Landscape Archaeology between Art and Science

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INTRODUCTION

LAC2010: First International Landscape Archaeology Conference

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INTRODUCTION

The study of landscape archaeology has historically drawn on two different groups of definitions of the term ‘landscape’ (Olwig 1993, 1996). On the one hand, the original, medieval meaning of landscape is ‘territory’, including the institutions that govern and manage it. Landscapes according to this definition can be observed subjectively, but also objectively by research based on fieldwork and studies in archives and laboratories (cf. Renes 2011). The second definition developed when artists painted rural scenes and called them ‘landscapes’. In the latter, not only the paintings, but also their subjects became known as landscapes. Dutch painters re-introduced the word ‘landscape’ into the English language, and the word therefore gained a more visual meaning than it had on the Continent. The visual definition turns landscape into a composition that is made within the mind of the individual, so using this definition it could be argued that there is no landscape without an observer (Renes 2011).

While in the latter definition the term ‘landscape’ originates from the Dutch ‘landschap’ (Schama 1995; David & Thomas 2008), it is probably more accurate to state that the study of ‘territorial’ landscapes originated as the study of historical geography and physical geography. This can be traced back to the classical authors, with Strabo noting that ‘geography (...) regards knowledge both of the heavens and of things on land and sea, animals, plants, fruits, and everything else to be seen in various regions’ (Strabo 1.1.1.). Physical geography is by nature an interdisciplinary field (geology, botany, soil science etc.) and in the late 18th and early 19th centuries it continued to focus on the study of the physical environment, for example in the work of the German researcher Alexander Von Humboldt. During the 19th century, most geographers saw human activities in the landscape as strongly defined by the physical landscape (such as in ‘Anthropogeographie’ in Germany: Ratzel 1882).

This approach changed in the early 20th century, when the human element was introduced. During
the early 20th century in France, a new generation of geographers defined a growing role for human socie-
ties (Vidal de la Blache 1922). Carl Sauer, an American geographer, argued in 1925 that geography cannot
be simply the study of the natural environment, because people have effected major changes on the land-
scape. He pointed out that there is a historical element: ‘we cannot form an idea of a landscape except in
terms of its time relations as well as of its space relations. It is in a continuous process of development or
dissolution and replacement’ (Sauer 1925). Sauer is credited with introducing the concept of the cultural
landscape, i.e. a landscape that owes much of its character to human intervention. The cultural landscape
became the focus for the Berkeley school of American Cultural Geography, founded in the 1920s. The geog-
raphy of this school included studies of the effects of people on the landscape and considered issues such as
population density and mobility, the structure and extent of housing and settlement, the nature of produc-
tion (e.g. farms, forests and mines) and the communication networks (Sauer 1925). Sauer made the point
that landscapes are not static, but are continually changing, and therefore a study of the cultural landscape
is a study of landscape history. Sauer said that one of the first steps that ought to be taken in historical geo-
graphy is to try to understand ‘the former cultural landscape concealed behind the present one’ (Sauer 1941),
a statement which more or less defines the aims of Landscape History and Landscape Archaeology. In fact,
Landscape History and Landscape Archaeology are so inextricably linked that they are often regarded as
being more or less the same thing (Barker & Darvill 1997; Johnson 2007a; Fleming, this volume).

The 20th century has been characterised by the creation of new interdisciplinary studies, the blending
of different disciplines and the emergence of new fields of research. Sauer noted that geography was
becoming increasingly interdisciplinary; economics were becoming an important element of landscape
studies, and ‘sociologists have been swarming all over the precincts of human ecology’ (Sauer 1941). An
important step in interdisciplinary thinking was Eugene Odum’s development of the field of Ecology in
the 1940s. He suggested that, rather than teaching Natural History as a range of separate subjects (botany,
biology, geology etc.), the subjects should be taught together. When he proposed that these subjects were
part of interacting systems and should be taught under the all-encompassing field of ‘Ecology’, he was
laughed out of the room by his colleagues at the University of Georgia. Odum (being a strong-minded
individual) went on to become one of the most influential leaders in interdisciplinary teaching and re-
search, publishing the first textbook on Ecology in 1953 (Odum 1953). The interdependence of different
species is now taken for granted, and has radically changed the way we look at the world today. This has
had enormous repercussions for the way we consider the preservation of ecosystems, but also of physical
and cultural landscapes and the application of landscape archaeology today.

**PROGRESS IN ‘INTERDISCIPLINARITY’ AND LANDSCAPE ARCHAEOLOGY**

The drive to carry out interdisciplinary research in physical geography and historical geography con-
tinued to grow and develop in the latter half of the 20th century, and the field of landscape archaeology grew
out of the continuing exchange of ideas. The French historian Fernand Braudel published an ‘histoire
totale’ of the Mediterranean world in the time of Philips II, in which he combined archive research, land-
scape topography and cultural, economic and political developments (Braudel 1949). Braudel was pre-
ceded by the historian Marc Bloch, who gave much attention to landscapes in his history of French rural
society (Bloch 1932).
In 1955, William George Hoskins published the groundbreaking book, *The Making of the English Landscape*, which drew together physical geography, economic and social history and aerial photographs, which were becoming more widely available from around the early 1950s (Hoskins 1955). Hoskins noted that, although there were many books on English landscape and scenery, this was the first to look systematically into the historical evolution of the landscape.

The discovery of deserted medieval settlements also made an important contribution to landscape archaeology. Hoskins was involved in this discovery, but the theme was largely developed by the economic historian Maurice Beresford and the archaeologist John Hurst (Beresford 1954; Beresford & Hurst 1971). The research combined fieldwork, aerial photographs (Beresford & St Joseph 1958) and archival study, and was probably the main basis for the development of the study of the history and archaeology of medieval landscapes in the United Kingdom.

