Reading the Land: The Archaeology of Settlement and Land Use

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Where Is Home?

Where are you from? This familiar question opens conversation with strangers the world over. The answer is full of information: preferences, attitudes, abilities, politics, and social standing are only some of the things one can learn from a simple question about origins.

In the four million years since ancestors of our species found food, water, and shelter in subtropical Africa, genus *Homo* has made more and more of the planet home. The places people make their homes vary greatly: Our ancestors found shelter in caves and overhangs, or made shelters with brush, or hides and mammoth tusks, heaped-up earth, adobe, or sun-dried brick. Contemporary shelters—a steel-and-glass skyscraper, an isolated cabin, or a tiny room overlooking a narrow street—all look just fine to the tired returning traveller, as long as they are "home," a place that is familiar and, relatively speaking, predictable and safe.

Home is bigger than the physical space in which we eat, sleep, and relax. Our surroundings—full of landmarks, familiar sounds and smells, and memories of people and events—are extensions of the structures we occupy. We have hometowns and home states or provinces, and even inveterate world travelers generally have what they consider a home country, although it may not be the same as the country on the passport. And, of course, we all share a home planet, the third from the star we call Sun.

There were not always so many human beings on the planet and, as a species, we have not always lived as close as we do today to people we don't know. Millions of people live in the largest cities, with densities of thousands per square mile. Extreme environments such as polar or desert regions attract fewer residents than our species' home tropics or the temperate latitudes, although contemporary desert cities such as Cairo and Phoenix call even such general statements into question. In short, human beings, thanks to broad adaptive abilities, can and do live in every conceivable environment.

The physical limitations on where people can live are, however, the same as they have always been: We must be supplied with food and water, and we have to be sheltered from the extremes of weather.

HOME IS WHERE THE RESOURCES ARE

Although miles of water pipelines and several means of long-distance transport now allow people to live very far from sources of water, food, and fuel, this is a very recent development. For most of human history, the work of finding (or tending) and preparing food for the group of people to which one belonged took up most of the working day.

Today supermarkets offer a wide variety of prepared foods, and most of their cost is payment for the work of production, preparation, and transport to the store from wherever the food was grown or raised. Most of us live far from the Kansas or Argentine feedlots where the beef cattle were raised for our hamburgers and the Idaho fields where potatoes were harvested for our french fries. We can get vegetables and fruit year-round from Florida, California, the Caribbean, and South America.

The desire to prepare and eat food in safe and social circumstances is still a hallmark of our species, but now a far greater percentage of the population is free to pursue activities unrelated to food production. While a few people were always excused from daily food-getting tasks (specialists in religion or certain crafts, the very young or old), now only a few, relatively speaking, produce food for all the rest of us.

GLOBAL HOUSEKEEPING

All this has had a profound and not unproblematic effect on where we live. As the human niche (that is, the kinds of environment humans could call home) expanded with new solutions to resource problems, the very success of the species has caused increased human impacts on fragile landscapes. Today, with the combined effects of greater numbers, long-distance transport, and gigantic land-modification machinery, the human mark on our home planet can be seen easily from space. What the satellites show us are polluted oceans and lakes, eroded croplands, sediment-choked rivers, and, in the ozone layer that protects us from deadly ultraviolet rays, a growing hole.

Issues of population control aside, there remains the fact that humans are disproportionately distributed upon the planet in a pattern characterized by huge urban areas and sparsely populated rural areas. Because they are so far from the sources of supply, this pattern puts urban populations at risk. As recently as the beginning of the twentieth century, 99.9 percent of the world's population lived close enough to food and water to obtain it themselves. Today many urban residents would have no idea where to get water if taps were dry, or food if the store shelves were bare.

How did this new landscape develop? How old are cities? What is the history of pollution? Could knowledge of past land use and the distribution of settlements give us ideas about how to solve contemporary social and environmental problems?

OBSERVING THE LANDSCAPE

When my family took trips, my job was always to navigate. My dad showed me how to use maps, read signs, find north, and keep my eyes open for landmarks. Soon (if I was confident of our route) I was looking at other things too: buildings, fields, and other evidence of human activity. The abandoned farmhouse and its tumbledown outbuildings and fences right next to the diner where we stopped for lunch told me that the road hadn't always been a busy highway. Bricked-up doors and windows in a city warehouse and a barely-readable sign told me the structure had once been a grain mill serving an agricultural countryside. These were clues to a vanished landscape, in which the land was put to different uses.

We often travelled between the black earth and ancient lakebeds of southeastern Michigan and the rolling, red clay hills of northeast Tennessee. I loved the game of waking from a nap and trying to guess where we were from analyzing the landscape: the architecture and materials of buildings, the topography, the vegetation, the *feel* of the place.

