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HUMAN-LANDSCAPE INTERACTION IN PREHISTORIC CENTRAL EUROPE: ANALYSIS OF NATURAL AND BUILT ENVIRONMENTS

ABSTRACT: In this paper, we examine human interactions within both the so-called natural environment and the so-called built, or architectural, environment. People exist in the world both as physical beings and as members of societies, and as such, they have sophisticated structures of behavior, many ways of thinking, and various cultural traditions and roles. Because people interact with and experience their world through these structures, roles and traditions, their interactions with the environment occur in diverse complicated ways. These interactions, with people, animals, plants, communities, climatic conditions, accessible resources, hydrology, etc., create what we call "built environments". Although increasingly sophisticated methods in the natural and formal sciences are opening new opportunities for archaeological research of these built environments, we still need to address the problem of methodological applications not being informed by social and humanistic sciences, and theory not being informed by data or the scientists who compile the data. In Central European archaeology specifically, stopping at the stage of methodology and working without an explicit theoretical agenda, as if interpretation refers only to describing or reorganizing data, remains a problem. We therefore strive to incorporate social theory in human-environmental research, and offer scientific methods and social theories that complement each other. By reconstructing complete palaeo-landscapes and considering how people may have experienced, altered and (re)experienced their built environments, we believe a more complete and inclusive archaeology is possible.

KEY WORDS: Built environment – Landscape – Methodology – Transdisciplinary approach – Human use of space

INTRODUCTION

In archaeology, it has long been established that there is a need for studying the relationship that humans have with both the natural and built environments. Nevertheless, understanding where the dividing line between these two environmental types lies, or indeed if we should even draw such a line, shifts in response to

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changing theoretical approaches in archaeology. The two most influential theoretical directions in Anglo-American archaeology, the New Archaeology and post-modern archaeology, have focused on the natural or the built environment, respectively. As archaeologists, we have come to understand that although the natural environment creates possibilities and limitations for human actions, it is neither external nor a neutral agent with respect to human societies; instead, it is continuously modified and subjectively reinterpreted. In a changing society, the social approach to what the natural environment is, what it does and how it should be treated changes alongside the picture we have of the built environment.

In this paper, we address theories and methods employed for research of human-environmental interactions and for research of built environments and landscapes. The concepts we present are well-known in Anglo-American archaeology, but are less widely appreciated in the archaeological traditions of Central Europe, and are not always rigorously connected to archaeological data in Anglo-American research. The aim of the paper is to sketch a possible common line in human-environmental interactions and landscape research, and to chart a course to transdisciplinary approaches (transcending any one discipline). We argue that every interaction between people and the natural environment creates a "built" environment. Typically, the built environment is taken to mean architecture, and architecture certainly provides data we can use to interpret certain aspects of social organization. Inclusion and exclusion (Bailey 2000), hierarchy and communalism (Coupland *et al*. 2009, Hole 2000), and social reproduction (Bourdieu 1973) are all examples of this. We can, however, go beyond these notions. Soil landscapes and agricultural fields are built, constructed, just as are houses and burial mounds. People interact with the environment in many complex ways, with sophisticated structures of behavior, ways of thinking, cultural constructions, etc., creating a "built environment" where the natural is inseparably mixed with the artificial.

Scientific and technological methods to examine these interactions are developing rapidly, as is the volume of data that can be used, leading Thurston and Salisbury (2009) to suggest that we "reimagine" regional analyses. However, it remains the case in present-day studies of landscape that "highly evolved empirical methodologies confront conceptual approaches" (David, Thomas 2008: 25) in the sense that the attempts to understand the social, experienced and sensory landscape seem to be largely detached from the effort to study it from a quantifying economical perspective. With notable exceptions (e.g., Gillings 2007, Sørensen, Rebay-Salisbury 2012, Salisbury 2012b, Thurston 2007), interpretations of quantitative empirical data do not always address the human, or social, aspect. In some cases explanations are essentialist or provide static views of past social dynamics. In other cases the emphasis is on methodological rigor and technological expertise, without explicit interpretations. At the same time, humanistic theory in archaeology is not always connected to physical data, and can be dismissive of empirical evidence and scientific perspectives.

