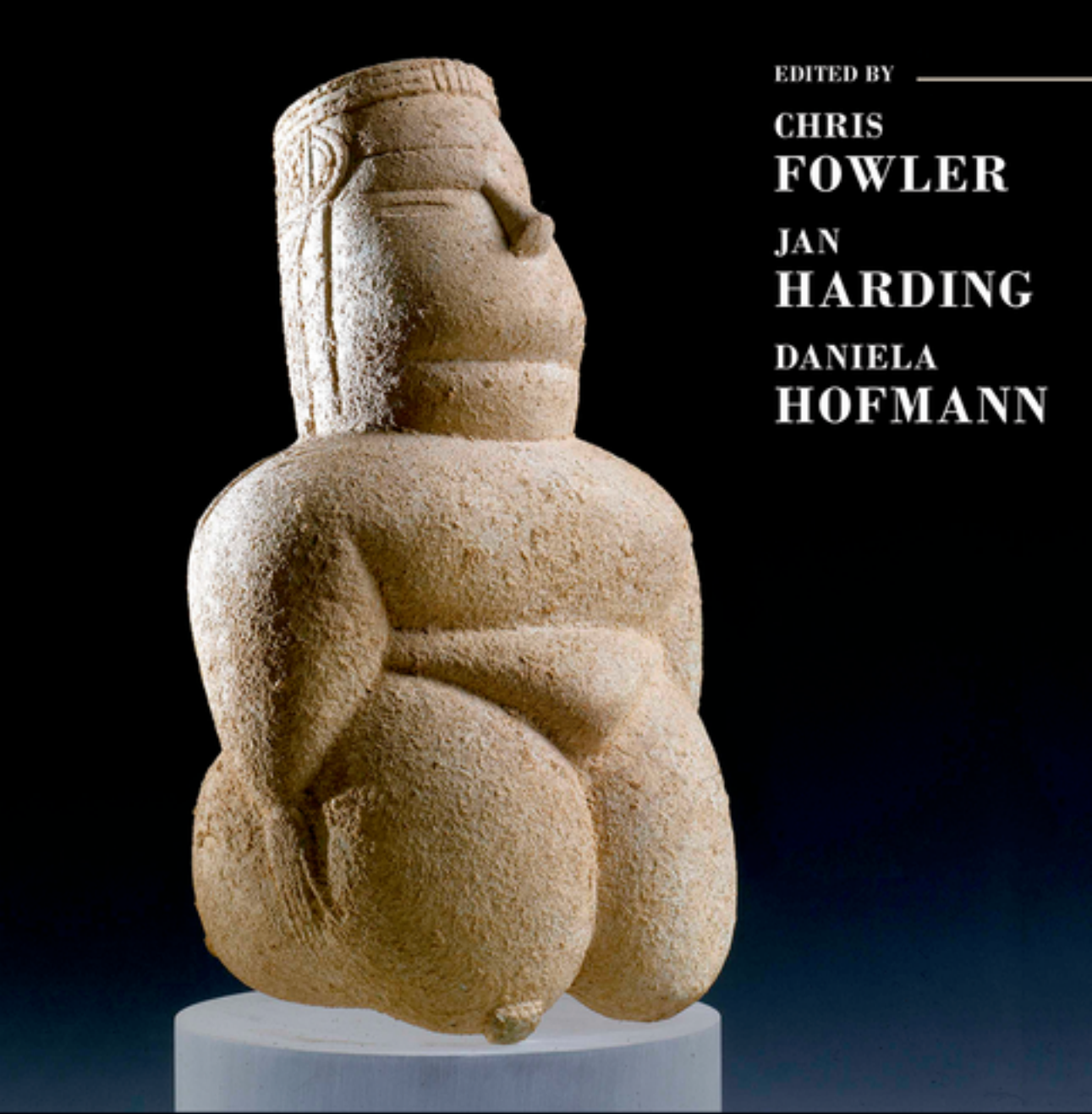

EDITED BY

CHRIS FOWLER

JAN HARDING

DANIELA HOFMANN

The Oxford Handbook *of* NEOLITHIC EUROPE

THE OXFORD HANDBOOK OF

NEOLITHIC EUROPE

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Edited by

CHRIS FOWLER, JAN HARDING,

and

DANIELA HOFMANN

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Cover image: anthropomorphic figurine in kaolinite, 4000–3500 BC,
from Cuccuru S'Arriu (Cabras). National Archeological Museum, Cagliari, Sardinia.
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Preface

This book is an ambitious project, involving over 70 authors working in more than 45 different institutions in 15 countries. We would like to thank all the authors for their hard work. A number of contributors agreed to co-author chapters with specialists they had not worked with before, sometimes based in different countries, and we have been delighted with the degree of cooperation and collaboration between them. This has been vital in producing a series of chapters that work across the national and regional boundaries which have often deflected archaeologists from synthesis at a scale that matches that of Neolithic phenomena. With a work of this scope, it is perhaps inevitable for delays to occur, and we would like to thank all contributors for their patience during this process.

First conceived in 2007, the *Oxford Handbook of Neolithic Europe* provides summaries of key debates that are ongoing and will remain current over coming years. The future is bright and exciting, and the chapters in the volume aim to function as valued waypoints, marking out how that future looks now and outlining how scholars have arrived at their present positions. Many authors reflect on emerging and future research at the time of writing; some have marked their chapters with a 'date stamp' indicating the last time that content was updated to put it in precise context, but all of the trends and trajectories identified remain valid at the time of press. Nonetheless, the European Neolithic is a very dynamic field of study, with every year yielding further projects on varied aspects of life in this period; just in the lifetime of the production of this volume there have been numerous significant developments in radiocarbon dating and chronologies, palaeogenetics, and the application of stable isotope analyses, to name just a few. No such work can be exhaustive, but this volume aims to be highly representative and as comprehensive as possible, both in terms of the regions and material covered and analytical methods and interpretative approaches.

Copyright permission for images has been obtained from the legal holder wherever possible. Every effort has been made to identify and contact the copyright holders, but in some cases this has not been possible; for instance, where the age of the images is such that their creators have passed away and/or the publisher no longer exists. Throughout, the copyright holders are acknowledged for each image, and we would like to reiterate our thanks to them here. If oversights or errors are identified with copyright acknowledgements we undertake to investigate these and if appropriate correct the information in any future edition. The editors would like to thank John Robb for supplying the base maps adapted for Maps 1–4.

We would like to thank Hilary O'Shea for commissioning the volume, three anonymous reviewers of the initial proposal for their constructive comments, Taryn Das Neves, Annie Rose, and Michael Dela Cruz at OUP for producing the hard copy and online versions of the book, and Sivaraman G, Janish Ashwin, and Prashanthi Nadipalli, Sunoj Sankaran at Newgen for their work with the copy-editing.

Contents

Sequences of Cultural Interaction and Cultural Change

PART III NEOLITHIC WORLDS AND NEOLITHIC LIFEWAYS

Houses, Habitation, and Community

Subsistence and Social Routine

Materiality and Social Relations

PART IV CONCLUSION: DEBATES IN NEOLITHIC ARCHAEOLOGY

List of Figures

List of Contributors

Niels H. Andersen Moesgaard Museum, Moesgaard, Denmark

Tony Axelsson Department of Historical Studies, University of Gothenburg, Sweden

Geoff Bailey Department of Archaeology, University of York, UK

Martin Bartelheim Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters, Eberhard Karls Universität Tübingen, Germany

László Bartosiewicz Institute of Archaeological Sciences, Eötvös Loránd University Budapest, Hungary

Amy Bogaard School of Archaeology, Oxford University, UK

Dušan Borić Department of Archaeology and Conservation, Cardiff University, UK

Kenneth Brophy Department of Archaeology, University of Glasgow, UK

Tony Brown Department of Geography and the Environment, University of Southampton, UK

Mihael Budja Department of Archaeology, University of Ljubljana, Slovenia

Marta Capote Independent researcher, Madrid, Spain

John Chapman Department of Archaeology, Durham University, UK

Andrew Cochrane Department of Archaeology and Conservation, Cardiff University, UK

Gabriel Cooney School of Archaeology, University College Dublin, Ireland

Anick Coudart School of Human Evolution and Social Change, Arizona State University, USA

Vicki Cummings Archaeology, University of Central Lancashire, UK

Pedro Díaz-del-Río Instituto de Historia, Consejo Superior de Investigaciones Científicas, Spain

Pavel Dolukhanov† School of History, Classics and Archaeology, Newcastle University, UK

Sara Fairén-Jiménez Independent researcher, Edinburgh, UK

Angelo Eugenio Fossati Dipartimento di Storia, Archeologia e Storia dell'Arte, Università Cattolica del Sacro Cuore, Milan, Italy

Chris Fowler School of History, Classics and Archaeology, Newcastle University, UK

Catherine J. Frieman School of Archaeology and Anthropology, Australian National University Canberra, Australia

Duncan Garrow Department of Archaeology, University of Reading, UK

Bisserka Gaydarska Department of Archaeology, Durham University, UK

Detlef Gronenborn Römisch-Germanisches Zentralmuseum Mainz, Germany

Marjorie de Grooth Independent researcher, Bad Münstereifel, Germany

Jean Guilaine Member of the Institut de France, Collège de France, Paris, France

Paul Halstead Department of Archaeology, University of Sheffield, UK

Jan Harding School of History, Classics and Archaeology, Newcastle University, UK

Volker Heyd Department of Archaeology and Anthropology, University of Bristol, UK

Daniela Hofmann Archäologisches Institut, Universität Hamburg, Germany

Michael Hoskin Churchill College, Cambridge, UK

Andrew Meirion Jones Department of Archaeology, University of Southampton, UK

Kristian Kristiansen Department of Historical Studies, University of Gothenburg, Sweden

Mats Larsson Department of Cultural Sciences, Linnæus University Kalmar, Sweden

Jonathan Last English Heritage, Portsmouth, UK

Tony Legge† McDonald Institute for Archaeological Research, Cambridge University, UK

Malcolm Lillie Department of Geography, Environment and Earth Sciences, University of Hull, UK

Roy Loveday School of Archaeology and Ancient History, Leicester University, UK

Caroline Malone School of Geography, Archaeology and Palaeoecology, Queen's University Belfast, UK

Arkadiusz Marciniak Institute of Prehistory, Adam Mickiewicz University, Poznań, Poland

Francesco Menotti School of Archaeological Sciences, University of Bradford, UK

Magdalena S. Midgley† School of History, Classics and Archaeology, University of Edinburgh, UK

Dimitrij Mlekuž Department of Archaeology, University of Ljubljana, Slovenia

Johannes Müller Institut für Ur- und Frühgeschichte, Universität Kiel, Germany

Stratos Nanoglou Ephorate of Antiquities of Messinia, Kalamata, Greece

Jörg Orschiedt Institut für Prähistorische Archäologie, Freie Universität Berlin, Germany

Demetra Papaconstantinou Athens Center, Arcadia University, College of Global Studies, Greece

Dave Passmore School of Geography, Politics and Sociology, Newcastle University, UK

Mark Pearce Department of Meditteranean Prehistory, University of Nottingham, UK

Joachim Pechtl Lehrstuhl für Vor- und Frühgeschichtliche Archäologie, Julius-Maximilians-Universität Würzburg, Germany

Rick Peterson Archaeology, University of Central Lancashire, UK

Jörg Petrasch Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters, Eberhard Karls Universität Tübingen, Germany

Joshua Pollard Department of Archaeology, University of Southampton, UK

Pál Raczky Institute of Archaeological Sciences, Eötvös Loránd University Budapest, Hungary

Morten Ramstad University Museum of Bergen, Norway

John Robb Department of Archaeology, Cambridge University, UK

Benjamin W. Roberts Department of Archaeology, Durham University, UK

Peter Rowley-Conwy Department of Archaeology, Durham University, UK

Chris Scarre Department of Archaeology, Durham University, UK

Wolfram Schier Institut für Prähistorische Archäologie, Freie Universität Berlin, Germany

Rick Schulting School of Archaeology, Oxford University, UK

Stephen Shennan Institute of Archaeology, University College London, UK

Karl-Göran Sjögren Department of Historical Studies, University of Gothenburg, Sweden

Robin Skeates Department of Archaeology, Durham University, UK

Kalle Sognnes Department of Historical Studies, Norwegian University of Science and Technology, Norway