As we have seen, the interdisciplinary approach had already been implemented by historical geographers in America, but aerial photography was accelerating the thinking and the understanding of palimpsest landscapes (Crawford 1953), which Sauer described as ‘the former cultural landscape concealed behind the present one’ (Sauer 1941). In 1957, Bradford argued in *Ancient Landscapes* that it is important to explore ‘complete social units, advancing from single sites to regions’ (Bradford 1957). This point was also well demonstrated in *A Matter of Time* (1960), which published the extensive cropmarks seen in aerial photographs of some of England’s major river valleys (RCHME 1960). The survey, undertaken by the Royal Commission on the Historical Monuments of England (RCHME), identified cropmarks covering immense areas of land. The survey made it clear that settlement sites were set within field systems and were linked by trackways that were visible for many kilometres. It was also clear that the landscape was a palimpsest of prehistoric and historic landscapes, one on top of the other, with traces going back to the Neolithic and with many features from different periods still surviving today. This book was an important factor in the emergence of Rescue Archaeology, as these massive river valley landscapes were rapidly being quarried away for gravel used in road-building.

Archaeological theory made another great breakthrough in the 1960s, with the ‘New Archaeology’, or ‘Processual Archaeology’ (Caldwell 1959; Binford 1962; Trigger 1989). This was essentially the introduction of scientific techniques into archaeology in a more rigorous way. Archaeology had always been multidisciplinary, linked inextricably with geology but also with the classics and art history – but Caldwell argues that before World War II, archaeologists in America concentrated on describing sites and defining cultures, and that classification did not lead further, to interpretation (Caldwell 1959). The New Archaeology, or Processualism, aimed to take archaeology into more rigorous territory. Processualism emphasised a scientific approach that was built into the research project designs and brought together archaeology, anthropology and natural history, including (eventually) the studies of botany (both charred seeds and pollen), entomology, molluscs, zoology, sedimentology and soil science.

Two important publications from the Council for British Archaeology illustrate the new thinking: *The Effect of Man on the Landscape: the Highland Zone* was published in 1975 (Evans et al. 1975) and the companion volume on the Lowland Zone was published in 1978 (Limbrey et al. 1978). Both included papers on a range of scientific techniques that were aimed at understanding the environment and people’s place within it, together with traditional subjects such as place name evidence. Environmental archaeology considered the landscape in which people lived; how they interacted with the landscape, how resources were used and how the environmental parameters of the landscape affected the people who lived in it. Such
studies included analyses of broad changes in the landscape, such as woodland clearance, down to detailed studies, such as how particular rooms were used based on the botanical and entomological evidence.

Over time, the questions that environmental scientists were asking became ever more varied and more imaginative. Archaeological theory was also moving on, and the emergence of Post-Processual Archaeology in the 1980s, aimed to ‘get into the minds’ of people in the past. Hodder (1986) makes a convincing argument that symbols mean different things in different cultures, but many proponents of post-processualism simply reject science altogether and settle instead for speculation. Barbara Bender argues that ‘one cannot be objective’ (Bender 1998, 5) and seems to suggest that we should therefore give up trying.

Scientists, on the other hand, argue that scientific methodology enables us to set up the parameters to test hypotheses under controlled conditions which can be reproduced by others. If subjective observations are to be part of archaeological landscape research, it is important that these observations are properly identified and weighed for their importance. When new ideas, thoughts or opinions are introduced into archaeological research, it provides the opportunity for others to weigh up the potential and perhaps set up experiments to test some of the more grounded speculations. Within the new school of post-processual landscape research, it is not so much the mechanisms of human adaptation to changing natural circumstances that are the focus of attention, but rather the different ways in which people in the past perceived and ordered their environments according to space, time and culture.

This apparent split within landscape archaeological research, with the division between processualists, earth scientists, geographers and environmental archaeologists on the one hand and post-processualists, new cultural geographers and social scientists on the other hand, has been one of the driving forces for the organisation of the LAC2010 conference. International scientific conferences as well as publications have shown an old-fashioned disciplinary division in themes and approaches that contradict the progress in interdisciplinarity that has been made so far.

**LANDSCAPE ARCHAEOLOGY TODAY**

Landscape Archaeology today is the result of the interdisciplinary developments in archaeology, historical and physical geography discussed in the previous sections. The basic division appears to be grounded in the two types of landscape definitions. The ‘territorial’ definition for landscape encompasses both natural and cultural types and is adopted by processual archaeologists, physical geographers and most historical geographers. The ‘perceived’ definition of landscape is claimed by the post-processual archaeologists, the new cultural geographers and the social scientists. The most important challenge of today is to develop fruitful conceptual and practical combinations of classical studies of natural and cultural landscapes in archaeology, physical geography and historical geography that can methodologically and conceptually be integrated into the cultural approaches of the New Cultural Geography and the Post-Processual Archaeology (Fleming 2007, 2008; Johnson 2007a, b). This question was raised during LAC2010 and is addressed in a number of the contributions within these proceedings.

What makes Landscape Archaeology such an interesting field of study today is the wide array of scientific disciplines involved and the further leaps forward in interdisciplinary work. The lectures and poster presentations at LAC2010 drew on more than twenty different disciplines, including social, cultural, hi-
torical and natural sciences (fig. 1). It was particularly interesting to note the leaps forward in technology, which are helping us to see and analyse the landscape in new ways. Geophysical techniques and aerial photographs have helped us to ‘see’ beneath the soils since the 1940s, but LiDAR images now help us to see through forested land and allow us to identify features on the ground with remarkable clarity. Geographical Information Systems enable us to pull together the great swathes of information that we are accumulating from the range of interdisciplinary techniques, helping to integrate the information but also to process it in new ways, such as viewshed analyses. Google Earth has also provided a new way to survey remote areas, with simple, visual satellite data providing vast quantities of new data. Looking at different electromagnetic spectra enhances the detail further, and recent studies in desert areas in the Middle East and Egypt have identified tens of thousands of new sites using this new method (Parcak 2009; Kennedy & Bishop 2011).