Soon enough, I discovered that archaeology allowed me views into the landscapes of distant times and places, even when all above-ground clues had been swept away. One sunny afternoon in third grade, my teacher asked me to read from our social science book. The subject was ancient Egyptian burial customs,

and the text explained that much of what was known about Egyptian life had come from the tombs of the dead, the very existence of which had been forgotten for thousands of years.

This evidence was even more challenging than "seeing" old landscapes still above ground. In places where peoples of the past had discarded smashed pottery, broken and used-up tools, or other household garbage, there were landmarks from the past. I realized that by studying how and where people used the land and made their homes, one could imagine the sights, sounds, and smells of the past and understand changes that distinguished them from those of the present.

CHRONICLES OF VANISHED LANDSCAPES

Modern archaeologists are not the first to notice landmarks of the past. The most easily recognized, and therefore the earliest recorded evidence of past human activity, were the big building projects. The great monuments of the old world (that is, the eastern hemisphere), such as the Egyptian pyramids, were already thousands of years old when Greek traveler-scholars wrote of them in the centuries just before the birth of Christ. Even the sites of big disasters, like the Italian towns of Pompeii and Herculaneum that were buried by the eruption of the volcano Vesuvius in A.D. 79, were known in the Middle Ages.

Renaissance (ca. A.D. 1350–1650) naturalists and antiquarians made painstaking records of monuments, such as Stonehenge and Avebury in England and Carnac in France, on their home soil. Their colonial counterparts, when the duties of conquest allowed, recorded the sites and monuments that figured in more distant landscapes.

Most easily recognized were burial monuments (mounds, pyramids) and large religious or domestic structures (temples, palaces). Built to impress, they continued to do so as elements of much later landscapes. Considered romantic and mysterious, ruined structures appeared as elements of an idealized landscape in Renaissance paintings.[1] Also easy to spot were the extensive heaps of debris: the great ruined cities of the past such as Assur (near modern Baghdad), Teotihuacan (near modern Mexico City),

and Great Zimbabwe (near Mas Vingo [colonial Fort Victoria], Zimbabwe).

While some naturalists and antiquarians concentrated on sites that were still a visible element in the contemporary landscape, others searched for much less visible dwellings, tools, and other debris left by peoples of more modest means. By the end of the eighteenth century, empirical methods of study had become standard in the physical and natural sciences (geology, botany, anatomy); these methods were applied to bones and stone tools found at considerable depth in caves and quarries and in the company of extinct plants and animals. In particular, advances in geology permitted sites to be placed in the context of their surrounding strata and dated to thousands of years earlier than the events in the Bible.

These sites, mostly invisible on the surface of the ground, were the homes, game butchering spots, and workshops of humans who lived thousands of years before the Pharaohs built the pyramids; considerably greater effort was required to imagine them or their surroundings. The clergy was especially disinclined to recognize a human antiquity which predated biblical events, and new theories of technological and biological evolution differed dramatically from the catastrophic version of human history found in the Bible. Religious authorities found themselves in heated defense of an interpretation of the Bible that placed the world's creation only six thousand years ago; according to Bishop Ussher of Armagh (in Northern Ireland), who had added up all the generations in Genesis and calculated backward, the world began in exactly 4004 B.C.

By the mid-nineteenth century, the ecclesiastical crisis had been resolved in favor of a less literal interpretation, in part through the offices of scientists who were also religious. Thus unpretentious sites, yielding evidence of everyday human activity, were instrumental in revising our understanding of all human history; the geological, biological, and archaeological data they contained gave Charles Darwin and others solid historical evidence for anatomical change and species extinction.

Thus, two "strands" of archaeology came into being. One studied humanity's great works, the other pieced together the lives and surroundings of ordinary people. The findings of both were sometimes commandeered in support of ethnic, nationalist, and colonial causes.[2] These two traditions began the history of the discipline and shaped subsequent study of human settlement and

land use. Today, a fresh perspective on the ways settlement and land use can be studied suggests some provocative questions for the future.

SYSTEMATIC STUDIES OF SETTLEMENT AND LAND USE

Airborne, one becomes quickly enamored with landscapes and their various elements. After the Wright brothers and others succeeded in making the long-held human dream of flight come true, the First World War made flight routine and gave many British and American archaeologists a new perspective. They saw the larger setting of the burial mounds at Cranbourne Chase, the limits of ancient fields, and other features of prehistoric and historic Britain; they spotted roads, overgrown with vegetation, which connected Maya centers in Yucatan.[3]

Archaeologists began to place sites in the larger spatial context of society, exploring in turn the diverse elements that comprised vanished landscapes. In Egypt, they searched for the quarries where stone for the pyramids was procured; realizing the mechanical and human effort that went into pyramid construction, they looked for access roads, workshops, workers' towns and cemeteries. In Chaco Canyon (NW New Mexico), they spotted ancient paths that connect abandoned pueblos.