Anders Strinnholm The Museum of Archaeology, University of Stavanger, Norway

Julian Thomas School of Arts, Languages and Cultures, Manchester University, UK

Nick Thorpe Department of Archaeology, University of Winchester, UK

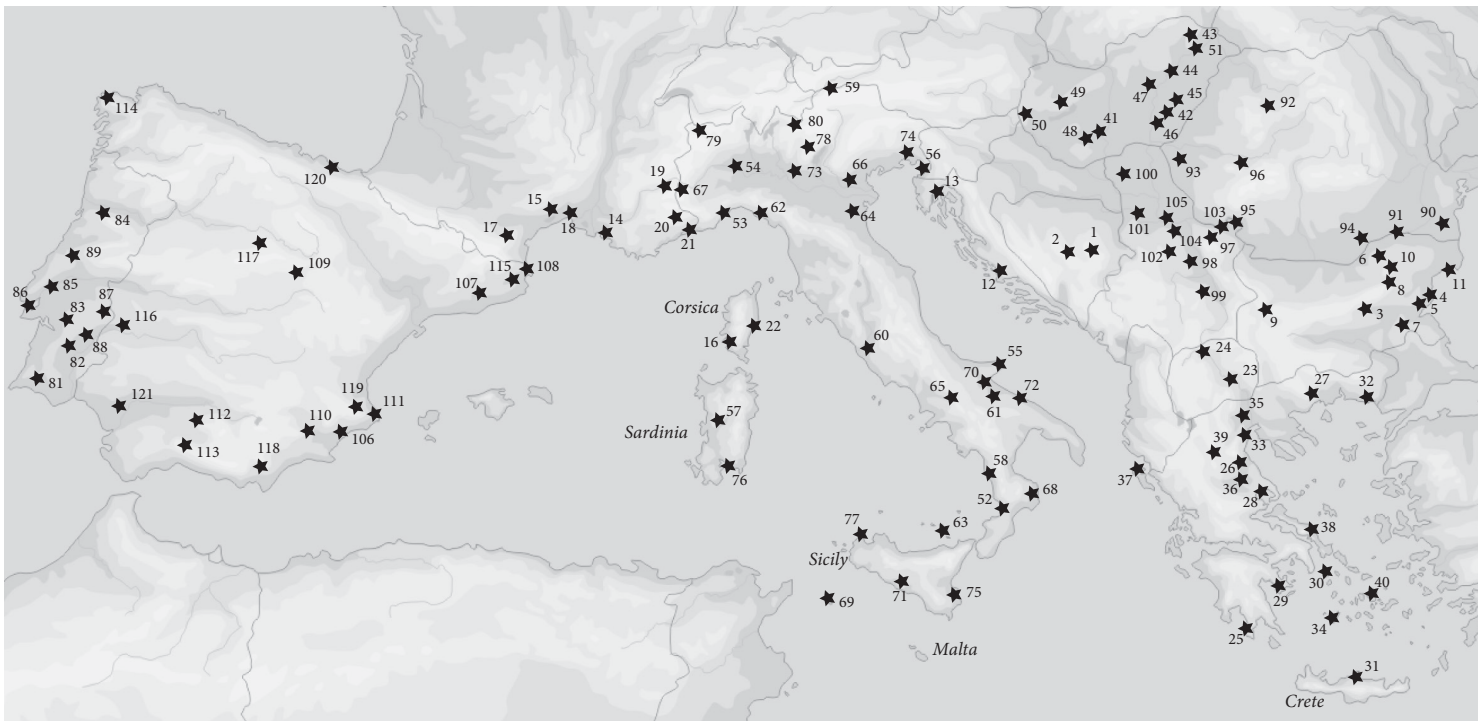
Anne Tresset CNRS Paris, France

Marc Vander Linden Institute of Archaeology, University College London, UK

Katharine Walker Department of Archaeology, University of Southampton, UK

Alasdair Whittle Department of Archaeology and Conservation, Cardiff University, UK

MAP 1 Map of main regions and geographical features mentioned in the volume. 1 = Alentejo; 2 = Almería; 3 = Colline Metallifere; 4 = Lunigiana; 5 = Tavoliere; 6 = Valais. Base map drawn by Jane Mathews and supplied by John Robb.


Corsica
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MAP 2 Selected sites in Mediterranean and south-east Europe mentioned in the volume (alphabetically by country):
Bosnia: Obre (1); Okolište (2) – ***Bulgaria***: Ai Bunar (3); Durankulak (4); Goljamo Delchevo (5); Kamenovo (6); Karanovo (3); Orlovo (7); Ovcharovo (8); Poljanitsa (8); Slatina (9); Targovishte (10); Varna (11) – ***Croatia***: Danilo (12); Pupicina cave (13) – ***France***: Camp-de-Laure (14); Causses plateau (15); Filitosa (16); Gazel cave (17); Le Crès (18); Les Oullas (19); Mont Bégo (20); Pendimoun (21); Saint-Véran (19); Terrina (22) – ***FYROM***: Anza/Anzabegovo (23); Tumba Madjari (24) – ***Greece***: Alepotrypa cave (25); Argissa (26); Dikili Tash (27); Dimini (28); Franchthi cave (29); Kephala (30); Knossos (31); Makri (32); Makriyalos (33); Melos (34); Nea Nikomedeia (35); Plateia Magoula Zarkou (36); Sesklo (28); Sidari (37); Sitagroi (27); Skoteini cave (38); Soufli Magoula (26); Theopetra cave (39); Zas cave (40) – ***Hungary***: Alsónyék (41); Berettyóújfalou (42); Bodrogkeresztúr (43); Csőszhalom (44); Ecsegfalva (42); Endrőd (45); Hódmezővásárhely (46); Kisköre (47); Lengyel (48); Szentgál (49); Szentgyörgyvölgy (50); Tiszapolgár-Basatanya (51); Zengővárkony (48) – ***Italy***: Acconia (52); Arene Candide (53); Botteghino (54); Defensola (55); Edera (56); Filiestru cave (57); Grotta della Monaca (58); Hauslabjoch/Ice Man (59); La Marmotta (60); Lagnano da Piede (61); Libiola (62); Lipari (63); Lugo di Romagna (64); Mirabello Eclano (65); Molino Casarotto (66); Monte Loreto (62); Monte Viso (67); Neto (68); Pantelleria (69); Passo di Corvo (70); Piano Vento (71); Pulo di Molfetta (72); Remedello (73); Sammardenchia (74); Stentinello (75); Su Coddu (76); Uzzo cave (77); Valcamonica (78); Valle d'Aosta (79); Valtellina (80) – ***Portugal***: Alcalar (81); Angerinha (82); Anta Grande do Zambujeiro (83); Antelas (84); Cabeço da Arruda (85); Escoural (83); Leceia (86); Mocissos (87); Olival da Pega (88); Vila Nova de São Pedro (85); Zambujal (89) – ***Romania***: Cernavodă (90); Gumelnița (91); Gura Baciului (92); Iclod (92); Parța (93); Pietrele (94); Schela Cladovei (95); Turdaș (96); Uivar (93) – ***Serbia***: Belovode (97); Blagotin (98); Divostin (99); Donja Branjevina (100); Gomolava (101); Grivac (102); Lepenski Vir (103); Padina (103); Rudna Glava (103); Selevac (104); Starčevo (105); Vinča (105); Vlasac (103) – ***Spain***: Almizaraque (106); Bóbila Madurell (107); Ca n'Isach (108); Casa Montero (109); Cerro de la Virgen (110); Cueva de les Cendres (111); Cueva de los Murciélagos (112); Cueva de Toro (113); Dombate (114); La Draga (115); La Pijotilla (116); La Vaquera (117); Los Millares (118); Mas D'Is (119); Pico Ramos (120); Terrera Ventura (118); Valencina de la Concepción (121).
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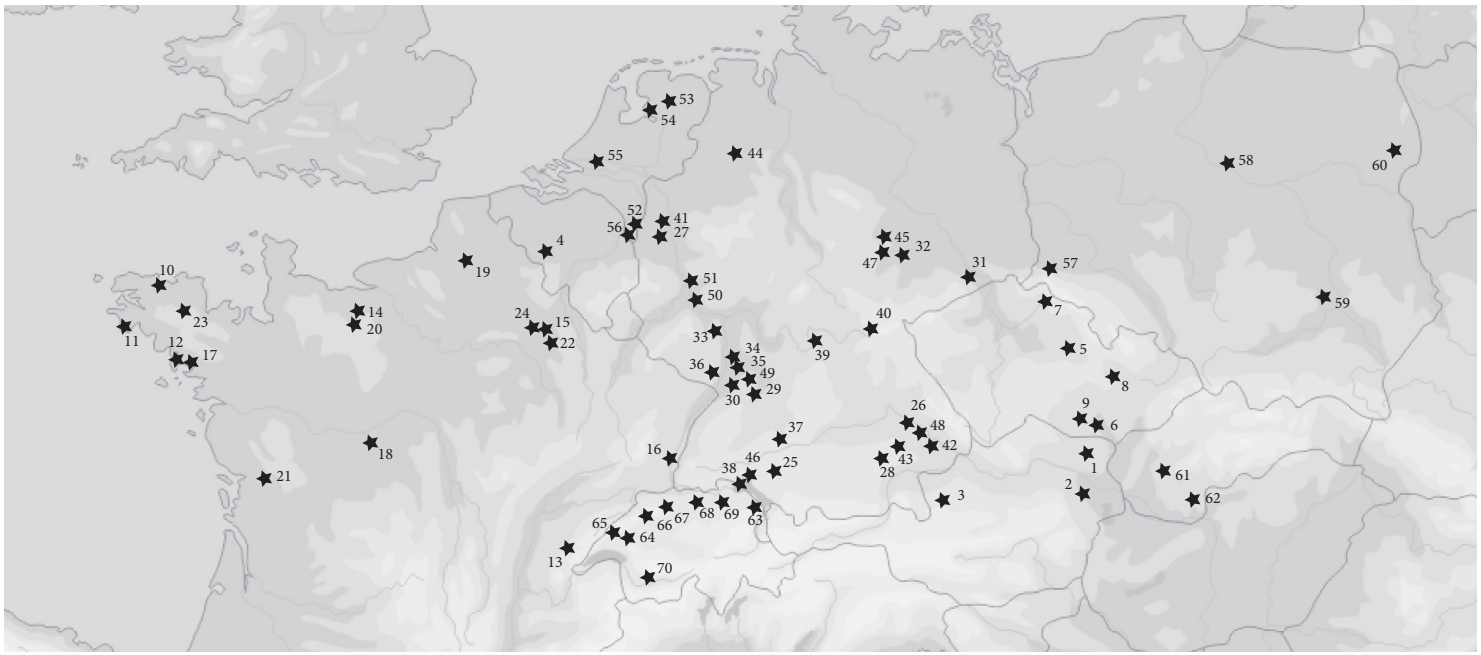
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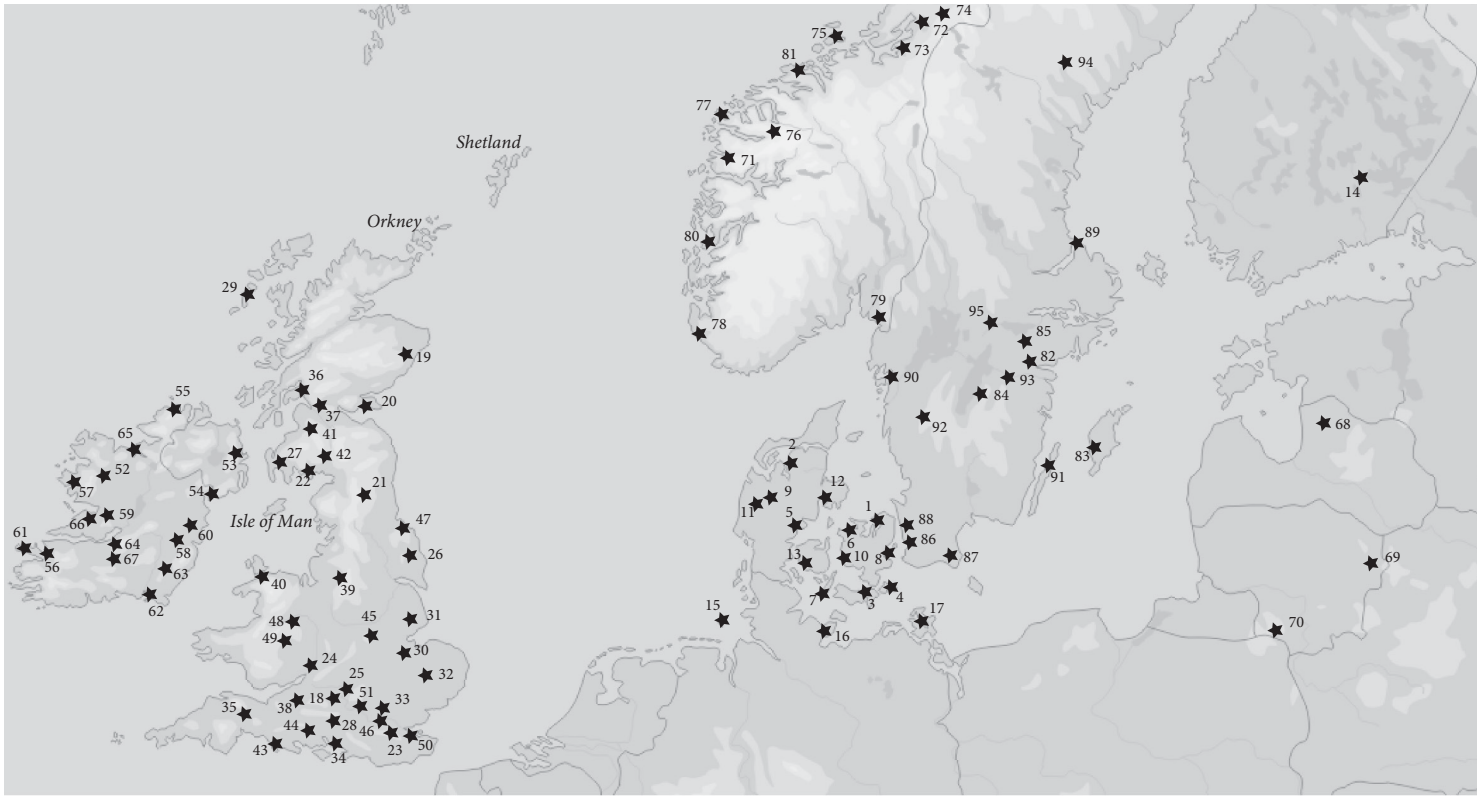
MAP 3 Selected sites in central Europe mentioned in the volume (alphabetically by country):
Austria: Asparn-Schletz (1); Brunn-Wolfholz (2); Friebritz (1); Mondsee (3) – ***Belgium***: Spiennes (4) – ***Czech Republic***: Bylany (5); Dolní Věstonice (6); Jistebsko (7); Miskovice (5); Těšetice (8); Vedrovice (9) – ***France***: Barnenez (10); Beg an Dorchenn (11); Carnac (12); Clairvaux (13); Chalain (13); Condé-sur-Ifs (14); Cuiry-lès-Chaudardes (15); Ensisheim (16); Gavrinis (17); Grand-Pressigny (18); La Chaussée-Tirancourt (19); La Hoguette (20); Locmariaquer (17); Menneville (15); Prissé-la-Charrière (21); Romigny/Lhéry (22); Sélédin (23); Table des Marchand (17); Tumulus de Saint-Michel (12); Villeneuve-Saint-Germain (24) – ***Germany***: Aichbühl (25); Aiterhofen (26); Aldenhovener Platte/Merzbach valley (27); Altheim (28); Bad Cannstatt (29); Bruchsal (30); Dresden-Prohlis (31); Dürrenberg (32); Federsee (25); Flomborn (33); Goseck (32); Heidelberg-Handschuhsheim (34); Heilbronn-Klingenberg (35); Herxheim (36); Hetzenberg (35); Hohlestein (37); Hornstaad (38); Ippesheim (39); Jülich (27); Jungfernhöhle (40); Kückhoven (41); Künzing-Unternberg (42); Meisternthal (43); Michelsberg-Untergrombach (30); Rheine (44); Rheindürkheim (33); Rheingewann (33); Rössen (32); Salzmünde (45); Sipplingen (46); Sondershausen (47); Stephansposching (48); Talheim (49); Trebur (50); Urmitz (51); Vaihingen (29); Wiederstedt (45); Wiesbaden-Erbenheim (50) – ***Netherlands***: Beek (52); Buinen (53); Eext (53); Elsloo (52); Emmeloord (54); Geleen (52); Molenaarsgraf (55); Rijckholt (56) – ***Poland***: Bozejewice (57); Brześć Kujawski (58); Krzemionki (59); Olszanica (60) – ***Slovakia***: Nitra (61); Svodín (62) – ***Switzerland***: Arbon-Bleiche (63); Arconciel (64); Auvernier (65); Bielersee (66); Breitenloo (63); Burgäschisee (67); Egolzwil (68); Lake Zürich (69); Marin (65); Sion (70).
Base map drawn by Jane Mathews and supplied by John Robb.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MAP 4 Selected sites in northern and north-west Europe mentioned in the volume (alphabetically by country):
Denmark: Bautahøj (1); Björnsholm (2); Bogø (3); Bornholm (4); Bygholm Nørremark (5); Dragsholm (6); Fakkemose (7); Hanstegård (8); Klokkehøj (9); Lindebjerg (10); Muldbjerg (11); Poskær Stenhus (12); Sarup (13) – ***Finland***: Astuvansalmi (14) – ***Germany***: Helgoland (15); Rosenhof (16); Rügen (17) – ***Great Britain***: Avebury (18); Balbridie (19); Balfarg (20); Briar Hill (21); Cairnholy (22); Coldrum (23); Crickley Hill (24); Dorchester-on-Thames (25); Duggleby Howe (26); Dunragit (27); Durrington Walls (28); Eilean Domhnuill (29); Etton (30); Giant's Hills (31); Grimes Graves (32); Haddenham (33); Hambledon Hill (34); Hazelton North (24); Hembury (35); Kilmartin Glen (36); Kilverstone (32); Knap Hill (18); Knappers (37); Knowlton (38); Lismore Fields (39); Llandegai (40); Lochhill (41); Lockerbie (42); Maumbury Rings (43); Monkton Up Wimborne (44); Rothley Lodge Park (45); Rudston (26); Runnymede Bridge (46); Slewcairn (22); Stonehenge (28); Street House (47); Sweet Track (38); Trelystan (48); Upper Ninepence (49); West Kennet (18); White Horse Stone (50); Windmill Hill (18); Yarnton (51) – ***Ireland***: Ballyglass (52); Ballyharry (53); Ballymacdermot (54); Carrowkeel (55); Cloghers (56); Connemara (57); Corbally (58); Corlea (59); Dowth (60); Ferriter's Cove (61); Kilgreany cave (62); Knowth (60); Linkardstown (63); Lough Gur (64); Magheraboy (65); Newgrange (60); Parknabinnia (66); Tankardstown (67) – ***Latvia***: Zvejnieki – ***Lithuania***: Kretuonas (69); Turlojiškė (70) – ***Norway***: Ausevik (71); Bardal (72); Evenhus (73); Hammer (74); Hitra (75); Hjelle (76); Leirfall (73); Mjeltehaugen (77); Ogna (78); Røkke (79); Stakaneset (80); Vevang (81); Vingen (77); Voll (78) – ***Sweden***: Åby (82); Ajvide (83); Alvastra (84); Bollbacken (85); Borgeby (86); Carlshögen (87); Dagstorp (88); Fräkenrönningen (89); Frälsegården (90); Kivik (87); Köpingsvik (91); Landbogården (92); Linköping (93); Malmö (86); Nämforsen (94); Piledal (87); Ramshög (87); Skumparberget (95); Turinge (93); Ystad (87).
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PART I