To overcome these pitfalls, we suggest investigating all human-landscape interactions by combining modern scientific data collection and analytical methods with explicit theoretical concepts to explore socio-cultural questions from a foundation of data. We will begin by delving into "natural" environmental approaches, then look at "cultural" approaches. In both directions we will focus on the "built" environment, using a broad definition of built, and avoid for now the problem of ideological constructions of topographic features (e.g., Bradley 2000). We then use specific case studies to explore how transdisciplinary approaches – methodologically, theoretically and interpretatively – can bridge the divide between so-called scientific and social archaeologies. These approaches can also help us reduce the nature vs. culture dichotomy to no more than an analytical dualism.

HUMAN-ENVIRONMENTAL INTERACTIONS IN PREHISTORY

The idea of human-environmental interaction suggests a "natural" environment for most people, although there is no reason why this could not include a built or cultural environment. The importance of the role the environment plays in human life gained wide acceptance with the rise of New Archaeology, tied to ideas of subsistence economy and resources exploitation (e.g., Higgs 1975), especially through site-catchment analysis (e.g., Higgs, Vita-Finzi 1972, Vita-Finzi, Higgs 1970).

Since then, many approaches to human-environmental interactions have developed, including cultural ecology, historical ecology, landscape ecology, human ecology and landscape archaeology, among others. Many of these approaches give preference to explanations that draw on evolutionary adaptations to the environment, most obviously in cultural ecology.

Practitioners of landscape archaeology, on the other hand, occasionally treat the landscape as only having influence where people allow it. These competing approaches only serve to maintain the ecological determinism vs. social determinism dichotomy. The key to understanding human-environmental interactions, and using them as evidence for, or narrative examples of, human responses to stress, lies in the word "interaction"; the reciprocal action or influence between human activity and environmental activity.

Whilst we are not focussing on landscape archaeology or regional archaeology *per se*, central European landscape archaeologists have had a strong influence on our work (e.g., Doneus 2013, Kuna, Dreslerová 2007, Müller 2008, Müller *et al*. 2013, Neustupný 1991, 1998). For example, contributors to an edited volume by Vasil'ev *et al.* (2003) explore Upper Palaeolithic Eurasian landscapes by examining human-built environments, at both single site and regional scales. These approaches differ from the Americanist regional archaeology or British landscape archaeology, and can be described as seeking a middle ground between ecological and social theory approaches. Still, there is a tendency in some of these approaches to stay within a data "safety zone", with little exploration of perception of the environment or feedback between human and environmental activity.

Focusing on interaction and acknowledging that the environment has been and remains a powerful force in human life whilst allowing that people, more than any other organism on earth, can be a powerful force on the environment, enables us to ask more interesting and perhaps more pressing questions, about how people change the environment, about human and environmental effects on cultural heritage, how people maintain cultural traditions or ways of living during periods of climatic or environmental change, and the relation between floodplain habitation and fluvial dynamics. To answer questions like these requires acceptance of humanistic questions and subjective thought on one hand, and on the other hand a willingness to interact with scientists from various disciplines, and to incorporate their interpretations and theoretical opinions into the archaeological narrative.

Human response to climate change – a subfield of human-environmental interactions – is one of the two or three most influential recent developments in archaeological research (mobility using aDNA and isotope studies is another). Drawing heavily on methods in palaeoclimatology, palaeoecology and environmental archaeology, climate change and human responses to environmental change is a hot topic getting a lot of attention and attracting funding for multinational and interdisciplinary research (e.g., Brown *et al*. 2011, Butzer 2012, Cooper, Boothroyd 2011, Cooper, Peros 2010, Crate, Nuttall 2009). Part of the reason that these topics are so influential is because they not only inform us about the past, but have relevance to the 21st century world. Much of the work on climate change outside of archaeology focuses on predicting future events and the impact of these events on urban coastal areas. In archaeology, the focus is often on the role of climate change and the collapse of complex societies (e.g., Butzer 2012), although some do focus attention on climate's effect on small-scale farming and rural communities (e.g., Cooper, Boothroyd 2011, D'Anjou *et al*. 2012). By examining the various ways that people react to climate change, and how human activity can exacerbate climate change and drive local environmental change, archaeologists can provide concrete examples from the past for possible reactions and options for communities today.