The LAC2010 conference in Amsterdam highlighted many of the new techniques used in landscape archaeology, but also demonstrated the value of traditional methods, especially in developing countries that have not yet experienced the extensive archaeological research that has been undertaken in the Western World. Above all, LAC2010 showed that the integration of disciplines advocated by the conference themes has led to various stages of collaboration and combinations in multi- and interdisciplinary research in landscape archaeology today.

Landscape archaeology is the science of material traces of past peoples within the context of their interactions with the wider natural and social environment they inhabited. The mission of LAC2010 was to have multiple sessions with papers that were complimentary to each other in terms of natural and cultural themes, so that cultural and natural landscape archaeologists, as well as archaeologists, historical geographers and earth scientists, could mingle and discuss relevant themes with each other. The 154 abstracts of LAC2010 are the basis of this first international initiative that is published digitally (VU IGBA Publications 2010). The conference was divided into six thematic sessions that are fully represented in the 35 papers of these proceedings (Table 1). Ten papers derived from abstracts of LAC2010 are published elsewhere in a special issue on LAC2010 in Quaternary International (Kluiving, Lehmkuhl & Schuett 2012).

Figure 1. Fragment of notebook of one of the participants during the LAC2010 conference 26-28 January 2010.

LAC2010: THEMES AND SUMMARIES

Below is a summary of the themes and subthemes of LAC2010, which are dealt with in the papers that belong to the specific sections (Table 1). In the following, all six themes will be discussed, along with short summaries of the corresponding papers. In this introduction a few papers have been regrouped within the additional theme of Rescue Archaeology. Finally, in this section a discussion on a post-processual theme will be presented: Landscape and Memory.
Table 1. LAC2010 themes, abstracts and papers in this volume.

<table>
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<tr>
<th>LAC2010 theme number</th>
<th>Themes and subthemes</th>
<th>Number of abstracts</th>
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<td>Landscape evolution</td>
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<td>Peopling of landscape zones</td>
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<td>Cultural forces in constructed landscapes</td>
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<td><strong>Improving temporal, chronological and transformational frameworks</strong></td>
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<td>Relation between landscape transformations by humans and landscape evolution by natural processes</td>
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<td><strong>Linking landscapes of lowlands to mountainous areas</strong></td>
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<td>Impact of relative sea level changes to landscapes and their inhabitants</td>
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<td>Landscape change by mobile human groups and sedentary people</td>
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<td>Behavioural continuity on a changing lowland landscape</td>
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<td>Dynamic interactions between people and their mountainous landscapes</td>
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<td>Relation between mountainous landforms and human presence</td>
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<td>Seasonal connections between landscapes (transhumance etc.)</td>
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<td><strong>Applying concepts of scale</strong></td>
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<td>Use of multiscale datasets, test pit observations, geo(morpho)logical mapping</td>
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<td>Changes in theorising space in archaeology</td>
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<td><strong>New directions in digital prospection and modelling techniques</strong></td>
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<td>Predictive modelling of archaeological sites using geomorphology and geoarchaeology, and using models of human behaviour and land use</td>
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<td>Landscape change, human occupation and archaeological site preservation</td>
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**HOW DID LANDSCAPES CHANGE?**

LAC2010 has shown that the theme of landscape change is dealt with in many diverse ways and disciplines. This general theme attracted the highest number of abstracts, as well as the highest number (10) of papers in this volume, together with theme 5: New directions in digital prospection and modelling techniques (table 1).

The majority of Theme 1 papers can be classified in terms of change in natural and perceived landscapes due to human interaction with the environment. Sometimes such changes in the landscape are discussed together with preservation issues, as well as with settlement location choices. Reher et al. (this volume) investigated the alterations made to an environment following the introduction of Roman gold mines. The geomorphological alterations are described, complemented by pollen analysis. Together, these methods show how the local population was drawn into the mining work, relocated to sites near the mines and given specialised work to do to support the industry. Agriculture already had an impact on the landscape in the Iron Age, but the removal of villages into the mountains meant that agriculture expanded in this unlikely area, rather than in the more promising agricultural land lower down in the valleys. The paper demonstrates clearly, in an interdisciplinary landscape archaeology project, how the Romans radically reordered the landscape, settlement patterns and economy of this region.

In a river basin in Extremadura, Spain, a combination of field walking and geomorphological survey was employed, using GIS to draw together the dynamic natural river sedimentation and erosion processes in relation to settlement patterns (Mayoral et al., this volume). The results produced a predictive model showing where archaeology is likely to be found in situ, and where natural and man-made changes will have removed archaeological sediments and finds from their original location. The research demonstrates that the First Iron Age landscape was in fact densely settled, so much so that it was already spreading off of the best agricultural land when the Romans colonised the area.

Demetradze & Kipiani (this volume) have surveyed an area of connecting river valleys in eastern
Georgian, gathering together information from historical records and published excavations. The aim was to integrate information from individual sites with the wider landscape, to consider the features in relation to each other and to the natural environment, and to place the landscape in a historical context, from the 4th century BC to the 4th century AD. Classical and medieval sources are also integrated, adding to the long-term perspective of this landscape study by providing evidence for the area’s decline.

Kampa & Ipsikoudis (this volume) demonstrate the importance of relic Byzantine monastic remains in Rhodope, Greece. Remnants of Byzantine structures, mills, cisterns, water towers, churches, settlements and a bathhouse have been discovered in this wooded landscape, but also the ecological traces left by the Byzantine methods of land management. The monasteries were destroyed in the 16th century, but the new Muslim settlers settled down near the monastic remains and they seem to have carried on some of the early agro-forestry systems. Much of the complex early landscape has now disappeared, largely due to modern afforestation.