INTRODUCTION

CHAPTER 1

THE OXFORD HANDBOOK OF NEOLITHIC EUROPE

An Introduction

CHRIS FOWLER, JAN HARDING, AND DANIELA HOFMANN

Introduction

Studies of the European Neolithic have changed considerably and diversified significantly over the past 50 years. Forms of evidence have been brought into the fold through the expansion of types of archaeological fieldwork and scientific analyses, from rock art studies to the analysis of DNA and stable isotopes in human skeletal remains. Calibrated radiocarbon chronologies have had a major impact on understanding sequences of prehistoric activity. New perspectives have also been developed, with a shift in emphasis from geographically sweeping generalizations to more fine-grained and often regionally specific accounts. This has been accompanied by an interest in new themes for analysis, including exploration of Neolithic landscapes, cosmologies, bodies, and personhood. Yet for a long time there has been no single volume that combines all of these forms of evidence and perspectives in a comprehensive and detailed study of the European Neolithic from Iberia to Russia and from Norway to Malta. This volume attempts to remedy this by bringing together the research of leading experts from across Europe into a wide-ranging discursive resource suitable for undergraduates, postgraduates, and more experienced scholars of the Neolithic. Its chapters disseminate the results of recent research, but importantly also set out agendas and themes for future work. As such, the book combines up-to-date syntheses with current innovative thinking, to both inform and inspire the reader. It ends with three commentaries which stand back from the detail and develop key debates for Neolithic studies. Contributors come from different archaeological traditions and perspectives, working in different languages and through different media.

In inviting this range of contributors the editors sought to portray the strength and diversity of Neolithic archaeology across Europe, whilst providing the reader with as comprehensive and detailed a coverage as could be achieved within the confines of one book.

Defining the 'Neolithic in Europe'

The timescale and duration of the Neolithic vary greatly from region to region. We consider the period from *c.* 6500 BC, when a Neolithic lifestyle is identified in parts of Greece, to *c.* 2500 BC when it reached northernmost Europe (though some contributions mention later evidence). Given this broad chronological frame, the book also touches on many 'Mesolithic', 'Chalcolithic', or even 'Bronze Age' societies, and indeed, the way in which these communities co-existed and interacted with 'Neolithic' societies is at the heart of investigating process, change, invention, and adoption just as much as interactions within and between differing 'Neolithic' communities. There is considerable variation in how the Neolithic is chronologically subdivided, and there is a bewildering array of different schemata and cultural labels across the continent (Fig. 1.1), built up according to different criteria. This does not, however, preclude the existence of broad trends. For instance, a recurring theme for large parts of Europe is the distinction between the early Neolithic and late Neolithic (e.g. Müller, Chapter 3; Schier, Chapter 5; Malone, Chapter 9; cf. Hodder 2013). The importance of transformation throughout the period is such that we can even question the extent to which it is meaningful to talk of 'a Neolithic', or, for that matter, 'a Mesolithic' or 'a Chalcolithic' (see, e.g., Allen et al. 2012; Lichardus 1991; Pluciennik 2008).

Indeed, the meaning of the term 'Neolithic' is constantly debated, and consequently so are the criteria used to define the archaeological presence of Neolithic communities. The identification of agriculture is usually paramount, although this still varies between European regions, and in some places the presence of polished stone or pottery is taken to indicate a Neolithic community (e.g. Kunst 2010; Barker 2006, among many others). More radically, the Neolithic has also been defined as a way of thinking about and reorganizing the world (Hodder 1990; Thomas 2013), or even as nothing more than a range of material and symbolic media that could be adopted and transformed by communities through a creative process of identity generation (Thomas 1988). Robb (2013) has recently argued that the Neolithic was initially characterized by varied novel relations between people, things, animals, and places, and decisions taken with the short or medium term in mind, but that this diversity and flexibility increasingly led to a series of emerging and converging unintended consequences, resulting in a widespread long-term process of transformation that could not be undone. In two commentaries closing this volume, Thomas (Chapter 55) and Kristiansen (Chapter 56) interpret the Neolithic as a form of social organization predicated on distinctive relations with things, places, and animals,