Climate change is only the most obvious and perhaps most obviously relevant field of human-environmental study. The ways that people, both individually and in groups, perceive the environment has important ramifications for how they react to environmental change. At the same time, these perceptions influence worldview, notions of identity and personhood (Llobera 2005, Salisbury 2012a, Wilson 2010). Therefore, a theoretically driven analysis of human-environmental interaction allows us to examine several complementary aspects of human life.

BUILT ENVIRONMENTS AND LANDSCAPE IN ARCHAEOLOGY

The issue of built environments is rarely discussed in context with landscape, at least as for the comparison of the ways we conceptualize space in these two kinds of environment. The concept of the historical evolution of landscape, which has been studied more intensively since the 1950s through the 1970s (e.g., Aston 1978), went hand in hand with the development of New Geography, GIS applications and the large scale incorporation of aerial photography into studies of both "inter-site" and "off-site" archaeology (Foley 1981). It has for some time been established in geography that any argument about theoretical concepts of landscape and the built environment is closely connected with the understanding of place. The concept of place is very wide, as it can be

seen as a single house, a settlement or a whole region (Pred 1986). The relationship between prehistoric settlements and cultural landscapes has been intensively researched by archaeologists since the late 1960s (cf. e.g., palaeoeconomy – Higgs 1975; Siedlungsarchäologie – Jankuhn 1977; Community Areas – Neustupný 1991 or works of the New Archaeology – Binford 1968). These and other studies have aided the understanding of the landscape from the perspective of the economics of space and adaptation theories.

One of 1970s research methods – site catchment analysis – represents the New Archaeology approach to landscape, as well as to human-environmental interaction. The idea behind the method is that the sites are not distributed haphazardly, but according to the most effective use of resources. The archaeologists walked around the sites and tried to find possible ancient sources. In this way they tried to understand the given place or landscape (see Higgs, Vita-Finzi 1972, Vita-Finzi, Higgs 1970). The method was criticized from its beginning, firstly because its working base was the current landscape, one unrelated to the past; and secondly because it lacked reflection on the relationship between the potential of landuse and the actual landuse (Jarman *et al.* 1982: 38–39). Another critique could point to its environmental determinism. However, the 1970s marked the first time that rigorous analysis was applied both to settlements and their surrounding landscape. The problem of such concentration on the economics of space is a reduction of human society to the society of *homo economicus*. This concept of what it means to be human was criticized in anthropology (to name the classics: Mauss 1990 [1924], Polanyi 1944, Sahlins 2003 [1972]), as in traditional societies the production and exchange of goods follows patterns of reciprocity or ethics of kinship-based reciprocity rather than capitalist economic principles. The arguments against the *homo economicus* concept also came from economics classics such as Veblen (1936), who stressed uncertainty and bounded rationality in the making of economic decisions, rather than direct rationality.

The divide between the natural and the built environment perhaps originates from the conceptualization of the importance and impact of the human action. The built environment has been described as the product of the activity of building, introducing alterations to the physical environment (Lawrence, Low 1990). The whole natural versus artificial/built dichotomy could be seen as structural divide upon which, however, some of the finest arguments in the research of human use of space have been based. The theoretical dichotomy between the natural and built environment can also serve a good purpose in facilitating a further inquiry into the processes of construction of the built environment and the way it is interwoven with natural space. In his well-known work on the meaning of the built environment, Rapoport (1982) takes the approach of highlighting certain features of the human-constructed environment to try and derive its meaning. Rapoport's (1982) argument is based on the observation that the human use of space stems from the fact that people understand space through associating it with meanings, rather than through simple perception. The meaning of artificially created urban landscape for example, may well be derived from the understanding of the pre-existing natural environment and its features. On a somewhat different note, Hillier (2006) focused on the concept of human-constructed space as an entity which was given certain properties (unconsciously or subconsciously), and these in turn have a tendency to influence the human behavior taking place within it. This approach is based on the principle that human activity has a natural geometry which becomes more pronounced the more individuals participate (Vis 2009).