In a study of English town commons, the archaeological content is investigated and reported on by Nicky Smith (this volume). The past, present and future of English town commons are discussed. Smith argues that town commons should be recognised as a valid historical entity and a valued part of the modern urban environment. In this study, landscape archaeology is landscape evolution: it is about the fabric of the land as created and modified over a long period, in which people’s current activities are part of that continuum.

In another cultural landscape change project, Nurme et al. (this volume) carried out an investigation of Estonian manor parks, researching historical archives together with field survey and cartographic analysis. Estonian parks are unusual in that the Baroque style arrived late to Estonia and lasted long after it had gone out of fashion in the rest of Europe. The manors built between 1730-1770 were in the Baroque style, characterised by symmetrical planning, straight lines, avenues of trees and water features. After 1770, the new, more naturalistic English style gardens were created, but often mixed with the more formal (and out-moded) earlier style. The combination has created a type of cultural landscape that the authors argue is unique to Estonia.

The last two papers in this section focus not so much on landscape change, but rather on settlement choices based on human interaction with the environment. Woltinge (this volume) combines archaeological data with geological features of pingo scars in the northern Netherlands in a statistical test. Pingo scars have historically been regarded as good habitation locations for hunter-gatherers, because of their relatively high position in the landscape and their easy access to water. Pingo scars also provide an excellent base for environmental reconstruction based on palynological research. The study demonstrates that human occupation and its interaction with the landscape seem to be based on much larger environmental elements than just the specific features of pingo scars.

In an interdisciplinary paper on irrigation and landscape, Maurits Ertsen (this volume) discusses the ancient irrigation systems in the Zerqa triangle in the Jordan Valley. How might they have functioned? Physical aspects of the irrigated landscape were explored by basic hydrological and hydraulic modelling. Here, water tapped from the Zerqa River was transported to the fields through open canals by gravity. The settlement patterns found in the valley suggest close connections to the canal system from the Iron Age onwards. Climatic conditions typically would give irrigation a supplemental character. The paper concludes that the application of physically based models yield realistic results when margins of uncertainty for the physical parameters are being constrained by nature.
The papers on this theme by Hajek et al. (this volume) and Kart Aktaş (this volume) are discussed in the additional theme of ‘rescue archaeology and threats to the cultural landscape’.

**IMPROVING TEMPORAL, CHRONOLOGICAL AND TRANSFORMATIONAL FRAMEWORKS**

In this theme we have encouraged the participants of LAC2010 to send in abstracts that deal with a) chronologies in landscape evolution, with respect to geological subdisciplines, and b) the relation between landscape transformations by humans and landscape evolution by natural processes (table 1). Traditionally, there have been two contrasting views on landscape change. On the one hand, there are many archaeologists who believe that cultural processes have been the dominant factor in landscape transformation. By contrast, those with a natural science background have tended to view natural processes such as climate change as the key factors influencing landscape change. All of the papers submitted under this theme illustrate the progress that has been made in interdisciplinary research, in which natural scientists and archaeologists now work together to determine the effects of both cultural and natural transformations on the landscape.

Interdisciplinary research in the coastal region of ancient Etruria (Tuscany, Italy) interlinks historical, environmental and archaeological data in a detailed long-term overview of landscape change. The research is drawn from a vast range of techniques including geomorphology, palaeogeography, remote sensing, geophysical surveys, archaeological research (including intensive surveys and monitoring, excavations and underwater archaeology), archaeometric and archaeological studies of finds (metals and pottery), bioarchaeology, the study of ancient and medieval epigraphy, literary sources, toponyms and historical cartography. This ‘total archaeology’ approach has ensured that a range of natural and cultural landscape features have been identified (Pasquinucci & Menchelli, this volume).

On a smaller scale, changes of vegetation connected to the erection and use of megalithic graves resulted in a high-resolution reconstruction of land use and forest history at Kråhenberg in Schleswig-Holstein, Northern Germany. Archaeological data corroborated by the pollen record suggests that human impact occurred periodically in a period from the end of the Atlantic period (Neolithic), with an increasing intensity during the Bronze Age (Sadovnik et al., this volume). The landscape of south-western Lazio, Italy, was studied in a combined geo- and settlement archaeological approach, focusing on the changes caused by humans in the Roman Republican and Imperial Age. The first results of a brief assessment of the nature and extent of man-made landscape alterations in a part of the suburban hinterland of Rome are presented, and the methodological framework is outlined (Teichman & Bjork, this volume).

An interdisciplinary study of the medieval city of Brussels showed that in its early stages the city was not densely settled, contrary to an image in an illuminated manuscript. Evidence from early maps, excavations and analysis of the soil and phytoliths indicate that agriculture took place in open spaces within the medieval city itself, and as the population rose, the city became more densely populated and the open spaces within it were slowly filled in (Vannieuwenhuyze et al., this volume).

The paper in this theme by Rössler et al. (this volume) is discussed in the additional theme of ‘Rescue archaeology and threats to the cultural landscape’.
LINKING LOWLANDS TO MOUNTAINOUS AREAS

The third theme addresses the links between lowlands and mountainous areas. The underlying assumption while formulating the theme was that the contrasts between the two types of natural landscapes are present in almost every part of the globe in variable scales and proportions. Moreover, lowlands and mountainous areas form the background for mobile human groups as well as sedentary people. In a qualitative model of human-environment interactions in a western Andean valley, Peru, the adaptation to the constraints of one limited resource (irrigable land) lead to the suboptimal exploitation of another limited resource (water), which lead to an overall decline in agricultural productivity per unit of arable land and to increasing vulnerability (Hesse & Baader, this volume). The paper shows that the inherent dynamics of cultural landscape evolution in the context of irrigation-based societies may explain the observed changes in the archaeological record. The paper is a contribution to the ongoing debate on potential causes for cultural change in pre-Hispanic coastal Peru.