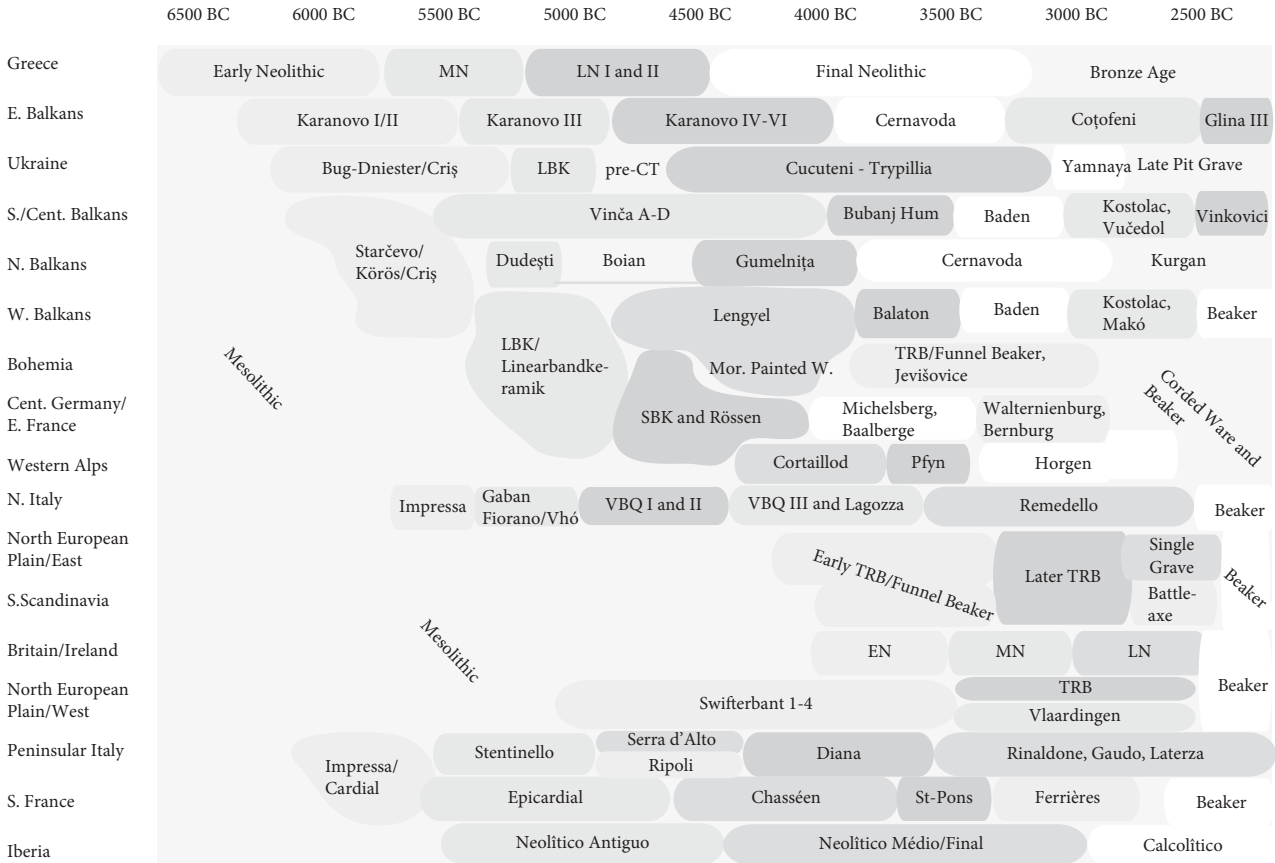

FIG. 1.1. Schematic representation of main archaeological cultures by key area. This is intended as a general guide only; not every grouping or geographical area could be covered, and details (especially regarding dates) are debated and constantly being revised. Spellings may also vary between regions and researchers. Abbreviations: EN = early Neolithic; MN = middle Neolithic; LN = late Neolithic; CT = Cucuteni-Tripillia; Mor. Painted W. = Moravian Painted Ware; TRB = Trichterbecherkultur (= Funnel Beaker culture). Information has been synthesized from the following sources: Bagolini 1992; Cipolloni Sampó 1992; Louwe Kooijmans 2007; Lüning 1996; Mottes et al. 2002; Strahm 1994; Whittle 1996. Advice on Iberia is courtesy of Ana Vale. Thanks also to John Chapman and Andrea Dolfini for critical comments.

competitive communities, and the control of wealth. As both Thomas and Kristiansen suggest, the simple presence or absence of certain material traits by themselves are not the right basis from which to identify communities as Neolithic or otherwise, but this does not mean period terms are redundant. Neolithic communities were diverse and varied, just as Mesolithic ones were, but we cannot escape the fact that almost everywhere in Europe and in most respects Neolithic communities became quite different from Mesolithic ones.

Underlying these various interpretations is the idea that the Neolithic was a way of life, a way of getting on in and with the world; what exactly this involved varied over time and across space, but that degree of variation was elastic to the extent that archaeologists still think it valuable to talk about some societies as Neolithic and others as Mesolithic or Bronze Age. It is particularly interesting that Thomas and Kristiansen emphasize that there is something distinctive about Neolithic communities, given that improvements in how chronologies are produced mean it is now possible that future generations of Neolithic scholars will be able to locate their studies in terms of specific centuries, or even decades (Whittle and Bayliss 2007; Whittle et al. 2011)—as has long been possible in the rare areas of Europe with exceptional dating evidence (Billamboz 2012). Dramatically improved chronological resolution may support discussion of certain centuries across a large area, encourage the consideration of more sophisticated models of coexistence between different kinds of society and stimulate further reflection on processes of change. The debate over whether or not we should term certain communities 'Neolithic', and what this means, will not end any time soon, but it should become more precise and refined in step with these improved chronological frameworks.

Much research into the European Neolithic has been completed within defined national boundaries and often according to national traditions and agendas, making comparisons between areas difficult. In addition, a region may show strong affinities with one area in one Neolithic phase, and with a different area in another. This makes creating and adhering to geographic limits complicated. Here it was decided that the geographical remit would be as comprehensive as possible. As a very general guide, four macro-regions are represented in most sections of the book: south-east Europe (broadly covering Greece and the Balkans up to Hungary and reaching as far east as Bulgaria), central and eastern Europe (from eastern France into eastern Russia), northern and western Europe (the Baltic, the North European Plain, the Atlantic façade of Portugal and France, and the British Isles), and the Mediterranean (including Italy, southern France, and Spain). Inevitably, coverage of some of these areas is stronger than others. There is a weakness in the coverage of eastern Europe, and more specifically Russia and the countries which achieved independence after the collapse of the Soviet Union. Similarly under-represented is interaction between the southern European fringe of the Mediterranean and northern Africa. The exploration of these eastern and southern 'extensions' to the European Neolithic offer an exciting agenda for future research which could not be exploited here. Our contributors, do, however, extensively investigate connections within Europe. As a result, landscapes and

regions often become collated into larger geographic entities, and frequent reference is made to 'northern' or 'north-western Europe', 'central Europe', and 'eastern Europe'. We did not predefine these, and so there is inevitably some variation in what is meant by each term. But the resulting freedom for contributors has enabled them to break free of traditional limits like national borders and create accounts which emphasize interaction and pan-European processes: indeed, authors were often encouraged to collaborate in order to provide expertise that crossed national boundaries and operated at the scale of the archaeological phenomena under investigation.

Scales of time and space: studying big issues from fragmentary and specific evidence

Dividing the book into thematic parts and constituent sections facilitates comparison across regions and between the chronological sub-divisions of the Neolithic. Arranging the material in this way has shown that in spite of our often tightly focused specialisms and differing traditions of research, Neolithic specialists from different regions grapple with many of the same problems. This is most evident when considering the archaeological evidence for *Mobility and interaction at the large scale*, with which this volume begins. Sections on the *Movement of plants, animals, ideas and people* and *Sequences of cultural interaction and cultural change* highlight the shared research agendas across Europe. In contrast to many of the important existing publications on the matter (e.g. Whittle and Cummings 2007; Gronenborn and Petrasch 2010, amongst many others), this section does not focus on the Mesolithic–Neolithic transition alone, but reflects on these factors throughout the Neolithic, their possible role in innovation and change, and whether different processes were responsible for dissemination over time and across space. As such, it provides broad overviews of the landscape and climate of the European landmass and the cultural development in each of the four main regions. These accounts of macro-process are preceded by an initial discussion of the physical and environmental opportunities and constraints found across Europe (Brown et al., Chapter 2), and a contribution (Shennan, Chapter 7) on relationships between the movements of languages, genes, practices, and people. Chapters in this section remind us of different, locally varied rates of change that mesh with or gel into large-scale trends and long-term processes. For instance, Brown et al. report that fluctuations in climate may relate to shifting subsistence practices in some cases, but seemingly not to widespread changes in material culture. Longer-term patterns can also be set alongside the impact of single events and relatively sudden changes, such as the long-distance diffusion of new products, practices, and people from the outset of and during the Neolithic (cf. Rowley-Conwy 2011; Tresset, Chapter 6). Indeed, such events and larger processes of change are arguably inseparable (see also Bolender 2010).

The section on *Sequences of cultural interaction and cultural change* complements many of these themes by exploring in greater detail the issues of cultural interaction, stability, and transformation. The transition in European Russia and parts of the Baltic was long and drawn out. Here ceramics were used for centuries by those practising hunting, gathering, and fishing, and persisted as agricultural practices spread in the region. These northern ceramic traditions developed independently from those of south-east and central Europe, where the initial spread of the Neolithic was more rapid. Even when ceramics derived from central European farming traditions appeared in parts of southern Scandinavia they were not always used for agricultural products: analysis of lipids and charred remains in early Neolithic TRB (Funnel Beaker) vessels from Denmark reveal dairy products for some vessels and freshwater fish for others, for instance (Craig et al. 2011). In central and south-east Europe dramatic but patchy expansion over a large area was often followed by processes of geographical infilling and a variety of other locally varied processes such as increasing levels of sedentism, settlement nucleation, and/or cultural fragmentation (Chapman, Chapter 8). When new areas were again settled, this was often accompanied by a marked change in material culture and practices. Thus when a broadly Balkan-style Neolithic spread into central Europe, complex tell settlement and elaborate clay artefacts (pottery, figurines) gave way and a central-European-style Neolithic dominated by longhouses developed (Gronenborn and Dolukhanov, Chapter 10; cf. Last, Chapter 14; Coudart, Chapter 16). Equally, the subsequent and more divergent trajectories across north-western Europe developed their own character, often drawing on distinctive features of landscapes, environments, climates—and even indigenous communities—in that region (Thorpe, Chapter 11; cf. Brophy, Chapter 17, Larsson, Chapter 18). This section also outlines patterns of cultural change beyond Neolithic beginnings, particularly the widespread social changes of the late Neolithic or Copper Age. During this period there was, for example, significant regionalization in all aspects of cultural identity with often staggering levels of material diversity, whilst at the same time far-flung regions became connected in new ways as new sets of material became desirable.

Chapters in both sections bring home the significance of environmental factors and demography, for too long either presented as 'deterministic' or shunned because of that perception by many accounts of the past 40 years (see, e.g., Gronenborn 2005; Bocquet-Appel 2009; Vander Linden 2011). These issues require reappraisal in our accounts of Neolithization and subsequent developments. As a number of contributors demonstrate, to continue to ignore them is to deny that early farming societies were susceptible to climatic fluctuations, the productivity of their crops and herds, and the ebb and flow of population numbers. This is forcefully expressed by Dolukhanov and Gronenborn (Chapter 10), who emphasize the significance of crises, directly or indirectly relating to major climatic events, in shaping the course of the Neolithic of central and eastern Europe. Yet even areas such as the Alpine lakes, where changes in climate could have marked impacts, were not settled or abandoned exclusively in response to environmental parameters (Menotti, Chapter 15), and the most satisfying explanations invoke multiple causes for social transformations (e.g. Guilaine, Chapter 4, Malone,

Chapter 9). Thus, contributors emphasize the importance of exploring the varied reactions of different communities to environmental events. Brown et al. (Chapter 2) outline how regionally differentiated, locally mediated, changing human–environment relations have an important part to play in our accounts, whilst Shennan (Chapter 7) stresses the potential of supplementing our meta-narratives of the Neolithic with local demographic histories. Müller (Chapter 3) goes one step further by modelling demographic developments and land use patterns around the tell of Okolište in Bosnia. These are offered as starting points for interpretation: it is essential to ask how different communities (consisting not just of human beings, but animals, plants, buildings, and artefacts—even materials and supernatural entities; see below) reacted to changes in environmental affordances, and how, in turn, their actions shaped their surroundings and altered their environments.

These sections of the volume also highlight how interpretations differ across Europe. One of the most apparent schisms in debate concerns the processes behind the spread of the Neolithic, and most notably the roles played by 'indigenous' communities and 'migrating' farmers. All the chapters in these initial sections deal with this to varying degrees. Especially in Britain, migration was rejected by large parts of the research community from the 1980s until recently, partly because the focus had shifted to regional and local analyses, partly because migration as the large-scale movement of people from one area to another was understood in simplistic terms, and partly because it was associated with culture-historical and processual approaches. In common with certain areas of northern Europe and the Baltic (Dolukhanov and Gronenborn, Chapter 10), the origins of the British Neolithic were seen in the adoption of farming by native hunters and gatherers. Some of these ideas were also applied to continental Europe (e.g. Whittle 1996; Kind 1998; cf. Scharl 2004), where they now have to contend with mounting evidence for large-scale migration, at least in the case of the early Neolithic of central Europe (Brandt et al. 2013). Migration has even made a much-needed, if occasionally polemical, comeback for Britain and other parts of north-western Europe (e.g., Sheridan 2010, *inter alia*; Rowley-Conwy 2011), supported by recent scientific advances which demonstrate that most domesticated animal and plant species were introduced from elsewhere (Tresset, Chapter 6), most likely by migrants. Elsewhere, migration was never so wholeheartedly rejected, and its relevance to the Neolithization of south-eastern, central, and Mediterranean Europe is explored in this volume (Guilaine, Chapter 4; Müller, Chapter 3; Schier, Chapter 5; Malone, Chapter 9), with considerable emphasis on the relative role of newcomers and indigenes. Researchers now see this as a complex process with differing kinds of constituent events, and are considering exactly when and how different overlapping processes of change occurred, as well as focusing on the historical events by which new media first appeared in any region (e.g. Garrow and Sturt 2011; Gronenborn and Petrasch 2010; Whittle et al. 2011). Monolithic and mono-causal explanations are giving way to nuanced local narratives in which specific episodes of activity are enmeshed with unfolding and cumulative processes of change at a wider scale.