Searching the land for archaeological sites, called surveying in North America and fieldwalking in the British Isles, joined excavation as standard practice. One of the first systematic regional surveys by American archaeologists was conducted as part of a large project designed to understand the origins of complex society in the Viru Valley, Peru.[4] The analysis of *settlement patterns*, the study of all simultaneously occupied sites, enabled the first visualizations of those ancient landscapes.

In the 1950s both British and American archaeologists began to reconstruct vanished environments to better understand past economies. They reasoned that the systematic collection of economic data (in the form of evidence for domestic and trading activity) was predicated upon the reconstruction of the physical environment (climate, plant and animal life, and other natural resources) which then permitted the interpretation of daily and

seasonal activities, the division of labor, and patterns of trade. J. G. D. Clark's study of the prehistoric environment surrounding the British Mesolithic site of Star Carr was influential on both sides of the Atlantic.[5] In the Americas, Richard MacNeish assembled an impressive multi-disciplinary team including botanists, geologists, and other environmental experts in the Tehuacan Valley of Mexico.[6] By the end of the 1960s, environmental studies were an indispensable element in every archaeological report.[7]

ARCHAEOLOGY AND THE INFORMATION AGE

Although settlement pattern studies had been a part of archaeology for over a decade, the expanded potential for the study of trade, politics, and social organization caught the imagination of a new generation of computer literate and statistically oriented archaeologists.[8] The respected quantitative archaeologist Albert C. Spaulding set the new agenda when he argued that the three dimensions of archaeology were space, time, and form, and that the spatial dimension could use a lot more attention.[9]

This reorientation changed the scale and focus of archaeological investigations. Chronological and typological studies did not disappear—they remained necessary but were not sufficient in the study of past human settlement. The patterning of artifacts within a site (as well as between sites) was analyzed to detect variation among individuals and groups. The various activity areas (for example, where food was prepared or a tool was made) were then related to social distinctions among inhabitants of the site (e.g., kinship status, occupation, gender).[10] Long-distance trade was reconstructed by finding the sources of excavated materials (e.g., obsidian, galena).[11]

Greater interest in individual behavior and in social relations moved Euro-American archaeology away from technological and typological studies to sociopolitical analysis. While settlement pattern archaeology had primarily charted the relation among dwellings and other buildings as they pertained to community life, now the term *settlement system* began to be used.[12] It emphasized regional connections among settlements and reflected the impact of systems theory on archaeology. For example, mining of

a resource like gold or tin might take place in the mountains, but the material might only be made into ingots at the extraction site; from there it would be transported by caravan to an urban workshop, where expert metalsmiths would fashion exquisite jewelry from the gold and mix the tin with copper from elsewhere to make bronze. On the return trip, the caravans would be laden with the artifacts of city life, destined for the elites who controlled the mines: spices from distant lands, wine, pottery, and other artisan-made goods. Thus did archaeologists turn to the study of reciprocal economic, social, and political relations among contemporaneous sites.

Taking their cue from geographers (many of whom had served as mapmakers, meteorologists and in other technical capacities during World War II), archaeologists enthusiastically embraced computer-based statistical and spatial modeling to predict where sites of varying function would be located. Sampling problems—both statistical and in archaeological surveys—began to dominate discussions of method. While the use of computers vastly increased the speed and even the very possibility of some calculations, computer modeling measured the always-flawed sampling universe of known archaeological sites against an ideal landscape in which all actors acted "rationally," that is, to maximize efficiency in resource procurement. These and other optimizing assumptions underlay what was to be known as the *new archaeology*. The problem is, of course, that people act in ways that are not always economically optimal. Kinship and political obligations between and within societies, trade routes rendered inhospitable by pirates or terrain, and many other reasons keep people from choosing the most economically sensible site for their homes and other activities.

THE NEW ARCHAEOLOGY AND SPATIAL MODELING

By the late 1960s, general availability of computers allowed large amounts of environmental and archaeological data to be statistically combined, offering a new approach to the study of settlement and land use. Researchers designed computer models of settlement systems based on hypotheses (for example, if agricul-

tural yield diminishes, there is more warfare). Collectively termed locational analysis, these approaches to settlement concentrated on habitation sites and their relationship to one another and to economic resources.

Many archaeologists hoped that these methods offered the possibility of predicting the location of sites; however, they had been designed for rather different purposes than finding archaeological sites. For example, central place models were employed in the analysis of mercantile activities such as the siting of fast-food restaurants or the deployment of trucks carrying bananas. These activities had characteristics archaeological sites would never have: The data were complete (one knew how many patrons, trucks, or bananas were required for the system to work properly), those elements' simultaneous existence in the world (contemporaneity) was assured, and the model dealt with only retail distribution, which more often than not obeyed certain rules of cost/benefit analysis. On the other hand, one could never be sure that all the archaeological sites of a period had been found, or that it could be said with certainty that the ones found had all been in existence at the same time.