Mientjes (this volume) investigates the complexities of pastoral transhumance, using an ethnographical approach coupled with historical research in order to understand the nature of pastoralism in Sardinia, Italy, over the past 200 years. Understanding pastoralism ethnographically provides clues to investigating it archaeologically, and shows that we can identify early transhumance routeways through the mountainous landscape, as well as animal shelters and pens, wells and shepherds’ huts. This paper is also discussed in the additional theme of ‘rescue archaeology and threats to the cultural landscape’.

An interdisciplinary landscape analysis, focusing on the Grosetto area of southern Tuscany, Italy enabled Pizziolo (this volume) to define ancient shorelines, identifying where dry land would have occurred in the different phases based on geological, historical and topographical criteria. The relation between lowlands and mountainous areas is nicely illustrated by the fact that prehistoric funerary activity took place in the surrounding hills, while the settlements which are related to them are difficult to trace because of the complex geological history of the low-lying alluvial plain.

APPLYING CONCEPTS OF SCALES

Theme 4 incorporates the use of multiscale datasets, from test pit observations to geological and geomorphological mapping, as well as how to apply concepts of scale in landscape archaeology. This theme also addresses a classic difference between concepts of scales in geological and archaeological research. Archaeological research often departs from find spots or excavation sites by synthesising material finds in economic, cultural and social networks that can extend over large areas. By contrast, geological research combines information from drill holes and sedimentary sections (including laboratory analyses) into e.g. regional-scale maps showing paleogeography or specific soil information. Often national scale maps in palaeogeography cannot be used in regional or local archaeological prospection (Bazelmans et al. 2011). Palaeogeographic maps usually integrate archaeological data only when it is useful for providing dating evidence, e.g. when archaeological finds in certain stratigraphic layers can be used to date specific landforms (e.g. Vos & van Heeringen 1997). On the other hand, is it still a challenge to explore an integration of reconstructed former landscapes including palaeovegetation with e.g. economic traffic on variable transport routes of former civilisations? Two papers that reflect the ‘scale’ theme have been incorporated within these proceedings.
In arid parts of Australia hunter-gatherers moved over substantial areas, complicating the task of archaeologists interested in understanding behavioural changes related to human-environment interactions. Holdaway et al. (this volume) analysed archaeological remains in a fifteen-kilometre long drainage system and provided information on the nature of land use and movement over areas that are orders of magnitude larger than those actually studied. The movement of flakes, interpreted as examples of ‘gearing up behaviour’, occurred across distances that moved people well beyond the limits of the lake in the study area. In the longer term, the accumulation of hearths indicates how the accumulations of behavioural events relate to long-term shifts in the climate and therefore resource availability.

Surface assemblages of prehistoric sites usually reveal only part of the actual extent of the archaeological activity below ground. The difference between surface scatters and buried sites was assessed in two archaeological case studies in Thesprotia, Western-Greece, which demonstrated discrepancies between surface and subsurface assemblages. Several multiscale data sets were acquired, including phosphorous sampling, trial excavations and geophysical techniques. Surface assemblages are biased mainly through erosion and modern landscaping, but also due to so-called ‘walker effects’ (Forsen & Forsen, this volume).

NEW TECHNOLOGY IN DIGITAL PROSPECTION AND MODELLING TECHNIQUES

The tradition of interdisciplinary methods is continuing and is now broadening to include new technologies, such as LiDAR and satellite imaging. GIS is enabling researchers to integrate different layers of data, which further enhances the potential for interdisciplinary research and for quantification and mapping. This was very well demonstrated in the fifth session of LAC2010: ‘New Directions in Digital Prospection and Modelling Techniques’. A useful introduction to this theme is given in a broad overview of the recent development of digital techniques within a ‘revolution’ in current landscape archaeology (Verhagen, this volume). As a warning, Verhagen concludes that we are caught somewhere between the shining perspective of using quantitative models as exploratory, heuristic devices that can be used for a number of different research questions and the technical and theoretical limitations of what we are trying to do with them.

Deodat & Lecoq (this volume) have used GIS and Google Earth satellite data to survey an area of the Peruvian Andes for archaeological villages and structures, together with an analysis of the ecological zones, rivers and roads through the mountains. Escobar has carried out a GIS-based investigation into the Romanisation of the Antequera Depression in Malaga, southern Spain, in a statistical analysis of settlement patterns. Viewshed analysis showed for the first time that pre-Roman, Iberian settlements were predominantly on high ground, with a high degree of intervisibility, while in the Roman period this pattern changed and inter-visibility became much less important (Moreno Escobar, this volume).

Opitz et al. (this volume) point out that LiDAR is a technique which is complementary to the traditional method of fieldwalking: although LiDAR works poorly on ploughsoils, it is very effective on many areas that cannot be fieldwalked, such as uplands, marshes and particularly forests. The case study makes the point very clearly: LiDAR is an extremely rapid and effective technique which is allowing archaeologists to see through forest cover and to map the archaeology below.

Van der Zee & Zuidhoff (this volume) argue for the use of LiDAR as a standard method to be used
in archaeological planning within a lowland area within the Netherlands, a theme which runs through many of the papers of Theme 5. Hesse (this volume) has used high-resolution LiDAR to carry out the complete archaeological mapping of Baden-Württemberg, and argues convincingly that extracting Local Relief Models (LRM) from high-resolution LiDAR data has the potential to greatly improve the potential of such data for the prospection, mapping and monitoring of archaeological sites.

Van Roode et al. (this volume) have combined a suite of methods for the survey of complex urban sites, including intensive fieldwalking, aerial photography, LiDAR, geomorphological studies and a range of geophysical methods, followed by limited excavation. The varied data is then integrated using GIS and computer modelling. The team aims to develop a standard set of methods which others can adopt, and which they hope to see become standard practice. The focus is on management and presentation and they argue that computer reconstructions are not only a very effective way of providing a visual impression of the site, but they are also a rapid way of communicating with the public, in that they can be produced early on in the excavation and survey process. This project demonstrates a very high level of co-operation and focus between three academic and research institutes and three private companies.