The next step is to identify different scales and kinds of migration and other mechanisms of diffusion, from inter-marriage over several generations to, say, the movement

of entire communities in one season. Processes of 'internal colonization'—in which environments close to currently occupied ones, but different in character (such as wetlands or higher altitudes), are settled—can coincide with new material culture boundaries expressed as a proliferation of regional cultural groupings, for instance in the case of the later Neolithic of central Europe. These are interspersed with periods in which certain aspects of material culture—and perhaps identities—are shared over wide areas, and occasionally connected with an expansion event, for instance in the case of the third-millennium Yamnaya culture (Schier, Chapter 5). At other times, for instance with the Bell Beaker phenomenon (Vander Linden, Chapter 31) or Corded Ware groups (Schier, Chapter 5), migration may have involved few people but wide geographical areas and a substantial cultural impact, often in spheres of activity particularly visible to archaeologists, such as metalwork, pottery, and burial practice. In either case, neither migration nor adoption should be seen as easy answers: they are the beginnings of interpretation rather than its end point, with their scale, reasons, modalities, and local impacts still to be determined. The dynamics between migration, individual mobility, colonization, and cultural trajectories are hence once again among the more exciting research questions to pose.

As contributors to this first section make clear, essential to such a debate is the importance of unpacking 'Neolithization' as complex and multi-stage across any one region. More specifically, it is evident that the 'Wave of Advance' model, and the following period of stability amongst agricultural communities, is a misleading oversimplification, as demonstrated by Müller (Chapter 3) and Guilaine (Chapter 4), who envisage a sequence of rapid expansion, stagnation, and renewed expansion following a period of cultural change for the arrival of the Neolithic in the Balkans and Mediterranean respectively. Similarly, Schier (Chapter 5) sees alternate episodes of very fast spread and stagnation across central and eastern Europe. In this way, the Neolithic unfolded in varied ways, with the consequence that demography, environment, and various socio-cultural factors will have been of varied significance in different scenarios.

Further work is still needed on how and why Neolithic practices and products spread, as well as on why they did not at other times, and new approaches are now emerging. For instance, the idea that Neolithic goods were 'prestigious' to neighbouring Mesolithic communities has long been popular. It may be that some forager or fisher communities were attracted to exchange with farming communities for various reasons, even travelling long distances for this purpose (Thomas 2013, chapter 8). Yet, as (Rowley-Conwy 2014; Layton and Rowley-Conwy 2013) has pointed out, the understanding of Neolithic goods as prestigious to others relies on analogies with seventeenth to twentieth-century AD colonial contact with its material asymmetries that do not fit the slighter differences between European Neolithic and Mesolithic communities. For instance, interactions between Ertebølle and Linearbandkeramik (LBK) or Rössen communities during the millennium or more when they co-existed have been rethought recently (Layton and Rowley-Conwy 2013; Bogucki 2008; Gronenborn 2009, 2010). LBK and Rössen Neolithic communities acquired, adopted, or copied more elements of Mesolithic material culture than has been conventionally realized, including

T-shaped antler axeheads, bone chisels, decorated bone ornaments, bows and arrows, microlithic tools, and in one case even a pointed-base pot. Whilst Neolithic communities may have treated some of these objects as prestigious (e.g. placing antler axeheads or decorated bone ornaments in burials at Brześć Kujawski—Bogucki 2008, 55–58), there is less evidence that Mesolithic communities understood Neolithic artefacts in this way, putting Danubian shafthole axes to the same uses as traditional local designs (Rowley-Conwy, 2014) and showing little interest in LBK or Rössen ceramics, whilst adopting pottery derived from hunter-fisher-gatherers to the north-east around 4600 BC. By and large these Mesolithic communities did not readily adopt agriculture, nor seemingly treat the artefacts of Neolithic communities as special, forcing us to question the seductive idea that a desire for prestigious goods was the thin end of a wedge that led to the adoption of agriculture.

A further area of contention lies in how archaeologists identify prehistoric communities from material remains. The concept of archaeological cultures has been central to classifying the diversity of material culture and architecture, ways of living with and subsisting on plants and animals, ways of treating the dead, and so on, since the early twentieth century—and continues to be seen as significant in many parts of central, southern, and eastern Europe, as shown by many contributions to this volume. Elsewhere, the concept has been widely dismissed or at least strongly critiqued (e.g. Winter 2009; Gramsch and Sommer 2011). The emerging consensus is that simplistic and universalizing equations of 'archaeological culture' with ethnic group are inappropriate, but that the coherence of some archaeological traits and assemblages nonetheless demands explanation—as does any strong coincidence of genetic markers with such archaeological cultures. Ethnicity is complex, and ideas about group identity may be framed in varying ways. In some cases, European Neolithic communities may have identified themselves with reference to biological, social, and/or mythic forms of ancestry. Generating traditions of artefacts and buildings that replicated ancestral things and structures might have been another important factor alongside or alternative to these forms of ancestry and identity. Group or ethnic identities might be more important at some times than others, more or less fluid, more or less shared and expansive, subject to sudden or gradual change—contextual analyses are needed to resolve these issues in each case.

Interpretations of cultures or societies are intimately connected with how we understand the constitution of past communities. People sharing material culture traits would not necessarily see themselves as forming a distinct community, and we must consider carefully how the production, use, circulation, and transmission of objects and practices can bring about various identities. In addition, traditional archaeological understandings of 'culture', 'society', and 'community' have been questioned, and the point made that such entities are composed of animals, plants, places, substances, and things, as well as human beings (e.g. Fowler 2004, 95; Harris 2014; Webmoor 2007). Hence, there is opportunity for revitalizing the study of the distributions of specific media, practices, and people, and the concept of 'archaeological cultures' may be a useful way to explore the emergence, effect, spread, mutation, and dissipation of inter-related and changing traditions of practice (cf. Robb 2008). For instance, Müller

(Chapter 3) illustrates how economic, social, and ritual spheres reacted quite differently during the late Neolithic of different areas, implying there was not 'one' social or cultural trajectory across south-east Europe, but a mosaic of development in which it is hard to draw clear boundaries. Equally significant here are the relations between different sections of society, such as the young or old, male or female, and those born into versus those marrying into a community. 'Society' is often tacitly envisaged as unitary and pulling in the same direction, yet this is merely an assumption, and multiple interwoven societies—some denser than others, some larger-scale than others, some more rigid than others—based on various categories of identity and kinds of practices may have co-existed without forming a singular coherent whole. Social differences developed during the Neolithic, as is perhaps best illustrated in the late Neolithic or Copper Age, when there is an increasing emphasis on strictly demarcating gender in burial rites throughout the Balkans (Borić, Chapter 49), in the Corded Ware and Bell Beaker horizons (Schier, Chapter 5; Vander Linden, Chapter 31), and in some Mediterranean traditions (Robb, Chapter 50); but the ways in which this was manifested and the degree to which it related to daily routines and differences in autonomy or efficacy in inter-personal relations may have varied. Social differentiation was probably widespread during the Neolithic, but it took many different forms and rarely coalesced into a single hierarchical arrangement.

Neolithic Worlds, Neolithic Lives (and Deaths)

One intention of the present volume was to grasp the breadth and diversity of evidence and interpretation by inviting as wide a range of scholars as possible to comment on major types of archaeological evidence for Neolithic daily life and worldviews. There are sections on *Houses, habitation, and community; Subsistence and social routine; Materiality and social relations; Monuments, rock art, and cosmology*; and *Death, bodies, and persons*. The aim of each is to demonstrate the spatial and chronological variability of the evidence and to explore its implications.

This part begins with a consideration of domestic space in *Houses, habitation, and community*. Sedentism, or settling down, has long been regarded as a defining feature of an agricultural way of life, although the two aspects did not necessarily always emerge together (Guilaine, Chapter 4; Papaconstantinou, Chapter 13). Both between and within regions, there was great diversity in the extent to which permanent, long-lived buildings or settlements were created. Long-running research traditions in many areas have amassed a wealth of data on domestic architecture, which suggest that Neolithic people regularly chose to live in larger, more permanent settlement agglomerations than ever before, their individual dwellings often impressive buildings. Elsewhere the evidence can often be less rich, reflecting the ephemeral nature of architecture as well as possibly

more mobile inhabitation strategies, perhaps with a greater role for herding. This has long been argued for the Neolithic sequence in much of Britain (Brophy, Chapter 17), the beginning of the Neolithic in Spain (Papaconstantinou, Chapter 13), and in later phases of the Neolithic for parts of southern Scandinavia (Larsson, Chapter 18) and the Balkans (Raczky, Chapter 12). This distinction between house-rich and house-poor areas and phases is intriguing and remains a key focus of research (e.g. Hofmann and Smyth 2013). We still need to explain why houses (Last, Chapter 14; Coudart, Chapter 16) and even settlements (e.g. in south-eastern Europe: Raczky, Chapter 12) were sometimes monumental but at other times slighter and less elaborate—and the extent to which these changes relate to other spheres of life, such as the creation and use of enclosures or other monuments, subsistence routines, or burial.

Houses were not only architecturally varied, but may have also been built for different reasons. In Britain (Brophy, Chapter 17; Garrow, Chapter 38), the relative paucity of houses has often been cited in support of the uptake of the Neolithic by indigenous foragers, who remained more mobile. Substantial houses were perhaps too quickly labelled as having only ritual, ceremonial, or symbolic functions, such as the 'halls' current for a short period during the beginning of the Neolithic in southern Scotland (Thomas 1996). Restricting interpretation in this way risks under-appreciating diversity in Neolithic ways of life and inhabitation. Furthermore, dwellings may have left little or no subsoil traces, even if communities occupied the same locale for decades or repeatedly returned to the same place for generations. Both Brophy and Garrow paint a picture of diversity, from the 'broad spectrum exploitation' of wild and domestic foodstuffs evident in East Anglian pits to the caches of burnt cereals at Scottish timber halls. There was significant variability in occupation sites in the British Neolithic and in the scale and nature of mobility, and regional and chronological patterns are coming into ever-sharper focus.

Even where substantial houses were common in Neolithic Europe, individual structures could be relatively impermanent, being replaced once a generation in the LBK of central Europe (Last, Chapter 14) and on tells (Raczky, Chapter 12), and even more frequently in the Alpine foreland (Menotti, Chapter 15). Contributions in this section draw out the differing temporalities of house biographies alongside the longer-term patterns of change and continuity. The social and symbolic importance of the house (e.g. Papaconstantinou, Chapter 13; Last, Chapter 14) remains crucial in understanding both these recurrent rhythms and architectural transformations in the longer term. Coudart (Chapter 16) addresses this through the relationship between idealized 'mental representations' of houses and the relative speed with which the constituent elements of central European architecture changed, and her discussion grapples with the tension between architectural standardization and variation. These could well be related to variations in household composition and routine practice, themes explicitly addressed by Last (Chapter 14) and Menotti (Chapter 15). Yet even in contexts with exceptional preservation, such as the Alpine lake villages, these factors remain difficult to trace. Overall, much more remains to be written about the social implications of different styles of

architecture and how they assisted in creating or maintaining certain kinds of communities and lifestyles.

Routines, whether associated with domestic spaces or out in the landscape, remain central for social reproduction and change, as discussed in *Subsistence and social routine*. The requirements and tasks associated with plants and animals were central to Neolithic life and took up the bulk of people's time. Although the Neolithic has been defined on the basis of the introduction of and reliance on domestic animals and crops, the extent to which this holds true is chronologically and regionally varied. 'Agriculture' could have been practised in many varied ways alongside other subsistence activities and as part of differing daily, seasonal, and annual routines, a point recently stressed in relation to the importance of garden-type cultivation in Neolithic societies (e.g. Jones 2005). Drawing on stable isotope analyses as well as more traditional forms of evidence, Schulting (Chapter 19) challenges the view that there was a gradual transition to a Neolithic lifestyle, as has long been argued for in north-west Europe, but points out that hunting, gathering, and fishing continued or made a resurgence during the Neolithic in some areas, such as the Netherlands and parts of Scandinavia (cf. Brown et al., Chapter 2). Bogaard and Halstead (Chapter 20) argue that we have spent too much energy focusing on the Mesolithic–Neolithic transition and on drawing up facile oppositions between hunting/gathering and farming/herding lifestyles. They explore the rich detail provided by faunal and palaeobotanical evidence in particular, identifying differential regional roles for activities such as gardening, hunting, and tending domesticated animals. In south-east and Mediterranean Europe, the transition to an intensive agricultural system was rapid and subsistence strategies were, at least initially, less varied than those related to social reproduction or settlement. This was also the case either side of a long-lasting chronological hiatus in the expansion of farming across western and northern Europe (Rowley-Conwy and Legge, Chapter 22). Bartosiewicz and Lillie (Chapter 21) contrast eastern central Europe, which exhibits greater coherence in spite of some regional variation, and the much more diverse, gradual, and piecemeal adoption of farming in the Baltic and Ukraine.