Archaeological research of urban contexts has predominantly been connected with uncovering the emergence of complex societies. Archaeological enquiry is very well-suited to answering questions about when and how cities form and comparing the patterns in various regions. Nevertheless, a focus on these questions has led to the pronounced emphasis on seeing the features of space, such as houses and streets, as units with primarily functional properties (Blake 2007: 238). Research has also focused on the study of individual buildings (understood as individual artifacts) from the perspective of their function and style, or analyzed complex settlements as organisms which, given the local conditions, evolve to function in the most efficient way (e.g., Hoffmann 2009).

The landscape that is charged with philosophical meaning has been gaining attention since the early 1980s, and the concepts of the peopling the landscape and understanding its local context were elaborated in a number of studies (e.g., Bradley 2000). From a social perspective, human intervention in the landscape were perhaps best first understood as part of the mythical and sacred places in the landscape.

The links between settlements have been understood as happening "across the landscape" and the relationships between them understood using the techniques as Thiessen polygons (Haggett 1965), GIS or most recently LiDAR (Doneus *et al*. 2008). The use of these techniques, however, does not stand in opposition to

attempting to understand the landscape from a more social position. The best results are perhaps reached when these methods are understood for what they are – the stepping stones and tools which allow us to access all natural and built features from a range of perspectives. The greatest danger lies in mistaking the method for the actual goal, which should be producing a locally relevant knowledge and contributing to general development of theory.

Built environment is inseparably connected with the concept of dwelling and landscape as a hybrid between environment and culture. In early 1990s, Tim Ingold introduced the notion of taskscape (Ingold 1993). A taskscape can be defined as a space of human activity; it is the link between humans and their environment. Ingold defines taskscape in an analogy to landscape: "Just as the landscape is an array of related features, so – by analogy – the taskscape is an array of related activities" (Ingold 2000: 195). In this definition, taskscape may seem to be related to the site catchment analysis described above, and its way of thinking about environments that humans inhabit. However, this is only a superficial resemblance: here we will specify only the most important differences. First, the difference is in the epistemological change of order of building perspective and dwelling one. Ingold uses Martin Heidegger's argument: "We do not dwell because we have built, but we build and have built because we dwell … *Only if we are capable of dwelling, only then can we build*" (Heidegger 1971: 148, 160, original emphasis, cited in Ingold 2000: 186). Another very important difference is in temporality of the concept, as Ingold argues: "… the taskscape exists only so long as people are actually engaged in the activities of dwelling" (Ingold 2000: 197). And the last and most important difference is in "separation between the domains of technical and social activity" (Ingold 1993: 158), which Ingold understood as one of the great mistakes of anthropology; the same could be said about archaeology.

In Central European archaeology specifically, there is a prominent long-term tradition of perfecting methods for collecting and organizing data. The archaeology of the Middle Ages in particular has often turned to economics and history, rather than other social sciences, and history is traditionally more concerned with dates and places. What is still largely lacking is a dialogue, which would consider the data and their acquisition from a greater range of theoretical viewpoints. We believe that the problem is twofold. First, the focus on method along with decades of work within problematic political environments has resulted in reluctance to frame arguments on explicitly theoretical grounds (Trigger 1989). Second, although a need for interdisciplinary archaeology has begun to be widely recognized, in striving for our enquiries to be respected as rigorously scientific, Central European archaeology has tended to understand the term "interdisciplinary" as seeking (almost exclusively) the assistance of natural sciences. Clearly, there remains a lot of potential in the wider application of social science approaches, and we need to realize that, as archaeologists, we can contribute to humanistic debates as well as methodological development.