Finally, and most problematically, past human behavior (except in narrowly defined circumstances) did not follow twentieth century Western economic principles.[13] Even in the contemporary data the geographers collected, people still had preferences and personal and social histories that took them out to dinner or shopping in another part of town or even to another city. The consumption of fast food and bananas varied from one neighborhood to another. By the late 1960s geographers had abandoned central place models except in specialized circumstances which combined the economic data with reliable social indicators.

Some locational techniques have had greater longevity. Gravity models (sometimes called distance-decay) predict that progressively less of a resource (for example, good clay for making pottery) will be found the further away one is from its origin. Theissen polygons (created by drawing a straight lines between sites in a region and bifurcating them at their midpoints) approximate the area of influence around a particular site in relation to the position of its neighbors.

These and other geometric techniques, while of use to archaeologists in posing research questions, still failed to account for the more interesting social, political, and historical reasons people do not make unanimous choices about anything. These very issues,

dear to the heart of anthropologists, were termed "noise" by modelers who employed the assumptions of rationalist economic theory. Yet even sociocultural anthropologists constructed "ideal types" to aid their analysis of cultures; the urge to contrast real and ideal human behavior seemed irresistible for a time throughout the social sciences.

THEORETICAL QUANDARIES AND SOME SOLUTIONS

This was the situation when I began a career in anthropology and archaeology. With undergraduate and graduate training in both the humanities (classics) and in the social and natural sciences (anthropology, geology), I felt theoretically homeless. I was intrigued by the idea that ancient texts could illuminate individual lives (although usually those of elites) and great historical movements, but, to my sorrow, classical archaeology seemed more an adjunct to art history than a window to life in the past. The new archaeology treated the lives of everyday people, but seemed too mechanistic in its search for laws governing human behavior. I began my own search for the work of archaeologists and others who offered a critique of the status quo, and for an alternative.

The first work I found was *A Study in Archaeology*, the dissertation of Walter W. Taylor.[14] Critical of the overly scientific approach to the interpretation of archaeological evidence, he advocated a contextual approach, by which he meant not just the physical environment but social and historical circumstances as well. Unfortunately, the work was admired and taught more for its spirited criticism of prominent archaeologists than for its persuasive argument for the integration of history and the humanities into archaeological interpretation.

Taylor, an American prisoner of war in Europe during WWII, may have been influenced by an important historical tradition in France, referred to as the *Annales* school. Shortly after finding Taylor's book, I discovered the Annales historian Marc Bloch, who was a member of the French Resistance and, unlike Taylor, did not survive the war.[15] In the 1920s the Annales founder, Lucien Febvre, had launched an unrelenting attack on the "old school" of history, in which narrow particularism and mind-

numbing chronology held sway and the context of events was left unexamined.[16] Instead, Febvre and his colleagues proposed an interdisciplinary history distinguished by its emphasis on pattern recognition at three temporal scales: the event, groups of conditions and events (*conjoncture*), and long-term (*longue durée*) history. By the 1940s, when Taylor was imprisoned, the Annales was the reigning paradigm in France.

It seemed to me that archaeology could use similar housecleaning. Enter Lewis Binford, whom many would credit with starting the revolution against the old "chronologies and typologies" school of American archaeology; this "new broom" would come to be known as the "new archaeology." Binford has always argued that "archaeology is anthropology or it is nothing."[17] Since the 1960s, he has exhorted American archaeologists to look for patterns of individual and collective behavior in the analysis of artifacts and the patterning of debris within sites. He employs ethnographic research to better understand the formation of the archaeological record, a tactic termed *ethnoarchaeology*.

My search led me next to the work of David Clarke, who had begun to refine and broaden locational analysis in Britain. He defined *spatial archaeology* as "the study of the flow and integration of activities within and between structures, sites, and resource spaces." Spatial archaeology "deals with human activities at every scale, the traces and artifacts left by them, the physical infrastructure which accommodated them, the environments that they impinged upon, and the interaction between all these aspects. Spatial archaeology deals with a set of elements and relationships."[18] Archaeologists on both sides of the Atlantic realized that by examining patterns of archaeological remains at different spatial scales (e.g. deriving regional economic and social conditions by studying gravestone art), long-term change could be more readily inferred than by examining archaeological patterns at a single (usually site-specific) scale.[19]

During the past two decades, I have drawn on Taylor, Bloch, Binford, Clarke, and others to redefine the concept of *landscape*, using it to integrate diverse temporal and spatial studies. Landscape is the "spatial manifestation of the relations between humans and the environment" and, as such is itself an artifact.[20] As archaeologists' units of spatial analysis became more inclusive (artifact to site to landscape), changes in landscapes could be studied over both the short- and long-term. Today, a theoretical and methodological framework for the interdisciplinary study of

landscape is in place, with implications well beyond any single field of study.