New directions in archaeological prospection are shown in two papers. The settlement probability mapping and model uncertainty assessment provided by Fernandes et al. (this volume) provides an opportunity to test the statistical model and a more profound insight into the settlement location choices for the Malia-Lasithi region in Crete during the Protopalatial period (1900-1650 BC). The methods presented here are totally novel within the field of archaeology. This quantitative assessment of model uncertainty based on confidence intervals is usually lacking in settlement probability mapping.

In southern Germany, Posluschny et al. (this volume) present a GIS and database system with which they model the agricultural potential of settlements within their natural surroundings based on topography and soil quality. The model is used to calculate the maximum number of people that can be fed from within the hinterland of both princely sites and ‘regular’ settlements by cattle and crops. The area around the settlements can be defined by cost-based calculations, which suggests a territorial border based on walking time. The model is then used to compare the agricultural potential of different settlement sites as well as of sites from different periods. The research shows the potential for landscape archaeology in general, but also bridges the gap between environment, culture and social behaviour.

The paper in this theme by Klagyivik (this volume) is discussed in the additional theme of ‘Rescue archaeology and threats to the cultural landscape’.

What all of the papers in this session demonstrate is that there is a wide range of new tools that can be applied to archaeological research, and integration of these methods has brought forth new ways of investigating and analysing the landscape. While van Roode et al. (this volume) would like to see a standardised practice, it is also worth considering on a case-by-case basis the range of possible methods, old and new, that would be most appropriate for any survey and excavation. There are broad ranges of scale, from mapping extensive areas using satellite data, to very detailed observation of the land surface, and finally, there is detailed excavation. We would be reluctant to be too prescriptive about the methods that any individual project or researcher ought to use; rather, we would argue that we should all be aware of the range of possibilities of these new developments and make informed decisions when designing new research projects.
THE FUTURE OF LANDSCAPE ARCHAEOLOGY

The last session of LAC2010 (theme 6) discusses the future of landscape archaeology and offers a wide range of different papers. Most authors discuss the interdisciplinarity of landscape archaeology and its ambiguous meaning in society and academia. The role, history and future of landscape archaeology in studies mainly situated in the United Kingdom are widely discussed. The future prospect of landscape archaeology is presented by Fleming (this volume) in the form of a SWOT Analysis (Strengths, Weaknesses, Opportunities and Threats), in which the flexibility of landscape archaeology and its capacity to operate at different scales are classified as strengths, next to contributions to human historical ecology. Weaknesses are formed by the dangers of localism, considered on geographical as well as historical scales and in political and social context. Opportunities within the field of landscape archaeology include discoveries that challenge our perceptions of the world, while threats are formed by limitations of digital resources as well as 'the postmodern challenge’ that has introduced an unhelpful and unnecessarily polarised debate. Meier (this volume) discusses the shapeless use of the term landscape archaeology in actual academia. With regard to the history of the term ‘landscape’, in Meier’s opinion ‘landscape archaeology’ is the proper term to refer to any academic approach which concentrates on the social construction of space. Interdisciplinary research necessarily has to communicate not only its results, but also the presuppositions and rationalities of the participating disciplines. The author concludes that interdisciplinarity is a specific form of academic social behaviour.

Most studies about landscape archaeology are studies of archaeology or geology, and are not about landscape in the way it is meant to be (Fairclough, this volume). Landscape Archaeology, as Fairclough argues, could become an important part of broader landscape research in addition to being a subdiscipline of archaeology. Landscape archaeology can bring special and unique expertise to landscape studies, and can in its turn benefit from exposure to the different horizons, theories and aims of other landscape disciplines. Herring (this volume) argues for the landscape archaeologist’s role to be widely inclusive in academia and society. If all society matters, then all landscape matters and all stories have relevance. Herring stated that all disciplines that are shown in inquisitive, theoretical, empirical and phenomenological approaches are drawn into this, as well as all actors. In addition, historic landscape characterisation can be used strategically as a spatial framework in which to assess the historic environment’s sensitivity to types of change, or its capacity to accommodate it. A future prospect is that landscape archaeology’s key role may be not only to demonstrate how landscape diversity, the outcome of long, medium and short-term change, came into being, but also how that understanding can most effectively inform a sustainable future.

Finally, Johnson (this volume) states that interpretations based on the direct field experience of an archaeologist should be revised. He argues that if landscape archaeology is to develop into a responsible and rigorous field science, it must abandon theories based simply on direct experience and should instead reflect more seriously on the relationship of evidence to interpretation.
One thing all of the papers in the section on New Technology have demonstrated is that the new techniques for survey, mapping and quantifying archaeological landscapes have a great deal to offer in the area of planning and conservation. In order to schedule or protect sites or landscapes, we have to first map and understand their character. Our techniques for doing so have increased exponentially. This is important, because the papers also demonstrate that we are not all doing research for pure empirical or scientific reasons: the new techniques can also be applied to rescue archaeology. The use of rescue archaeology as a vehicle for research has been demonstrated in a number of papers in this volume and raises the subject of the threat of destruction of archaeological sites and landscapes.

There are a number of threats to our cultural landscapes, some ongoing and some new. The way that we react to these threats is an insight into what we value most highly. Archaeological sites and cultural landscapes are threatened by urban sprawl, as exemplified in Kart Aktaş’s paper on Istanbul (theme 1, Kart Aktaş, this volume); poor planning legislature can allow sites to be built upon or quarried away. Gravel extraction has destroyed large areas of intact prehistoric landscape in England, including some remarkably well preserved landscapes that were buried under alluvium (RCHME 1960). The Valetta Convention has protected the archaeology in many European countries by regulating planning legislation so that archaeology is taken into consideration, but agriculture is not specifically covered by the agreement (Valletta Convention 1992). Agriculture is a major force for destruction, and plough damage has destroyed countless sites across Europe. In Wiltshire (United Kingdom) a vast area of Salisbury Plain is held as military land used for bombing, tank exercises and other destructive practices, and yet the aerial photographs and LiDAR show that the archaeology has survived much better in this area than in the surrounding, heavily cultivated farmland (McOmish 1998; Barnes 2003).