The multiplicity of voices in analyzing the built environments and human use of space has a great potential in archaeology, which only grows with the development of the discipline. It can inspire new questions, reveal motivations behind human actions, promote dialogue and cooperation between archaeologists interested in a range of research regions and time periods, and last but not least – inform us for the future.

TRANSDISCIPLINARY APPROACHES TO LANDSCAPE – NATURAL SCIENCES AND SOCIAL THEORY

Comprehensive scientific analyses of sediments, settlements, architecture, catchments and environmental proxies can provide much information about people and their world, including resource affordances, climate change and human impact on the landscape. Not unexpectedly, these analyses borrow heavily from the natural and formal sciences, including biology, geology, chemistry, ecology and computer science. Problems arise during interpretation, whether done by archaeologists with no deep understanding of the science involved, or by scientists with no real understanding of archaeological time-depth or the nature of archaeological data. Stratigraphic context, essential to illuminating the proper relationships between any archaeological finds, may not be given to laboratory scientists, so that they develop their findings "in the dark".

At the same time, some of the most exciting and potentially productive theoretical approaches building upon the social sciences appear to ignore data provided by natural sciences. For example, phenomenology is sometimes applied to archaeological landscape studies as a method to understand whole past landscapes (Tilley 1994) without consideration of changes to topography, vegetation, and human perception, not to mention anthropogenic additions to the environment (e.g., new

sounds and new smells). Although this approach has been accepted by some (e.g., Hamilton, Whitehouse 2006), it has been rejected by others (e.g., Bintliff 2009, Fleming 1999). Whilst "unscientific" is often used as a pejorative when dismissing phenomenological approaches, it is the case that some applications of phenomenology have relied heavily on the perceptions of the modern observer and not on data. Palaeoenvironmental reconstructions analyzed within GIS, using multiple proxies and parameters, clearly demonstrate that the landscape we experience today is nothing like that of the past (Gillings 2007). This does not mean that phenomenology is not useful for archaeology; on the contrary, there are several ways to employ it (e.g., Gillings 2007, 2012, Hamilton, Whitehouse 2006, Pauknerová 2012a, b, Salisbury 2012a, b). Perhaps one of the most important contributions of phenomenology of landscape is the fact that phenomenology, among other approaches, reminds us that space is experienced, understood and constantly reinterpreted through movement and sensory perception, and that it is an artifact which is inherently dynamic, not static (for landscape as a process see e.g., Bender 2002, Hirsch 1995). Therefore we should be very cautious when interpreting the site, and not fall into the trap of describing the site and its surroundings as static. One possible way to retain phenomenology as lived experience whilst analyzing phenomenology via computer models is through augmented reality (Eve 2012) or from an informed combination of GIS and landscape phenomenology (e.g., Gillings 2012, Rennell 2012).

EXAMPLES OF INTERDISCIPLINARY APPLICATION OF THEORIES AND METHODS

The mutual dependence of environment and culture was studied for various periods in the past. We present three examples: from the Epipalaeolithic, the Neolithic and Bronze Age, and the Middle Ages. The examples all have one thing in common – they use transdisciplinary or interdisciplinary approaches to interpret a variety of archaeological data. As the examples show, such archaeological data, or better to say complex archaeologically documented situations, would be difficult to interpret, and interpretations would be much more limited, using only an archaeological point of view.

Rowley-Conwy and Layton's study of the transition from foraging to farming uses the ecological concept of constructing niches. In ecology, niche construction is understood as active, compared to older concepts of passive response of organisms to environmental challenges. They use numerous examples of foraging societies from various periods across the globe to show how these groups actively construct niches via so called low-level food production, e.g., by burning natural vegetation, hunting particular animals at particular times, concentrating wild plants into new stands, etc. As they convincingly argue, such niches are generally stable; if they are unstable they transform into other foraging niches. Using this background, they develop a new interpretation of the Neolithic transition in the Near East. The Epipalaeolithic niche in the Near East was, according to the study, complex but stable. However, it was destabilized by a substantial climatic change and was transformed into an agricultural niche. This happened due to an accidental combination of genetic and behavioral qualities of some wild animal and plant species (Rowley-Conwy, Layton 2011).