CONTEMPORARY LANDSCAPE AND REGIONAL STUDIES

Today the many strands that enable us to understand the domestic relationship humans have with the earth have begun to come together. Archaeologists study elements (artifacts, features, sites) and spaces as they form the landscape, charting the ways regions have changed over time. Of course, excavations and the search for locales of activity (survey or fieldwalking) are still fundamental to archaeology everywhere, but now the goal is to understand landscapes and entire regions in the past rather than a single site, and to read the history of human activity all the way up to the global scale.

Multiple-investigator projects, often organized by archaeologists based both in cultural resource management (CRM) and in research institutions, seek to do this by assembling teams of scholars who can cooperate to maximize the scope, complexity, rapidity, and quality with which such projects can be completed. Such an approach is traditional for archaeologists, who regularly employ both natural and physical sciences (biology, geology, physics, chemistry) and the humanities (history, classics, philosophy, linguistics). Despite what sometimes appear to be rather parochial interests, archaeologists routinely consult science and humanities colleagues or have training themselves in these disciplines. Most important, archaeology offers the temporal and spatial breadth required for long-term ecological analysis.

A suite of specialized studies are undertaken, and preliminary findings are shared among the researchers. A beginning assumption is that humans can modify the environment and vice versa. Although the physical environment of a region (topography, soils, water, climate, plants, and animals) may have changed as humans utilized various resources, other events and conditions (volcanic activity, a cold period) could also have played a role. Researchers also expect that human responses to changing environmental conditions, whether they had caused those changes or not, can yield valuable insight into contemporary human ecology. These integrated, regional histories of human-environment relationships are

termed historical ecology.[21] The word ecology is from the Greek *oikos* (household); it is related to *oikonomos* (the setting from which households draw provisions), which gives us the word economy.

Ecofacts, the natural scientific evidence of human activity, can yield as much information as artifacts. For example, a paleoethnobotanist (someone trained to identify the plant remains humans used in the past) might examine burned seeds from all levels of an archaeological site, finding that a native plant species becomes more common as time goes on *and* that it underwent marked genetic change. A biological anthropologist, looking at human skeletal material from the same site, reports that the people who lived there began eating almost solely grain, with marked negative effect on their nutrition, and that many of the site's later inhabitants died violently. A geologist notes that erosion becomes a problem in the entire region during the period that corresponds to the latter part of the site's occupation. A climatologist, using information collected locally, regionally, and globally, finds evidence for a dry period in the entire region.

Archaeologists, surveying and excavating sites throughout the region, report that settlements were small and widely dispersed at the beginning of the period, but by its end there were only large, fortified sites around sources of water. A linguist and an ethnohistorian (someone trained to look for cultural information in documents) collaborate to translate stone tablets found at one of the fortified sites; they are prayers to deities asking that the population be spared from war and pestilence. Thus, by integrating evidence from the natural and social sciences and the humanities, we can trace long-term changes in climate, resources, population distribution, human health, and warfare as they pertain to a particular region.

An Exciting New Tool of Analysis

While the conclusions of such research might appear seamless, these understandings are hard-won. Not only are they labor-intensive (just think about identifying and counting hundreds of thousands of burned seeds!), but it takes effort for people trained in very different disciplines to learn to share their findings in less technical

language. Fortunately, the biggest practical problem has been solved.

Geographic Information Systems (GIS) manages the huge amount of data generated in regional-scale research, storing spatial information in such a way that it can be supplemented and compared with ease.[22] Before the last decade, when the availability of both powerful computer hardware and complex software made GIS possible, the archaeologist who wondered if early Neolithic farming communities in Belgium were significantly correlated with sandy soils would run a statistical analysis based on geomorphological (sediment) studies conducted in association with excavations. If, after finding that 75 percent of the sites were on sandy soil, she wondered just where the other 25 percent were located, she would have to mark the locations of all the early Neolithic sites onto a soils map by hand. If her colleague, a geologist, wondered what percentage of the distribution of sites could be explained by the correlation among soils, elevation, and distance from the sea, he would have to start a new map, duplicating some of the long hours at the light table his archaeologist colleague had already spent.

A GIS allows the assemblage of a spatial database all team members can use and encourages "what if?" questions. Each layer of information (elevation, stream courses, administrative boundaries, site and artifact locations, etc.) is entered separately into the GIS either manually (with digitizers) or electronically (by scanners). Although this too takes time, it need only be done once. Cultural data (such as roads and river fords) and environmental data can be entered, and researchers can display any combination of layers on a monitor. Color maps of the combined layers can be printed and the combinations stored for future use.

Even old maps and aerial photographs can be georeferenced (that is, made to match a standard scale) and added to the database. Thus, forests marked on 1759 and 1854 maps in Burgundy, France, can be compared with forest cover in the same area as photographed by military reconnaissance in 1944 and satellite imagery from last month. In addition, the location and percentage of change in forest cover can be calculated for just the area indicated on the 1759 map or for the entire *scene* (the area covered by a single "snapshot" satellite image).