These varying rates of adoption were not only due to environmental and climatic differences, but were also intimately connected to new socialities, social identities, and worldviews. These too would have affected daily routine. Taking a phenomenological perspective, Mlekuž (Chapter 23) connects the often repetitive rhythms of the seasonal round to the formation of identities by interlinking the biographies of people, gardens, and houses in south-eastern Europe. He also stresses the importance of harvests and festivals as potentially subversive episodes during an otherwise harmonious flow of interconnected activities (potentially also ritualized) throughout the year. Equally important points about the social and symbolic dimensions of human–animal relations are discussed later in the volume by Marciniak and Pollard (Chapter 39). Through feasting, their role in myths, or as wealth 'on-the-hoof' which needs to be cared for, animals were clearly critical factors in the biographies, identities, and routines of Neolithic people. Daily life was also punctuated by other concerns. Religious routine and pilgrimage is explored by Loveday for Britain (Chapter 24), where these concepts have a particularly

long research pedigree associated with the study of earthen, wood, and stone monuments. Loveday associates specific beliefs and practices with particular monuments which were only built in certain landscapes in some periods of the Neolithic. His suggestion that pilgrimage was a key mechanism for the spread and distribution of certain types of monuments and practices once again brings connectivity across parts of the British Isles and continental Europe to the fore: all the more so if we place this contribution alongside the discussion of causewayed enclosures across northern Europe by Andersen (Chapter 42), or the evidence for related traditions of megalithic and non-megalithic chambered tombs discussed by Cummings et al. (Chapter 43).

New subsistence practices, social identities, and worldviews also meant new objects. The rejection of 'archaeological cultures' in some parts of Europe during the 1970s to 1990s arguably led to a neglect of the interpretive potential inherent in the close stylistic study of a variety of artefact types. Detailed appreciations of typologies of objects and architecture are crucial to exploring change: object 'types' are not merely archaeological descriptions but outline the key relationships constituting those things. Changes in artefact types do not only occur at period boundaries, although they may be more pronounced at such times, but repeatedly and unevenly through periods. This theme, whilst taken up by earlier chapters, is the focus of the section entitled *Materiality and social relations*. Artefacts have often been used to define the onset of new periods—most notably pottery and polished stone tools for the Neolithic, and the first metal objects for the Copper Age. Yet chapters in this section transcend the formal description of such objects, focusing also on the complex relations and meanings with which their making, use, and deposition was imbued. This can take the form of biographical approaches which broadly link the life courses of things and people (e.g. chapters by Cooney, Pechtl, Chapman and Gaydarska, and Axelsson et al.). Comparing artefact biographies can draw out diversity in the use of superficially similar types of artefact. Flint daggers, for example, were seemingly prestige goods in some areas, but used for routine plant processing in others (De Grooth, Chapter 25). This cautions against a too simplistic identification of 'high-status' goods which have the same significance in all the regions in which they appear.

These complexities are traced by focusing on three sets of material—lithics, pottery, and a variety of 'exotic' items. Whilst lithics are employed in routine, everyday tasks, contributors here also stress their importance to the creation of social identities and their symbolic implications. The sourcing of materials is especially significant in this regard, be this through the technologically demanding mining of high-quality flint (Capote and Díaz-del-Rio, Chapter 26) or the careful selection of sources for stone axes (Cooney, Chapter 27). It may also be useful to think about different spheres of use and exchange, some more routine than others. Various artefacts, some the products of part-time specialists (De Grooth, Chapter 25), could circulate within and across these spheres in the course of their biographies, occasionally punctuated by rather formalized acts of deposition (e.g. Cooney, Chapter 27). We can also consider places of production as 'special', or even as monumental, as in the case of the flint mines (Capote and Díaz-del-Rio, Chapter 26), and such locations may have been connected with

ancestral powers (Cooney, Chapter 27). Again, the movement of some axeheads, such as those of Alpine jadeite, across enormous distances underlines the degree of interconnectedness and mobility that was a key feature of Neolithic Europe (Pétrequin et al. 2012).

Whilst clay artefacts generally moved less far, the chains of activities connecting people and materials in the production of pottery were as significant as for stone tools. Pechtl (Chapter 29) and Petersen and Müller (Chapter 30) provide insights about the tasks associated with procuring and transforming materials during the production of pottery, the participants involved, the spread of potting techniques, styles, and decorative motifs, and the implications for understanding social dynamics. It is also apparent that variations in size, shape, and decoration yield important information about the affordances and effects of vessels, particularly when combined with contextual information about deposition and analyses of fabric composition and food residues. Pechtl explores the implications of conservatism and innovation in ceramic design for understanding cultural identity among LBK communities, whilst Petersen and Müller discuss the use of ceramic vessels in both domestic and monumental contexts in northern Europe. Both contributions stress the restricted range of vessel forms present at the outset of the Neolithic in each region.

Despite the importance of fabric analyses, the sourcing of raw materials for pottery conventionally plays a secondary role compared to the shape and surface decoration of the finished piece. Traditional culture history has (sometimes unfairly) been criticized as equating these stylistic aspects with prehistoric 'peoples', a theme taken up in detail and with the use of new biomolecular techniques by Budja (Chapter 28), who investigates the relationship between pottery and population flows across south-east Europe. Similarly, Vander Linden's (Chapter 31) discussion of Bell Beakers combines the archipelagic nature and local diversity of this phenomenon with the evidence for considerable individual mobility. Interestingly, in spite of some discussion about the use of differently-sized vessels for different social occasions (Pechtl, Chapter 29), there is still a division between studies of pottery, where routine practices and production processes have proven very fruitful avenues for research, and items such as figurines and miniatures, particularly frequent in south-east Europe (Nanoglou, Chapter 32) and traditionally discussed with reference to a 'ritual' sphere. Where available, figurines—through their degree of standardization, hybrid nature, use, and deposition—can provide productive avenues for the discussion of personhood and identity, but they need to be more consistently related to other aspects of Neolithic life to reveal their full interpretive potential. We still need to understand why these miniatures were a central and long-lived part of Neolithic life in some regions but rare or absent in many others; and their connections with routine activities and the everyday links between bodies and materials is an under-explored avenue in this context. Perhaps this could also shed light on the contrast between areas exhibiting representational art in enduring media like stone and those where representation was largely either avoided or reserved for ephemeral media (see Chapters 44–46 and Fowler and Scarre, Chapter 53; cf. Robin 2012).

The last set of chapters in this section is concerned with durable artefacts which were distributed over long distances—in some cases thousands of kilometres. Perhaps the best-known example is the Mediterranean *Spondylus* shell, exchanged across central Europe and as far west as the English Channel. As Chapman and Gaydarska (Chapter 33) show, its use in different regions was bound up within changing local discourses of prestige and the exotic, providing yet another example of the way in which widely shared materials were enmeshed in a myriad of local concerns. In contrast to *Spondylus* shell, Baltic amber was collected and worn from Mesolithic times, but saw fundamental changes in manufacture and distribution in the Neolithic, with the quantities of amber deposited varying widely over time and space (Axelsson et al., Chapter 34). Like *Spondylus*, the restricted littoral distribution of amber made it a rare, exotic material inland, but its value, significance, and use changed through time and varied between regions.

The relationship between metal manufacture, specialization of production, and social differentiation is taken up in the contributions by Heyd and Walker, Bartelheim and Pearce, and Roberts and Frieman (Chapters 35–37). The earliest objects have long been regarded more or less exclusively as indicators of wealth and identity, but these contributions highlight the complex and varied relationships instrumental to the emergence and spread of early metallurgy. Heyd and Walker explore the geographical ebb and flow of metal supply and metallurgical activity across central and south-eastern Europe, emphasizing variations in the availability, value, and impact of early metal objects whilst stressing the complex chains of relations needed to produce these artefacts. Connections with other areas like the central and western Mediterranean were established and enhanced through trade in copper, but these were unstable. Bartelheim and Pearce consider how copper may not always have been regarded as valuable in the earliest period of its use across the western Mediterranean, and may have been available in greater amounts than previously thought, whilst Roberts and Frieman illustrate that whilst metal objects were often 'eye-catching' ornaments, they did not directly cause social transformation, nor in themselves consolidate any existing social differentiation in northern and western Europe. All these contributors highlight how much is still to be done in better understanding the relationship between the circulation and deposition of various categories of object. Taken together, they invoke a Neolithic world populated with a plethora of colourful and diverse things with a range of uses, properties, and effects, of which but a fraction of the most durable have survived.

As with all sections of the volume, the chapters in *Monuments, rock art, and cosmology* are necessarily selective given the enormous variety in Neolithic monumentality across Europe: the megalithic monuments of the Mediterranean, and from northern Europe cursus monuments, stone alignments and henges are the most notable omissions. Nevertheless, a wide range of site types are represented. The contributors concerned with enclosures (Petrasch, Chapter 40; Skeates, Chapter 41; Andersen, Chapter 42) highlight the diversity in their shape, size, and use, which precludes a single function for such sites. Certain divisions are possible, for instance between continuous enclosures surrounding settlements, as in earlier fifth millennium Italy (Skeates, Chapter 41), or fourth millennium causewayed enclosures in northern and western Europe

(Andersen, Chapter 42), which often form the focus for deliberate deposits of human remains and artefacts. Enclosures of both types exist in central Europe, where Petrasch (Chapter 40) draws out how fifth millennium roundel enclosures were oriented towards celestial events and along cardinal points, providing an *axis mundi*. In common with Hoskin's (Chapter 48) interpretation of passage graves across Europe, this suggests that celestial and particularly solar phenomena were a significant element to religious worship and practice across large areas.

The question of whether such monuments were 'central places', crucial in the creation of power relationships and of community identities, also applies to other kinds of site, such as the chambered cairns discussed by Cummings et al. (Chapter 43). Their wide-ranging geographical coverage, extending from Iberia to Britain and southern Scandinavia, enables the authors to draw out regional patterns alongside broad cosmologies. Building chambered tombs changed the nature of place and drew together materials from different locales and sources in producing new architectural effects. Indeed, a review of the chapters in this section, and related recent work (e.g. Cummings 2012; Noble 2006; Scarre 2011), suggests that the earliest Neolithic monuments in northern Europe were subtle translations of local places, integrated within cosmologies that may have identified specific places (and rocks and trees) as special. Subsequently, in each region of north-western Europe, monuments increasingly also exhibited a concern with celestial bodies, and arguably with the cosmos at a grand scale. Such monuments created new social relationships, but also became vital media through which people made sense of their world—from the changing tides (and sea levels) to flowing rivers and streams, from gradually opening vistas to the passages of the celestial bodies—and their place in it. As a result, they became places of renown that drew in pilgrims from afar, as suggested by Loveday (Chapter 24).

The importance of natural places and phenomena in the cosmology of Neolithic peoples is also illustrated by the contributions on rock art. One key research problem is the relationship between figurative and abstract rock art motifs, particularly in Iberia (Fairén-Jiménez, Chapter 44), the Alps (Fossati, Chapter 45), or Scandinavia (Cochrane et al., Chapter 46). In Britain, rock art is exclusively abstract, and the glimpses of figuration in media such as carved chalk are predominantly of body parts rather than complete bodies (Fowler and Scarre, Chapter 53). As Cochrane et al. argue, the presence or absence of figuration may well indicate different prehistoric meanings and effects, and has arguably also caused some divergence in methodological approaches: the symbolic meaning of images is often stressed in areas with representational art, whilst the performative effects of engravings are brought to the fore where these are abstract. Rock art is also one of the ways in which the landscape is textured, and there are striking differences between, for instance, Britain, where smaller panels of art are often situated along routeways, and areas such as Valcamonica (Fossati, Chapter 45), which may have been centres for large gatherings revolving around the repeated production of rock art and stelae. As Fairén-Jiménez notes, open-air rock art in Iberia was densest and most complex at 'natural corridors' through the uplands. Skeates (Chapter 47), discussing the natural caves and artificial hypogea of the Mediterranean, underscores the variety of

practices at these sites. His chapter also invites us to reconsider whether the distinction between 'natural' and artificially created spaces was important for their Neolithic users—much as in the case of monuments elsewhere in Europe, the merging of different kinds of site into a meshwork of powerful places and landscapes may be the more appropriate line of investigation.