Another recent body of work providing an example of the usefulness of interdisciplinary approaches both to data analysis and interpretation, and to building a narrative from credible evidence, focuses on transitions within the Neolithic and Bronze Ages in Hungary. Cultural transitions during later prehistory have often been explained through either simplistically humanistic theories such as migration, or Neo-Darwinian theories such as adaptation. One of the more readily apparent phenomena in the Carpathian Basin and northern Balkans is the rise and dissolution of Neolithic tell communities. Tells, as defined in this body of literature, are large settlement mounds created by rebuilding houses made of wattle and daub (clay) in one place for multiple generations. Examples are found throughout the Balkans and the Hungarian Great Plain. Neolithic examples include the type-sites of Vinča-Belo Brdo and Berettyóújfalu-Herpály, as well as lesser known places like Szeghalom-Kovácshalom and Öcsöd-Kováshalom. Well-known Bronze Age examples include Százhalombatta-Földvár in the western Carpathian Basin and Békés-Várdomb in the east. The Bronze Age examples are most often explained though political and economic developments such as the rise of chiefdoms and control over trade. Transitions in both periods could benefit from transdisciplinary approaches to data collection and interpretation.

In the Körös area of eastern Hungary these tell locations were first settled during the late Middle Neolithic Szakálhát phase (ca. 5200 BC). The tell sites were then more or less constantly occupied throughout the classic Late Neolithic (ca. 5000 BC) and then were

abandoned at the end of the Late Neolithic (ca 4500 BC). Various suggestions have been offered as to why people lived in these nucleated, permanent villages for several hundred years and then dispersed across the region, including control over exchange, managing water, keeping animals in or out of the settlement, and fortification, but until recently there have been few attempts to connect local environmental data with these social questions about tell lifeways (Parkinson 2002, Raczky 1987, Sherratt 1983).

Recent attempts to recover direct evidence for these interactions have resulted in some evidence that fluctuating groundwater levels and changes to resource affordances may have played a role in settlement change, resulting in a social mitigation process (Gulyás, Sümegi 2011, Salisbury, Bácsmegi 2013, Salisbury *et al*. 2013a, b). Gulyás and Sümegi (2011) have combined new palaeoecological data with existing archaeological information at sites south of the Körös Basin, with a special focus on analyzing mollusks. They found evidence for increasing floods during the pre-transitional period, which was followed by the known changes to settlement structure, as well as new subsistence and land-use practices. Further north, preliminary results (Salisbury *et al*. 2013a) suggest that people moved towards nucleated settlements along active river channels and may have abandoned some settlement areas, like the one around Csárdaszállás, during this transition. It is worth noting that higher groundwater levels would simultaneously improve exchange routes along waterways and reduce the number of well-drained areas for settlement and agriculture, so that environmental change may have offered both new opportunities and new limitations in several spheres, thereby affording people a different set of possibilities. These changes are reflected in both the archaeological and palaeoenvironmental data, but the key is not in the assertion that things changed, but in the interpretation of how changes in water levels could affect people's lives, what they may have done to cope with these changes, and even how people may have exacerbated environmental changes.

The extent to which environmental change and economic development are believed to play a part in observed architectural development is also apparent, for example, in studies of Czech medieval villages. The study of the well-known Czech medieval village of Mstěnice exemplifies this. The settlement of Mstěnice developed in five stages, but I focus here only on two phases of occupation of the village (dated to the first half and second half of the 12th century), which both lasted for about 50 years and represent a complete rebuilding of the village after catastrophic fires (Nekuda 2000). These phases have been interpreted by the excavator as essentially "the same, with no apparent changes in the built environment", on the basis of the fact that the size of the village, the environmental and economic constraints, and the outer architectural form of the typical house did not change from one period to another (Nekuda 2000: 140). However, analysis of the changes in the positioning of houses and compounds to each other and respective to the village green show that the particular periods under study in fact represent a time of major shifts. If we consider these configurational factors of the social space in the village as meaningful and not coincidental, then several transitions seems to have occurred in the village. The spatial arrangement wherein village green was the social and visual centre of the settlement's life was transformed into one where the village green remained the physical centre of the village, but privacy and visual control within the house compounds as individual units gained primary importance (Baumanová 2010). This was achieved by different positioning of house doorways respective to the compound entrances and both of these to the village green. In the later phase, the space of the village can no longer be directly controlled from the house doorways (and vice versa), while at the same time the entranceways of the compounds can. Hence, the privacy in the houses increase and the space of compounds becomes more integrated forming a coherent unit with the house (Baumanová 2010).