This new tool not only saves time but is also beginning to reconfigure the questions we can ask. We may know that several of a region's Iron Age sites are fortified hilltops, but with a particular GIS display (called view-shed analysis) we can see that several of these

sites together offer an unrestricted view of all major routes through the area. We can devise ways of testing the hypothesis that these particular sites were critical to the region's defense: Are they permanently or sporadically occupied? Are they more heavily fortified than other contemporary hillforts? When we have the configuration of defensive sites, the direction from which enemies were expected can be hypothesized. The next round of questions would then concern relations with other groups, terrain, and resources in the region.

Perhaps of most importance, the GIS enables us to use actual site and artifact locations and other data which do not need to be compared with situations the researcher might postulate as "ideal"; instead the physical evidence of social, political, and economic circumstances which formed the landscape of past populations can be read and queried.

Although GIS has great potential, there are some things it cannot be used to do. We cannot search for sites in front of a computer screen, because we can never be sure we know everything about the settlement and land use of the population being studied. It must always be considered possible that deeply buried sites went undetected or that particular methods of site survey biased the sample of sites found.

In fact, GIS analysis and fieldwork must be pursued together for two reasons. The first is that, in order for the computer to recognize the variations in reflectivity in remotely sensed data, the elements must always be verified. To classify all the wheat fields or lakes in an image, a sample of the very cells or polygons representing a wheat field or lake must be found in order to "train" the program to read similar cell or polygon values elsewhere in the imagery. The second reason is that working back and forth from the real world to the model should remind us that it is the model which is subject to critique, not past human behavior.

EXAMINING A FOURTH DIMENSION

In the past century archaeologists have added many important concepts, methods, and techniques to explore past human-environment relationships. Formal (typological) studies, which served as a basis for comparative dating, were joined mid-century by

absolute dating techniques (e.g., C^{14}, potassium-argon); in the last half of the century, Spaulding's suggestion that all three dimensions of archaeology (form, time, space) deserved equal attention helped transform site-based archaeology to global historical ecology.[23] With this transition has come the realization that we must now turn our attention to a fourth dimension—perception.

People modify their environment according to their values. For example, a grove of oaks in first century B.C. France was sacred to Celtic peoples, and beneath their branches rites were performed and pigs were fattened on the acorn mast. The Celts' Roman conquerors unsentimentally clearcut the grove, considering the trees an economic resource. To the former, each tree was the living embodiment of deity; to the latter, all were candidates for strong ships' timber. Today, a French farmer might selectively harvest for sale some oaks in such a grove, culling sick and damaged trees and leaving room for new growth. While he follows for the moment his grandfather's management strategy, financial circumstances might force him to contemplate other uses for the land. One option, planting a quick-growing North American species of fir, is lucrative but reduces soil nutrients and is said to change the local microclimate. All three perceptions of the grove are the result of historical, environmental, economic, social, and political conditions which shape, and are shaped by, religious and philosophical values.

Although there are limits to the understandings material remains can give us, they can nonetheless reflect habits of thought and action for which we may have no other source of information. If we have documentary or ethnographic data in addition to archaeological remains, it is possible to construct a rich account of the way humans adapted to and modified their immediate environs. Even where other information is lacking, the archaeological and environmental record offer, for every part of the world, a remarkably complete picture of past landscapes and, implicitly, past mindscapes.

For example, the Imperial Chinese city of Chang An (near the modern city of Xi'an, in the province of Shaanxi) was laid out in the pattern of the cosmic forces that governed Chinese life; this not only rendered the whole city a huge icon, but also reinforced the right of the elite to rule, since their home was synonymous with the structure of heaven.[24] Similarly, the modest sanctuaries of the early Christians bespoke a vastly different attitude toward society, wealth, and the importance of the individual than was transmitted by the cathedrals of Western Christendom's High Middle Ages. The former was meant to comfort, the latter to awe.

We still, both intentionally and unintentionally, transmit such messages in architecture and in the modification of the landscape. Organizers of historical theme parks such as the Civil War battleground at Gettysburg (PA) or the colonial town of Williamsburg (VA) employ the powerful mixture of politics and meaning when they re-create those landscapes for contemporary visitors. Yet they too have been forced to recognize others' perceptions. Contemporary groups of Civil War re-enactors have complained about the inauthenticity of mown grass and the irreverence of concession stands at Gettysburg; scholars of African-American archaeology (among others) have criticized colonial Williamsburg's park management for "beautifying" a slaveholding past by excavating and reconstructing owners' homes but not slave quarters. Students of garbology (the study of trash, a truly ubiquitous artifact) have noted another false beautification: Reconstructed Williamsburg's tidiness bears no resemblance to the muddy, garbage-strewn townscape revealed by archaeological excavations.[25]

Thus past landscapes are as much contested ground as are today's issues, such as whether to allow timber companies concessions in federal parks, or Native Americans access to sacred spots on military reserves. Who owns them? To whom are they accessible? Whose version of history triumphs? Archaeologists have great responsibility in that they must provide thoughtful criticism of all reconstructions of the past, rather like the master sleuth in a mystery tale. How closely does the reconstruction fit the material evidence? What sources were used to document the reconstruction? How reliable are they? What other interpretations are possible? Who benefits from the interpretation chosen as a basis for the reconstruction? Here broad anthropological training pays off, because contemporary archaeologists must be ethnographers, archivists, ecologists, and, more often than not, cultural brokers between factions in dispute.