Contributors to the final section on *Death, bodies, and persons* explore human bodies and personhood through mortuary evidence and bodily representations. As the authors are at pains to stress, these media can only provide a partial perspective, and need to be contextualized alongside the evidence for daily routines, the use of artefacts, and the inhabitation of space. As well as outlining both general trends and local diversity, most chapters in this section stress that archaeologically visible funerary rites are not representative of the whole population, and that a degree of selection must have taken place. The bases for such selection are seldom easily discernible, though factors may include age and/or sex, and in some cases these may reiterate or chime with older, Mesolithic, values (Borić, Chapter 49). Funerary rites may achieve many varied things, including idealized representations of identities or the material composition and connectedness of the community or individual—as explored in Borić's account of burial in south-eastern Europe. Robb (Chapter 50) considers the importance of both local practices and their relation to broader episodes of change, exploring the importance of interaction at the larger scale. Thus, he analyses the impact of a convergence of new mortuary practices and anthropomorphic decorated stelae during the third millennium, with neither sphere evidently intended to record individual biographies. Within such general trends, the standardization of burial varies widely across regions and periods, and the interpretation of such patterns remains a significant challenge.

In their contribution, Hofmann and Orschiedt (Chapter 51) draw particular attention to the changing significance of disarticulation in the central European sequence. Often marginalized as 'deviant' in previous accounts of the early Neolithic, the fragmentation of corpses at this time actually seems connected to shared ideas of personhood, whilst in the late Neolithic it is more likely reserved for outcasts. Variation also remains an interpretative challenge in southern Scandinavia (Sjögren, Chapter 52). There, early Neolithic mortuary practices were diverse and complex, but the deliberate disarticulation of human remains in chambered tombs may have been far rarer than archaeologists imagined in previous decades. By contrast, Sjögren warns, some late Neolithic 'single graves' actually show signs of the manipulation of the body after death. Hence, body treatment does not neatly correspond with the context in which the remains were placed, and this resonates with the review of evidence from Britain, Ireland, and northern France presented by Fowler and Scarre (Chapter 53). Placing emphasis on mortuary practices as transformations of the dead, Fowler and Scarre highlight a range of treatments, with bodies variously buried intact, cremated, or after a period of decay, and with a wide range of contexts used for their disposal. Whilst the monumental bodies of tombs endured in the landscape, human bodies were often shown to be ephemeral by contrast, albeit it in varied ways, and this is echoed in the lack of stone or ceramic anthropomorphic representations. As several of these chapters explore, bodies may

have belonged to groups as much as, or more than, to individuals—and both depictions of bodies and their treatment after death may have formed an important arena through which the concerns of at least some of the community were brought to the fore. Each of the contributions in this section explores not only varying ways in which the dead were treated, but also varied reasons for, and effects of, those treatments.

Looking Ahead

The volume highlights just how much has been achieved in our understanding of Neolithic Europe. Investigations have often been ambitious and open to new and radically different approaches—and the result is a diversity of interpretation and a wealth of debate. This collection summarizes past traditions and current thinking, but crucially also provides a sense of the future direction of research that is exciting, productive, and sometimes unexpected (e.g. Whittle, Chapter 54). Throughout, contributions refer to issues and problems which can absorb future efforts, and it is clear that innovations in archaeological techniques and increasing opportunities for prehistorians to work outside their national traditions are opening up scales of study and research questions which hitherto would not have been possible. One important part of this is an increasing willingness to abandon interpretations which are exclusively rooted either in the grand narrative or the micro-scale, in the monocausal or in singularly historic factors, and to challenge ingrained theoretical perspectives, whether those are implicit or explicit in prior research. Instead, there is an awareness that the integration of studies across scales, and combining different techniques, themes, and theoretical heritage, opens the door to thorough and insightful syntheses. In this sense, the volume is as much about the future of Neolithic studies as it is about its past.

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PART II

MOBILITY, CHANGE, AND INTERACTION AT THE LARGE SCALE

CHAPTER 2

ENVIRONMENTS AND LANDSCAPE CHANGE

TONY BROWN, GEOFF BAILEY, AND DAVE PASSMORE

Environments, scale, and agendas 6500–2500 BC

This chapter considers the 'environment' between 6500–2500 BC, a period which encompasses most of what archaeologists have regarded as 'Neolithic' within Europe. This enormous stretch of time amounts to 40% of the Holocene sub-stage of the Pleistocene. At about 10.2 million km^2, Europe as defined here is also large, equivalent to 7% of the Earth's landmass. It stretches over 35° of latitude and 50° of longitude and from just below sea level to 5633 m in altitude (Mt Elbrus in the Caucasus). Two implications follow; first, this chapter is necessarily an overview and highly selective, and secondly, 'scale' is itself an important issue when dealing with any idea of the European Neolithic.

The 'scale' problem becomes apparent when considering the record of climate change across Europe. Europe has today a wide variety of local climates ranging from the Arctic-Alpine to the semi-desert. The only climates (*sensu* the Köppen climatic classification) it does not have are the sub-polar continental, hyper-arid, and monsoon-dominated wet tropical climates. Local climates are determined by latitude, continentality (effectively longitude), and altitude. This can be illustrated by the variety of local winds which affect the countries bordering the Mediterranean alone (Fig. 2.1). It is, however, possible to identify common forcing conditions (pattern of global pressures and temperatures) for this region due to the underlying importance of the Westerlies and therefore conditions over the north Atlantic. So, for example, even the Mediterranean parts of Europe are under the influence of westerly cyclonic tracks for the delivery of precipitation. The extent to which these air masses penetrate into Europe is controlled through blocking by eastern high pressure systems. The Azores High and

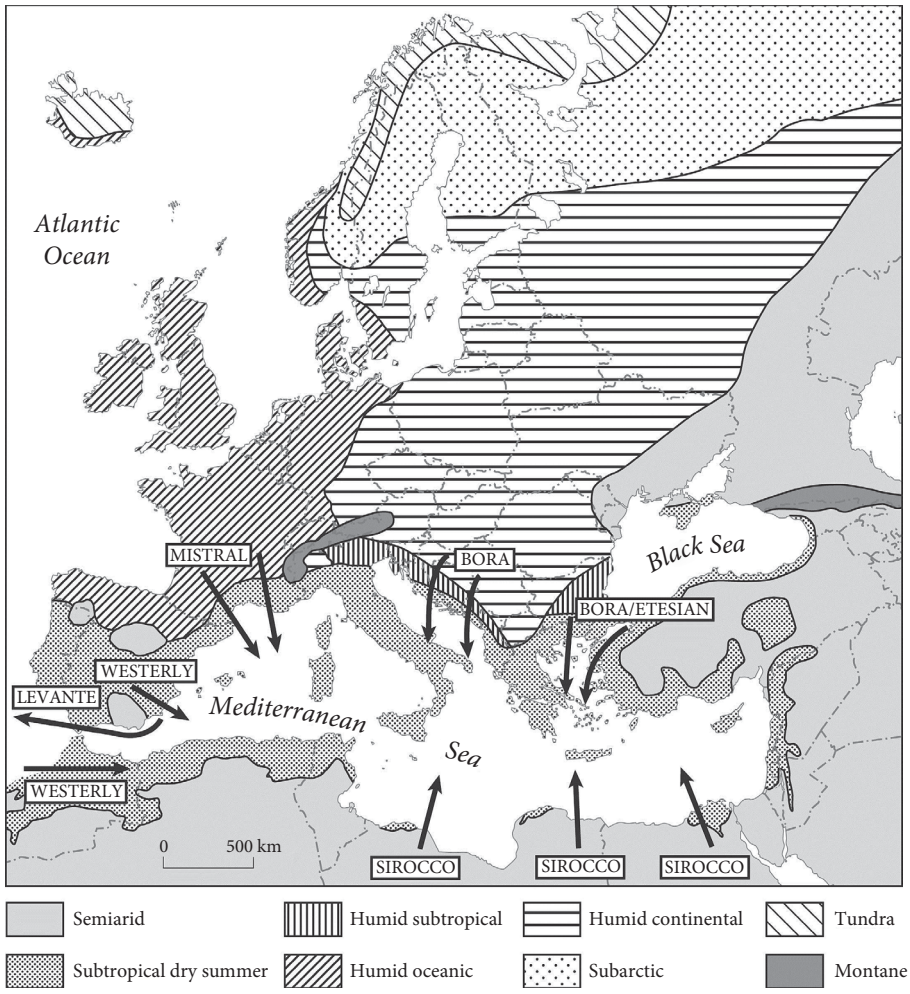

FIG. 2.1. The present climates of Europe with local Mediterranean winds derived from a variety of sources.

North Atlantic High also affect the path of these Westerlies over Europe and this control has been associated with differential climate change in northern and southern Europe. From these synoptic constraints it is apparent that the Holocene climate of Europe would have been closely related to fluctuations in the North Atlantic Oscillation (NAO) index and to both El Nino–Southern Oscillation (ENSO) and the thermohaline circulation (THC), and through these ultimately to global factors such as variations in solar output (so-called sub-Milankovitch forcing) and astronomically forced variations in solar influx (Milankovitch forcing). However, the European landmass is characterized by small–medium altitude mountain ranges especially at about 42°–47° of latitude (Picos de Europe, Pyrenees, Alps, Apennines, Carpathians) which create strong orographic

(topographic relief induced) patterning including rain-shadows and local winds, both now and in the past.

Neolithic European Climates from Lakes and Bogs

Over the past 20 years there has been an explosion of research into Holocene climatic change, driven by the need to test global and regional climate models and by the prevailing ideological belief that climate change is the greatest scientific challenge of the present age. Within Europe, appropriate geochemical and biological climate proxies covering this period can be derived from lake sediments, raised mires, and alluvial sequences. Probably the most comprehensive source of palaeoclimatic data is the lake level record, which covers both southern and northern Europe. Within the Global Lake Level Database there are over 700 records from Europe (Prentice et al. 1996) which have been used by the BIOME 6000 project to map vegetation patterns. The Alpine region, being in the centre of Europe, is probably the most valuable. One of the most comprehensive data sets is provided by 26 lakes in the Jura Mountains (Magny 2004), from which 15 phases of higher lake levels were identified, four within the Neolithic (Table 2.1). In a more recent study of Lake Le Bourget in France, Arnaud et al. (2005) have correlated the lake level record with at least three periods of flooding by the Rhone, suggesting that this record is applicable for the entire western Alps region. Studies of lake levels in southern Europe are less common but several crater lakes in Italy have produced long sequences, such as Lago Grande di Monticchio, which shows rather subdued Lateglacial interstadials and Younger Dryas with relative climatic stability in the early Holocene (Allen et al. 2002). This is in contrast to northern Africa where there is abundant evidence of wetter conditions well into the Neolithic (Roberts 1998).

One climatic event during the early Neolithic that has received attention is the so-called 8.2 ka event. Analyses of seasonally laminated varved sediments from Holzmaar in southern Germany provide evidence of differences in duration and onset time of changes in summer temperature and winter rainfall during this event (Prasad et al. 2009). The data show that the onset and termination of the summer cooling occurred within a year, and that summer rains were reduced or absent during the investigated period. The onset of cooler summers preceded the onset of winter dryness by *c*. 28 years and statistical analysis of the varves indicates that the longer NAO cycles, linked to changes in the north Atlantic sea-surface temperatures, were more frequent during the drier periods. This suggests that the event is likely to have been associated with perturbation of the north Atlantic sea surface temperatures. This work is helpful in that it helps us define the magnitude of climatic perturbations which could have affected some early Neolithic communities.

Table 2.1 Climatic shifts (dry in italics, wet in bold) during the Neolithic identified from mire and lake records in Europe.

Sites	Dates BP	Data	Postulated cause	References
Temple Hill Moss, Scotland	*6850* **6650** *6350* **5850** **5300** *4850*	plant macrofossils and testate amoebae	millennial scale climatic periodicities	Langdon et al. 2003
Walton Moss, northern England	**7700–6700** **c. 5300**	plant macrofossils	millennial scale climatic periodicities	Hughes et al. 2000, Barber 2007
Bolton Fell Moss, northern England and Abbeynockmoy, Scotland	*c.* **4400–4000**	plant macrofossils	solar forcing	Barber et al. 2003
Mallachie Moss, Scotland	**4450** *4650*	plant macrofossils	wetter climate	Langdon and Barber 2005
Lille Vildmose, Jutland, Denmark and Butterburn Flow, northern England	*c.* **4150**	wiggle-match AMS dating of plant macrofossils and testate amoebae	decline in solar activity	Mauquoy et al. 2008
Jura, France (26 lakes)	**8300–8050** **7550–7250** **6350–5900** **4850–4800**	sedimentological phases dated by 14C, tree-rings, and archaeology	solar activity	Magny et al. 2004

Climatic reconstruction from bog surface wetness (BSW) has the advantage of more reliable and higher resolution dating than can be achieved for most lakes. However, it depends upon the continuous or semi-continuous growth of raised rain fed (ombrogenous) mires (Barber 2006), restricting its application to northern Scandinavia, European Russia, the western seaboard as far south as the southern English lowlands, or mountainous 'outlier' regions as far south as north-west Spain (Cortizas et al. 2002) and mount Troodos in Cyprus (Ioannidou et al. 2008). Most raised mires start as lakes and in the early Holocene become groundwater–fed fens, at some point—most commonly sometime in the Neolithic—going through a fen-bog transition. This means that the number of BSW curves for the Neolithic is restricted temporally and geographically. This work has its origins in the climatic stratigraphy of mires used to formulate the Blytt-Sernander climatic scheme (Sub-Boreal to Sub-Atlantic covering the Neolithic and Bronze Ages) and the overturning of the autogenic theory of bog-regeneration by Barber in 1981 provided the stimulus for many studies of increasingly higher temporal resolution (Charman et al. 2007). The method of using macrofossils of *Sphagnum* spp. and peat humification has been applied in environmental transects (Barber et al.