At the same time, agriculture is an essential part of our cultural landscape and agricultural practices have made our landscapes what they are today. The form of fields and field boundaries, drainage and irrigation are all part of our national character, for instance hedgerows in Britain, drainage dykes in the Netherlands and high pastures in the Alps and Mediterranean. Both arable and pastoral agriculture play an important role in maintaining the landscape. The foot-and-mouth crisis in European agriculture caused huge numbers of livestock to be destroyed, and one fear was that the landscape would change dramatically without grazing animals maintaining the ecosystem. Chalk grassland was once regarded as a natural ecosystem, but after experiments in grazing reduction on England’s South Downs, it was discovered that when sheep are removed from chalk grassland, it will revert to woodland (Hope-Simpson 1940) – as will many of our moors and heathland (Svenning 2002). The degree of openness in the woodland due to wild herbivores and other natural occurrences is debated (Vera 2000), but there can be no doubt that pastoralism has had a major impact on our cultural landscapes.

Mientjes (theme 3, this volume) has investigated the complexities of pastoral transhumance in Sardinia over the past 200 years, showing that ethnographic studies can shed light on the cultural complexities of past and present land use, ownership and grazing rights. He argues that understanding pastoralism ethnographically provides clues to investigating it archaeologically, and shows that we can identify early transhumance routeways through the landscape, animal shelters and pens, wells and shepherds’ huts. Ethnographic evidence helps us to put such features into context, adding to our understanding of the culture, history, economy and physical geography of the cultural landscape.
In some regions, there have been active efforts to eradicate the landscapes of the past. During the Cultural Revolution in China, attempts were made to sweep aside the art, culture and landscapes of earlier regimes. In the USSR and other former Eastern Bloc countries, the government attempted to eradicate religious sites and symbols, or they were disregarded in the planning system. This issue was discussed in Hájek et al. (theme 1, this volume). The authors describe the problem of restoring a landscape of great historical importance, which has been largely destroyed by open cast mining. In the Middle Ages the region had a religious element which dominated the way the landscape would have been seen and understood. Whole villages were destroyed by coal mining, and what is possibly even more poignant, pilgrimage routes – dotted with chapels, crosses and other markers – have been obliterated. The authors pose the question: how do you restore such a landscape? They argue that minor landmarks such as crosses, chapels, statues and milestones should be preserved, even if they are preserved out of their original context, which no longer exists. It is not ideal, but it is preferable to losing these monuments altogether, along with all that they represent.

Klagyivik (theme 5, this volume) tells a similar story of destruction. She has undertaken interdisciplinary research on monastic gardens in Hungary and the vicinity, using historical maps and GIS to identify the surviving remains of garden features. She went on to apply geophysical methods (particularly resistivity) to survey any areas which have not been built upon or destroyed. A particular problem with such research in Eastern Europe is the disregard of the former Soviet regimes for religious structures and the wilful destruction of so many monastic features in the landscape. An example is the hermitage at Majk, where there are surviving remains of Baroque, English, 19th-century and early 20th-century garden styles – a whole history of monastic garden design on one site. The tragedy of this example is that after hundreds of years of both preservation and development, it suffered the most devastating destruction in the period after World War II. On a more hopeful note, research into garden design is providing the information needed to reconstruct and preserve such monuments, and Klagyivik has provided a fine example of how this should be done.

Rösler et al. (theme 2, this volume) have also addressed problems of widespread landscape destruction. Their study, set in Eastern Germany, uses rescue excavation in advance of open cast mining as a vehicle for archaeological landscape research. Charcoal was created in this area on a small scale in the Middle Ages and on a large scale from 1567 until the 19th century, when it was used for fuel in the nearby iron manufactory. Over 400 charcoal-burning hearths have been excavated, and the impact on the environment has been analysed in terms of geomorphology and vegetation change. A key impact of deforestation for charcoal burning has been the erosion of the underlying Pleistocene sands, which have blown away and buried areas of the medieval and later landscape. Pre-medieval sites have also been discovered, including Mesolithic flint scatters, Neolithic and Bronze Age burials, Bronze Age post structures and a 3rd/4th-century Germanic village. This study is a good example of rescue archaeology, turning round a destructive process and using it to gain information.

**LANDSCAPE AND MEMORY IN POST-PROCESSUAL ARCHAEOLOGY**

The notion that our landscapes are made up of elements of past and present is hardly new. The past has always been a source of fascination, and we can see evidence for this in religious structures and burial traditions from earliest prehistory to the present day (Bradley 1987, 2002). Bronze Age barrows cluster around
earlier, Neolithic barrows, seeking an association with what came before (Parker Pearson 1993). Early Bronze Age barrows become incorporated into field boundaries in the Late Bronze Age (Bradley 1978), or later shrines were built on top of them. In 601 Pope Gregory advised the English Abbot, Mellitus, to build Christian altars on pagan religious sites, and there are many examples of this in England (Muir 2000, 153). In the city of Bath, for instance, the Roman bath sits upon the Celtic Shrine to Sulis, and beside the two, providing further religious continuity, is the Abbey church of Saint Peter and Saint Paul. This phenomenon is widespread (Bradley 1987), a key example being the Dome of the Rock in Jerusalem, which is built on top of the Temple of Solomon.