EMPLOYING PAST LANDSCAPES IN PLANNING CHANGE

Of course, if everyone waited until there was complete unanimity on a subject, considerably fewer aspects of the world around us would change for the better. Rather than allowing things to

change willy-nilly, most of us would like to benefit from a modicum of planning as regards the landscapes of our daily lives.

For example, a spatial pattern of urban blight, suburban sprawl, and rural abandonment characterizes more and more of the world. Under-employed urban populations sink into poverty, while the well-to-do seek carefully managed "rural" vistas far from the concrete jungle. As a result of mechanization in agribusiness, fewer and fewer people grow their own or anyone else's food. How old is this pattern? When were the first cities, the first suburbs, the first ghettos? Under what conditions did the shift from an agrarian to an industrial population occur? Must this be the future everywhere, or are there historic or contemporary societies in which the population is distributed differently and that could offer ideas for planning a different landscape?

My graduate students and I have been conducting research on the history of rural settlement and land use in Burgundy (east-central France) since 1975.[26] Our collective goal is to trace three thousand years of changes in the region, as they are manifest in the landscape, from the period before the Roman conquest, when Celtic peoples ruled Western Europe, to the present. Our research methods include archaeology, ethnography, the analysis of documents and maps, satellite imagery, and a variety of paleoenvironmental studies (e.g., geomorphology, climatology, ethnobotany). We integrate the spatial components of these data in a GIS. Each of us has several specialties and particular research goals, and we share information and ideas.

My current research on behalf of the project is to learn how vegetable gardens help people maintain the food supply in times of harsh climate or political upheaval. I have begun studying gardens and interviewing gardeners in the commune of Uxeau (an administrative division like a county); as a test of my understanding of what they tell me, I plant my own garden and solicit their advice.

I collect documentary evidence on plants and gardening practices from almanacs; from leather-bound volumes holding records of baptisms, marriages, and deaths in Uxeau (which are complete from 1670 to the present) I am reconstructing the community's population profile. Each person had two (birth, death) or three (marriage) life-events that were written in the volumes by the village priest, who also noted the person's address (by farm name) and the names and occupations of attending family and friends. Detailed maps of the area dating to the 1500s still

exist and, in conjunction with the population data and new excavations of the medieval town center, figuratively enable us to repopulate the landscape of nearly five centuries ago.

Archaeological evidence from a nearby hilltop site called Mont Dardon (which has a 2,400-year-long chronological sequence) includes carbonized seeds excavated from levels dating from the Iron Age (1000 B.C.) through Roman (52 B.C.–ca. A.D. 400) to late medieval times (fourteenth century A.D.) and overlaps with the documentary information. Local and regional environmental evidence, including a massive synopsis of Swiss weather by ten-day periods since 1528, allows a relatively confident reconstruction of climatic conditions during the past three thousand years. The spatial component of all these data has been added to our GIS database.

There are several advantages to the use of ethnography and archival research in conjunction with archaeology and paleoenvironmental studies; in the foregoing example, documents and people's memories can bring alive a period before harsh local conditions were ameliorated by rail transport from more fortunate areas. These insights then serve as links to the even more distant past, accessible only through archaeology. Households had to have a garden then, before long-distance transport of domestic supplies; now, despite the ready availability of produce in stores and at markets, most rural households still do. This tradition appears to be unbroken as far back as at least the first millennium B.C., and offers a remarkable opportunity to study the role gardens have played in allowing households a means of autonomous adaptation to Burgundy's sometimes freakish weather.

Gardens play a critical role in reducing risks associated with inclement weather all over the world. Unlike field crops, gardens shelter numerous species in special soils and under controlled microclimatic conditions. Plants receive individual attention and enable the gardener to develop an intimate understanding of soils, winds, and seasons as they relate to the garden plot. Gardens both conserve traditional species and are filled with small experiments that yield new information as well as abundant produce.

How gardens have been used during periods of environmental stress can be a valuable source of information in buttressing world food resources and fostering domestic economic autonomy. In urbanized countries where a gardening tradition continues, gardeners are usually older (in their fifties or sixties) and

remember when gardens enabled their families to survive hard economic times and periods of severe weather. In most parts of the world, techniques of successful gardening are transmitted intergenerationally, from one individual to another.

