Historical Archaeology. The MASCA Journal 4(1):31–36.

Reitz, Elizabeth J. 1992 The Spanish Colonial Experience and Domestic Animals. Historical Archaeology 26(1):84–91.

—— 1994 Zooarchaeological Analysis of a Free African Community: Gracia Real de Santa Teresa de Mose. Historical Archaeology 28(1):23–40.

Reitz Elizabeth J., and Bonnie G. McEwen 1995 Animals, Environment and the Spanish Diet at Puerto Real. *In* Puerto Real: The Archaeology of a Sixteenth-Century Spanish Town in Hispaniola. Kathleen Deagan, ed. Pp. Gainesville: University of Florida Press.

Reitz, Elizabeth J., and B. Ruff 1994 Morphometric Data for Cattle from North America and the Caribbean prior to the 1950s. Journal of Archaeological Science, 21(5):699–713.

Reitz, Elizabeth J., and Margaret C. Scarry 1985 Reconstructing Historic Subsistence with an Example from Sixteenth-Century Spanish Florida, Society for Historical Archaeology Special Publication 3. Ann Arbor: Society for Historical Archaeology.

Rogan, Walter J., and James H. Ware 2003 Exposure to Lead in Children – How Low is Low Enough? New England Journal of Medicine, 348(16):1515–1516.

Rothschild, Nan A. 1989 The Effects of Urbanization on Faunal Diversity: A Comparison between New York and St. Augustine, Florida, in the Sixteenth to Eighteenth Centuries. *In* Quantifying Diversity in Archaeology. R. D. Leonard and G. T. Jones, eds. Pp. 92–99. Cambridge: Cambridge University Press.

—— 1990 New York City Neighborhoods: The Eighteenth Century. San Diego: Academic Press.

Rothschild, Nan A., and Donna Balkwill 1993 The Meaning of Change in Urban Faunal Deposits. Historical Archaeology, 27(2):71–89.

Scarry, Margaret C., and Elizabeth J. Reitz 1990 Herbs, Fish, Scum, and Vermin: Subsistence Strategies in Sixteenth-Century Spanish Florida. *In* Columbian Consequences, vol. 2: Archaeological and Historical Perspectives on the Spanish Borderlands. David H. Thomas, ed. Pp. 343–354. Washington, DC: Smithsonian Institution Press.

Schávelson, Daniel 1999 The Historical Archaeology of Buenos Aires: A City at the End of the World. New York: Kluwer.

Schrire, Carmel 1995 Digging Through Darkness: Chronicles of an Archaeologist. Charlottesville: University of Virginia Press.

Schuyler, Robert L. 1999 Comments on Historical Archaeology in the Next Millennium: A Forum. Historical Archaeology, 33(2):66–67.

Scott, Elizabeth M. 1996 Who Ate What? Archaeological Food Remains and Cultural Diversity. *In* Case Studies in Environmental Archaeology. Elizabeth J. Reitz, Laurie A. Newsom, and Sylvia J. Scudder, eds. Pp. 339–356, New York, Plenum.

Sealy, Judith C., Alan G. Morris, R. Armstrong, A. Markell, and Carmel Shrire 1993 An Historic Skeleton from the Slave Lodge at Vergelegen. South African Archaeological Society Goodwin Series 7, 84–91.

Selevan, Sherry G., Deborah C. Rice, Karen A. Hogan, Susan Y. Euling, Andrea Pfahles-Hutchens, and James Bethel 2003 Blood Lead Concentration and Delayed Puberty in Girls. New England Journal of Medicine 348(16):1527–1536.

Shackel, Paul A. 1996 Culture Change and the New Technology. New York: Plenum.

Silliman, Stephen W. 2004 Lost Laborers in Colonial California: Native Americans and the Archaeology of Rancho Petaluma. Tucson: University of Arizona Press.

Sluyter, Andrew 2003 Neo-Environmental Determinism, Intellectual Damage Control, and Nature/Society Science. Antipode 35(4):813–817.

Soper, Kate 1996 Nature/"Nature". *In* Future Natural. George Robertson, Melinda Mash, Lisa Tickner, Jon Bird, Barry Curtis, and Tim Putnam, eds. Pp. 22–34. London: Routledge.

Stahle, David W., Malcolm K. Cleveland, Dennis B. Blanton, Matthew D. Therrell, and David A. Gay 1998 The Jamestown and Lost Colony Droughts. Science 280(S363):564–567.

Teich, Mikulas, Roy Porter, and Bo Gustafsson, eds. 1997 Nature and Society in Historical Context. Cambridge: Cambridge University Press.

Trigg, Heather 2004 Food Choice and Social Identity in Early Colonial New Mexico. Journal of the Southwest 46(2):223–252.

Wallerstein, Immanuel 1974 The Modern World System I: Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century. New York: Academic.

Wolf, Eric 1982 Europe and the People Without History. Berkeley: University of California Press.

Zeitlin, Judith F., and Lillian Thomas 1997 Indian Consumers on the Periphery of the Colonial Market System: Tracing Domestic Economic Behavior in a Tehuantepec Hamlet. *In* Approaches to the Historical Archaeology of Mexico, Central and South America. Janine Gasco, Greg Charles Smith, and Patricia Fournier-Garcia, eds. Pp. 5–16. Los Angeles: The Institute of Archaeology, University of California.