A WAY OUT – HYBRID METHODOLOGIES AND TRANSCENDENTAL INTERPRETATIONS

These examples show how the integration of methods, theories and questions from multiple disciplines can produce new interdisciplinary interpretations of the built environment. However, to find a way out of the several problems that arise in world archaeology – essentialist interpretations, methodological and technological rigor without any interpretation, or interpretations derived solely from theory and disconnected from data – we need more than hybrid approaches. We need to reach interpretations that transcend paradigmatic disputes within disciplines, as well as transcending disciplinarity itself.

The study of cultural soilscapes provides one example of a beneficial transdisciplinary combination of social science and natural science methods, wherein

phenomenological experiences are prominent. A soilscape is an area of similar soil-landscape relationships, and a soilscape that was formed or heavily altered by human activity is a cultural soilscape (Wells 2006: 125).

Cultural soilscapes are reconstructed through detailed investigations of the chemical and physical properties of sediments. Changes in the properties of soils and sediments at archaeological sites are the direct result of human activities. For example, the deposition of organic material, such as manure and food waste, elevates soil phosphate and soil organic carbon (Eidt 1977). Fires, especially regular and intensive fires like those in kilns or furnaces, will elevate the magnetic susceptibility of minerals in the soil (Scollar 1965). When wood is used a fuel, ash will elevate soil pH and potassium levels (Wells 2004), while smelting ore will lead to heavy metal enrichment (Bintliff *et al.* 1990). These changes can be quantified using soil chemistry, soil micromorphology and sedimentology.

Through an interpretative geoarchaeology, wherein the data from chemical, sedimentary and stratigraphical analyses are combined and interpreted in an anthropological or social theoretical framework, cultural soilscapes emerge as a significant yet heretofore largely unrecognized aspect of the relationships between early farmers and their environment (Salisbury 2012b). The combined methods and research questions of geochemistry, sedimentology, pedology, ecology, anthropology and social archaeology are directed towards the way people interact with soil. For example, continuity in the formation of cultural soilscapes during the Neolithic in eastern Hungary implies entrenched cultural traditions grounded in the intersubjective phenomenological experience of soilscapes. Middens and other waste disposal areas have elevated levels of phosphorus and organic matter, areas used for cooking often have elevated pH, magnetic susceptibility and chemicals such as calcium and iron, spaces with high animal traffic experienced lots of churning of the surface layer and have elevated phosphorus, and areas that were kept clean and exposed to high human foot traffic generally have lower levels of most chemical elements and show evidence for compaction through trampling. Scientists see these changes through various analytical techniques, but for people in the past these changes would be evident in the color, texture and fertility (and perhaps the scent) of the soil. They would be quite different from undisturbed soilscapes, and should have been remarkably similar at other settlements with similar patterns of activity and subsistence. People at these settlements would share similar perceptual experiences of the cultural and natural soilscapes, which might provide a foundation for ideology and identity.

A phenomenological approach also allows us to consider the multiplicity of meaning that soil can have. By thinking of soil as material culture, we can begin to address the role of these soilscapes in social life (Salisbury 2012a) and how interactions with soilscapes can influence ideas of place, identity and community (Salisbury 2012c). This approach to reconstructing and interpreting cultural soilscapes integrates natural scientific methods, social science theory, and ethnographic and ethnohistoric sources (e.g., Adderley *et al*. 2004) within an overarching archaeological question.