Today, most citizens of urbanized nations buy internationally-grown produce at the grocery store and know little about the practical art of gardening. Agreements governing international trade (e.g., the GATT accord, hotly protested by French farmers who used their tractors to block the streets of Paris), revealed the extent of urban ignorance of rural risk reduction strategies. Western attempts to foster third world industrial centralization and the support of high yields with complex technology (the "Green Revolution") ignored intricate lessons of rural ecology.

With its long history of climatic instability and an educated and activist rural population, Burgundy offers valuable lessons to policymakers about the role gardens play in buffering extreme weather events. Furthermore, Burgundian gardens provide a strong argument for maintaining the genetic diversity of domesticated species; by growing several varieties of every species of plant, gardeners make sure that unseasonable weather or pests destroy only part of the harvest. The varieties are maintained through trade (among gardeners whose gardens are located in slightly different microclimatic conditions), are passed down from generation to generation, and are purchased from catalogues.

Next I will write about my findings and ask the people I interviewed to review the manuscript until most agree that I have everything right. I will continue to search for information about the history of these practices, especially through archaeological excavation that will yield material for paleoenvironmental analyses. Bit by bit, we will be able to determine the species and practices that enable temperate-latitude rural populations to protect themselves from unpleasant climatic or political surprises without dependence on long-distance trade. Fortunately for the people of the former Soviet Union these lessons had not, despite forced collectivization, been lost; their government's collapse and the suspension of long-distance transport did not result in widespread famine.

Researchers will need to engage in similar activities for each region of the world, because the effects of global environmental changes on regions are now understood to be characterized by frequent periods of unseasonable weather. Everywhere, as depen-

dence on grocery stores (and the governmental infrastructure of roads, ports, bridges, and airports necessary to stock them) replaces more self-reliant domestic patterns, intricate and important local knowledge is being lost. Although it is doubtful that urbanized, industrialized societies will ever return to strategies of independent gardening, it is nonetheless important to understand gardens as a strategy for reducing risk that could yield important lessons for development worldwide.

We hope to demonstrate to policymakers that available and plentiful data about how societies in the past have adapted (or failed to adapt) to major climate shifts can be used to buffer future global- and regional-scale environmental change. Such information can avoid loss of life, help predict future migration, and offer many ideas for buffering "at risk" populations from hardship.

These are enormous issues. So far, physical and natural scientists have been asked to answer questions about the future of the planet with only part of the picture at their disposal. There exists an as yet untapped body of data awaiting application: the record of some three million years of human-environment dialogue. Historical ecology, practiced at local (landscape), regional, and global scales and integrated through GIS, can complete the picture and offer sound planning principles for both the neighborhoods and the planet we all call home. Global ecology is global housekeeping.

NOTES

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SUGGESTED READINGS

Allen, Kathleen M. S., Stanton W. Green, and Ezra B. W. Zubrow, eds. *Interpreting Space: GIS and Archaeology*. New York: Taylor and Francis, 1990. A comprehensive introduction to the interface of GIS and archaeology.

Clarke, David L., ed. *Spatial Archaeology*. London: Academic Press, 1977. A collection of articles important to the understanding of early approaches to spatial issues in archaeology.

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Research TOC

19. Reading the Land: The Archaeology of Settlement and Land Use, C. Crumley. 20. Archaeological Survey in the Mixtec Sierra, L. Finsten. 21. Exploring Aztalan and Its Role in Mississippian Societies, L. Goldstein. 22. Ancestor Veneration in Lowland Maya Society: A CaseStudy from K'axob, Belize, P. McAnany. 23. De-Mystifying the Past: The Great Zimbabwe, King Solomon's Mines, and Other Tales of Old Africa, J. Vogel. IV. Archaeologists at work. The extensive land use has a major impact on the earthâ€™s environment as it reduces wilderness and threatens biodiversity. Reducing the consumption of resource-intensive products and increasing the productivity of land makes it possible to produce food with much smaller inputs and reducing the impact on the environment. All our charts on Land Use.Â For much of human history, most of the worldâ€™s land was wilderness: forests, grasslands and shrubbery dominated its landscapes. Over the last few centuries, this has changed dramatically: wild habitats have been squeezed out by turning it into agricultural land. If we rewind 1000 years, it is estimated that only 4 million square kilometers â€“ less than 4% of the worldâ€™s ice-free and non-barren land area was used for farming. Find, read and cite all the research you need on ResearchGate.Â The ways in which a broadly conceived study of land use at historical homesites affects both methodological and theoretical approaches to the archaeology of the household are discussed. Special attention is given to ideological factors that resulted in manipulation of domestic landscapes as a means of social display; to the need for an archaeology that can provide a detailed chronological perspective on changing land use over time; and to the methods appropriate to such a study.