The degree to which people are aware of the age of their landscape differs; some farmers can be good sources of information, while others scoff at the notion that there is anything of interest below their ploughsoils, unaware of the extensive remains that exist just below the surface. Knowledge of local history and folk memory are variable; there are still villages in England with rivalries going back to the Civil War. The way that people perceive the landscape around them, and the age of the landscape, is an area that spans both archaeology (particularly post-processual archaeology) and Environmental Psychology. Environmental Psychologists look at the responses of people to particular landscapes, their perceptions and how they experience the landscape; influences include culture, personality, role (e.g. farmer, painter or hillwalker) (Craik 1986). An interesting new discovery is that not only do views of natural landscapes or vegetation actually reduce stress, but landscape paintings reduce the anger and stress of workers in office settings (Kweon et al. 2008). This is another interesting overlap between the arts and sciences within the field of Landscape Archaeology.

CONCLUDING REMARKS AND FUTURE RESEARCH

The LAC2010 has shown that an interest in landscape archaeology is worldwide and is emerging in new places which have not previously had much support for such studies. LAC2010 has made a first thorough inventory of international landscape archaeological research that has been carried out in the first decade of the 21st century. Overseeing the results of the papers presented in this volume, while comparing them with the initial LAC2010 conference themes (table 1), shows that quite a number of subthemes have been covered, while some remain still to be explored. In natural and cultural processes of landscape change, true integration of social change and processes in natural landscape evolution is still a challenge (e.g. Reher Diez et al., this volume). We need more integrated examples of landscape transformations by humans and landscape evolution by natural processes (e.g. Pasquinucci & Menchelli, this volume; or Vanniewenhuyze et al., this volume). Variable scale concepts can be further applied on lowland and mountainous landscape systems, while also the integration of information on the scale of historical geographical landscape research with archaeology and physical (palaeo)geographical data (e.g. Holdaway et al., this volume) will be a next step in future research in landscape archaeology. The papers presenting new technology illustrate the new possibilities for integrating interdisciplinary data (e.g. Deodat & Lecocq, this volume; or Escobar, this volume), and are therefore an important driving force into the future of landscape archaeology. In the ‘Future’ session the interdisciplinary nature of landscape archaeology and its ambiguous meaning in society and academia is well covered by all papers in this theme (Fleming, this volume; Fairclough, this volume; Herring, this volume; Johnson, this volume; or Meier, this volume), and should set the stage for the future research agenda.
Based on the results of LAC2010, we call for more integration and collaboration with respect to the various (sub)disciplines involved in landscape archaeology. In the United Kingdom the distance in academia between the ‘field’ and material landscape studies with post-processualism is extremely large (Fleming 2007, 2008; Johnson, 2007a, 2007b). In this volume the discussion goes on (Johnson, this volume; Meier, this volume), and is also described as an unhelpful and unnecessarily polarised debate (Fleming, this volume). Within continental Europe (Germany, The Netherlands) the division appears to be moderate, although also in these regions a formal division in academic educational systems hinders integration between the archaeological sciences, such as environmental archaeology and geoarchaeology, with humanities-based archaeology departments where archaeological theory plays a greater role (see also Meier, this volume). The objectives of LAC2010 were set out to form a medium of discussion between disciplines. Within the contributions of these proceedings it has been shown that the methodology in many papers covers multiple disciplines, and also that various examples of collaboration exist between archaeologists, historical geographers and earth scientists, which gives rise to the hope that future developments will show more interdisciplinary studies and therefore better integrated landscape archaeological research.

The course of the discussion at LAC2010 in all six thematic sessions also gave rise to a discussion on what other themes in Landscape Archaeology might be pursued in the future. Some suggestions were:

- Can the understanding of the relationship between other cultures (past and present) and their landscapes inform our community as we seek to manage changing modern landscapes in a sustainable way?

- Can the behaviour of past people in changing landscapes inform our decisions and help us to adapt to climate change in various changing landscapes in the world today?

- What is the impact of relative sea level change on former landscapes, and how did people in the past react to such processes of natural landscape change?

- What is the relationship between landscape transformations by human causes and landscape evolution by natural processes? How dependent are people on their natural landscape?

- How are landscapes described by a) natives with traditional values, and b) geographers and archaeologists? Is there a connection between landscape perceptions in cultural traditions and the natural conditions of landscape processes and/or geological resources?

- How are landscapes perceived by people today, and how might this have differed in the past?

- How are landscapes influenced by anthropogenic, historical, social, and/or economical processes through time and space?

Some of these ideas are already being pursued, which demonstrates that we are sharing a worldwide ‘climate of opinion’ in which many of us are thinking along the same lines. The final question has been a key area of landscape research since the 1920s, but the climate change issues are more recent. When we
look into the future of the 21st century we see that the impact of climate change on the global landscape can only be considered in a wide interdisciplinary approach, such as that taken in the latest reports of the IPCC (Pachauri & Reisinger 2007). Today, for example, there is much focus on the Inuit and the ways that they are coping with climate change (e.g. Ford et al. 2008). The United Nations and many NGOs are supporting the use and development of indigenous technology and engineers are promoting ‘intermediate technology’ which often relies on traditional methods of agriculture, water management and engineering (Scialabba & Hattam 2002; IAASTD 2009). Attempts are being made to correlate indigenous soil classification techniques with modern soil analysis and mapping, with some success (Gray & Morant 2003), although it is difficult to reconcile the two systems which rely on different variables and observations (Payton et al. 2003). This is certainly a forward-looking approach, however, and using GIS to map the different soil types has had some success.

LAC2010 has attracted a wide variety of relevant disciplines in landscape archaeology today, has made an inventory of the current situation and presented its potential for future research in these proceedings. It is useful to have ideas for further research, and to identify lacunae in our understanding, but we are also very aware that our colleagues at the LAC are a group of dynamic researchers who have ideas of their own. With the Proceedings of LAC2010 established, we can now look forward to hearing about the new research directions and results that our colleagues come up with at the next international Landscape Archaeology Conference (LAC2012), to be held at the Freie Universität in Berlin in June 2012. Landscape archaeology today has been positioned clearly within this new developing field of research between art and science.

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