Another example of beneficial combination of methods from humanities and science can be a combination of phenomenology and GIS with its possibility of statistical analyses that could be used for analysis of patterns of settlements or distribution of any objects of archaeological study (e.g., Gillings 2012). In Czech archaeology, which is a good representative of central European archaeology GIS has been used since 1990s (e.g., Dreslerová 1998, Kuna 1996) and statistics has even longer tradition at least since 1970s (e.g., Pavlů 1977). Nowadays use of both belongs to standard analyses, however they are often used one way. So far GIS is mostly used for pure visualization and statistics to support archaeological conclusions. Cooperation of two specialists – archaeologist and geographer, or archaeologist and statistician is still very rare. In our opinion hybrid use of two or more methods and approaches would be more beneficial than only borrowing from others. An example of connection of the methods that proved fruitful could be a phenomenological study of Neolithic settlements nearby Pilsen, the Czech Republic, where GIS was used in a phenomenological study of settlements for calculation of maximum visibility from settlements and was compared with a horizon line drawn in hand on paper (Pauknerová 2012a). In all cases the horizon line was the same, even though the area visible from the sites differed significantly, it was concluded that the people intentionally dwelled in localities with this view. On the other hand the area visible from the sites was significantly smaller in case of younger settlements, which might be explained e.g., by more secure position in the landscape. These results could hardly be obtained using only phenomenology or they would be more limited as in the case of patterns of Neolithic and Early Bronze Age settlements in Kolín region, the Czech Republic (Pauknerová 2012b). However, this phenomenological analysis discussed with statistical

evaluation of the settlement qualities (now under process) would be definitely more valuable and the argument would be much stronger. On the basis of the two above mentioned case studies, it can be concluded that phenomenology itself leads to interesting, and in archaeology potentially novel, interpretations of one or several sites. However, when we are interested in settlement patterns, in prediction or in constructing models and we are working with tens of sites, qualities such as the previously mentioned line of horizon, or, proximity of features like raw material sources or waterways, are much more convincing when supported by multivariate statistics, or other type of statistics (for a detailed discussion of the use of statistics in archaeological reasoning see e.g., Read 1989).

CONCLUSION

What the examples and discussion here are intended to show is that we cannot develop or adopt interpretive concepts without consideration of archaeological data, and we cannot interpret data without considering people and how they experienced the environment. Neither people nor the environment exists in vacuum – human activities and interactions occur in the environment in response to the environment and cause changes to the environment. The ways in which the environment reacts to these changes will affect the people, who then respond with new activities or behaviors. The best ways to approach these interactions is creating intellectual spaces wherein methods, theories and interpretive tools from multiple disciplines are combined to produce data-based humanistic narratives. In palaeoecology and soilscapes research, for example, geologists, ecologists, anthropologists and archaeologists can alter their discipline-specific approaches through knowledge exchange and sharing of resources. The same is true about study of settlement patterns and exchange of knowledge between archaeologists, anthropologists, statisticians and geographers. A common scientific goal – understanding how people perceive their landscape and therefore how they respond to changes in it – can be achieved through disciplinary integration.

Modern science explanations built upon so-called natural dichotomies, in our case nature: culture or natural: built, were criticized and found wanting. Instead of society-nature dualism, more effective and beneficial approaches are those like Noel Castree's relational ontology (Castree 2003) or use of hybrid methods and concepts (for a discussion of hybridity in archaeology see e.g., Shanks 2001). In this point we agree with Ingold, who argues that there can be "… no absolute distinction between "natural" and "artificial" structures. Buildings, like other environmental structures, are never complete but continually under construction, and have life-histories of involvement with both their human and non-human inhabitants" (Ingold 2000: 154). Natural environments become built, as in the development of cultural soilscapes or the construction of burial mounds, whilst ideology creates a cultural environment wherever people are. As archaeologists, we are well situated to explore these interactions across time and geographical space and cultural boundaries. What we need are transdiciplinary approaches, mindscapes where innovative theories, technologies and methodologies can interact to provoke new questions and new methodological and conceptual frameworks.

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