2000) and combined with other proxies such as pollen, testate amoebae (Hendon and Charman 1997; Charman et al. 1999), and most recently $\partial^{18}O$ and ∂D from plant macrofossils (Brenninkmeijer et al. 1982; Barber 2006). Temporal resolution has been improved by both wiggle-matching and the use of *in situ* tephra deposits (Mauquoy et al. 2004; Plunkett 2006) and at the best sites a decadal resolution is claimed (Mauquoy et al. 2008) which is as fine, if not finer, than the dating of most archaeological sites within the Neolithic.

One reason for generally trusting these climatic reconstructions is the correlation between them and a vast array of other proxies, including later written records from the post-Roman period. Well known historical climatic 'events' often derived from soft data, such as the late Medieval climatic deterioration (Lamb 1977), the Medieval Warm Period, and the Little Ice Age, are also clearly shown in the mire-derived data sets (Barber 1981). For the prehistoric period BSW data has been correlated with a variety of both global and regional proxies, including the European lake level record (Magny et al. 2004), ice drift records from the north Atlantic (Bond et al. 2001), and ocean core proxies for the North Atlantic Deep Water (NADW) circulation (Chapman and Shackleton 2000). In terms of the causal mechanism, most interest has focused on solar events (van Geel et al. 1996; Mauquoy et al. 2004). However, no such solar episodes have so far been identified in the Neolithic and it is likely that solar activity was moderated or overwhelmed by other factors, particularly ocean circulation, especially in the western European seaboard. Most studies have shown a statistical climatic periodicity in the mid–late Holocene (Aaby 1976; Langdon et al. 2003; Blundell and Barber 2005; Swindles et al. 2007) with values of 200 years (Chambers and Blackford 2001; Plunkett, 2006), 265 and 373–423 years (Swindles et al. 2007), 550 years (Hughes et al. 2000), 560 years (Blundell and Barber 2005), 580 years (Swindles et al. 2007), 600 years (Hughes et al. 2000), and 1,100 years (Langdon et al. 2003). These can be compared with periodicities in other proxy data such as 210, 400, 512 and 550, 1,000, and 1,600 years in tree rings and ocean core-data (Chapman and Shackleton 2000; Rosprov et al. 2001). Although most of the records used in these studies start around the end of the Neolithic or in the Bronze Age (e.g. Charman et al. 2006), it is highly unlikely that these quasi-rhythmic climatic fluctuations started at this time. They probably started prior to the Neolithic in the early Holocene during the re-arrangement of the northern hemispheric circulation system following deglaciation.

Traditionally the Neolithic has been regarded as a period of relative climatic stability dominated by the Holocene thermal optimum at *c.* 7500 BP, when temperatures were 1–2°C warmer than today (Davis et al. 2003), and then a climatic deterioration *c.* 6500 BP (Karlen and Larsson 2007). In the original Blytt-Sernander climatic sub-division of the Holocene the Neolithic spans the later part of the Boreal (10500–7800 BP), the Atlantic (7800–5700 BP), and the early part of the Sub-Boreal (5700–2600 BP). The Boreal Atlantic boundary was largely based on a 'recurrence' surface or *Grenzhorizont* (layers of sudden change in peat humification caused by a change in climate) common in Swedish bogs (Barber 1981), whilst the climatic optimum was based upon biostratigraphic data such as thermophilious (warm adapted) vegetation in northern Europe

and the occurrence of the pond tortoise (*Emys orbicularis*) outside its present-day breeding range (Stuart 1979). Another classical indicator of the mid-Holocene thermal optimum is high rates of ambient-temperature carbonate or tufa (calcareous spring deposits) deposition (Goudie et al. 1993). Although tufas continue to be deposited outside the mid-Holocene (Baker and Sims 1998), their occurrence is reduced. Tufas can also provide stable isotopic temperature records from a wide range of terrestrial and lacustrine sources throughout Europe, as well as through inferences from floral and faunal remains (Ford and Pedley 1996; Gedda 2006; Davies et al. 2006). Both of these thermal indicators are rather complicated but not invalid, and the concept of the thermal optimum remains valid, although the record of raised mires shows relative BSW stability during the Neolithic at least for north-west Europe. For example, only a few mires such as Temple Hill Moss and Walton Moss show short-lived wet phases (Langdon et al. 2003), (Fig. 2.2). Local variability is shown by the state of Scottish mires before, during, and after the deposition of the Hekla-4 tephra at 2310±20 BC (Langdon and Barber 2004). In the absence of definitive Europe-wide studies of BSW in the sixth millennium BC, it is probably safest to assume a relatively gradual shift to the cooler and wetter conditions during the late Neolithic.

Table 2.2 Major volcanic events in the European Neolithic and some published dated tephras. Data from the tephrabase (Newton et al. 2007) and other sources.

Eruptive source	Name/ Location recorded from	Date	Reference
Southern Italy; Campi Flegrei caldera	Agnano Monte Spina Tephra (AMST)	4690–4300BP	Blockley et al. 2008
Central Anatolian Volcanic Province (CAVP)	Eski Acigol	10 tephra layers between 14,300/11,300 and 8150/5000 years BP	Kuzucuoglu et al. 1998
Iceland	Hekla-4	2350–2250 BC	Pilcher et al. 1996
Iceland	Hekla-5	*c.* 6800 BP (5050 BC)	Smithsonian Institution's Global Volcanism Program (GVP)
Iceland	Hoy Tephra, Keith's Peat Bank	5560±90 ^{14}C years BP	Dugmore et al. 1995
Iceland	Lairg tephra A, Sluggan Bog, northern Ireland	6036±20 ^{14}C years BP	Pilcher et al. 1996
Iceland	Lairg tephra B, Sluggan Bog, northern Ireland	5811±20 ^{14}C years BP	Pilcher et al. 1996
Iceland	Mjauvotn A & B, Eidi, Faroe Isles	5910±45 ^{14}C years BP	Wastegard et al. 2001

At the end of the Neolithic, one of the most significant shifts in the climate of Europe occurs. The '4.2 Ka event' has been identified from a number of proxies including the ocean and ice cores (Bond et al. 1997; Brown 2008), from a severe drought event in eastern Africa, and from increased sand movement in coastal dune systems along the eastern Atlantic coast (Gilbertson et al. 1999; Knight and Burningham, 2011). In the British Isles it has been identified as a cool/wet phase from the BSW record of a number of sites in northern England (Chiverrell 2001; Charman et al. 2006; Barber and Langdon 2007) and Scotland (Langdon and Barber 2005), and from combined BSW and chironomid data from Talkin Tarn in northern England (Barber and Langdon 2007).

This climatic chronology will probably be further refined in the next few years with the increasing use of tephra layers, but the broad pattern is unlikely to change. A problem is what these shifts mean in climatic terms and how these bog-proxies relate to other hydroclimatic variables. As Barber (2006) has emphasized, the BSW proxy is a composite measure of past climate, principally because a change to a more continental climatic regime is likely to alter the relative importance of precipitation and temperature. Even for the present oceanic climate of north-west Europe, there is a correlation between temperature and precipitation at least at the mean annual scale (Barber 2006). At the annual scale the linking factor is the correlation between summer precipitation and the winter NAO index (Kettlewell et al. 2003), which is also correlated strongly with changes in mean annual temperature, and on the longer term the THC. Given these complications

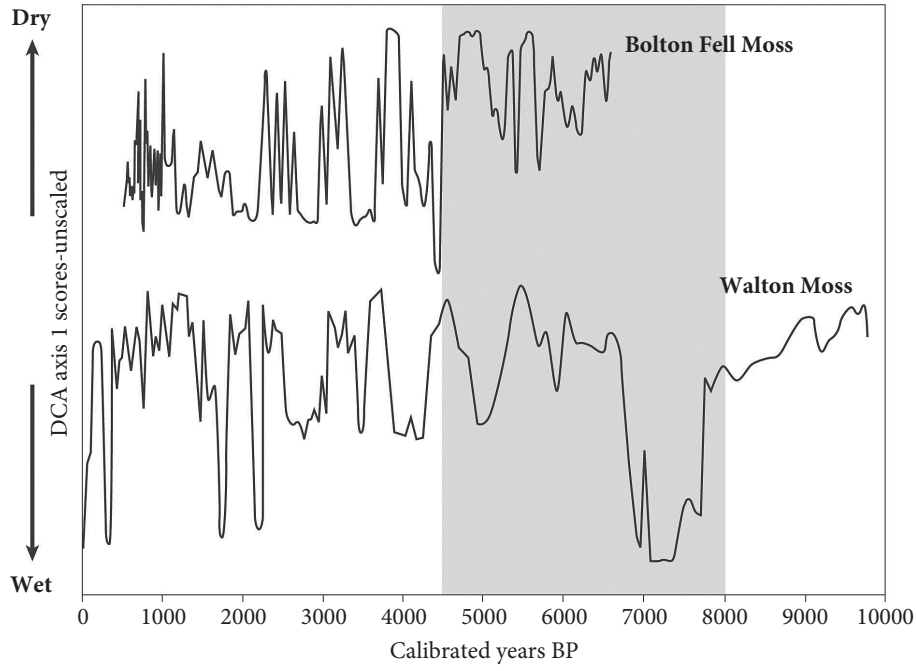

FIG. 2.2. Proxy climatic reconstruction from two raised mires in the UK.

Adapted from Hughes et al. (2000) and Barber et al. (2003).

it is best to regard the BSW record as principally a response to north Atlantic sea surface temperatures transmitted through prevailing synoptic regimes and the resultant summer water deficit. Perhaps more attention should be paid to the dry shifts, which may also have significant, if not greater, archaeological implications.

Two other palaeoclimatic techniques, probably more closely related to variations in precipitation and applicable to the Neolithic, are speleothem (stalagtites, stalagmites, flowstones) luminescence and stable isotope studies. Due to its geological history, Europe is especially rich in limestone cavern systems and speleothem/tufa/travertine deposits. Long-term variations in the intensity of the luminescence under UV light of the growth bands within a speleothem can be related to climate and especially precipitation (Baker et al. 1999), although it is also sensitive to local vegetation change (Baldini et al. 2005). Using data from both mires and speleothems from Sutherland in north-west Scotland, Charman et al. (2001) have shown a correlation between peat humification, speleothem luminescence emission wavelength, and ice-sheet accumulation. The use of speleothems has further potential to produce regional data in areas lacking ombrotrophic mires such as south-west England, north-west Scotland, northern Norway (Lauritzen and Lundberg 1999; McDermott et al. 2001), and southern Europe. Due to the frequent occurrence of annual luminescence laminae this technique has high potential to record annual climatic data, although so far most studies have focused on the short-term fluctuations in climate recorded over the last one to two millennia (Jackson et al. 2008).

Mapping Neolithic Vegetation Change

Many of the lake studies have produced direct evidence of vegetation from pollen and plant macrofossils. During the Late Glacial Maximum (LGM) most of Europe was dominated by *Artemisia* (mugwort) and Chenopodiaceae (goosefoot) steppe, but many refugia existed: evergreen oak (*Quercus ilex)* type woodland survived in Sierra Nevada; Atlantic cedar (*Cedrus atlantica*) and pistachio (*Pistacia* spp) existed in the Apennines and Balkans; and oak, pistachio, and olive survived together in the Levant (van Zeist and Bottema 1991) suggesting re-colonization of Europe from the east. Herb-steppe was replaced in the early Holocene by sub-humid forest sometimes dominated by conifers but more typically by broad-leaved deciduous trees. The xeric (drought tolerant) evergreen forests, shrub, and heathland now typical of the Mediterranean part of Europe are rarely represented in early Holocene pollen diagrams. Attempts to map the Neolithic vegetation of Europe have produced a vegetation pattern closely resembling the climatic pattern shown in Fig. 2.1, but this uniformity is rather misleading since biogeographical, topographic, and edaphic factors pattern vegetation at the regional and sub-regional scale (Skinner and Brown 1999). The composition of the mixed deciduous forest varied from north to south. Oak-birch-hazel dominate its northern limits, lime-oak-hazel the south, and oak (deciduous and evergreen)-hazel-hornbeam the southern fringes. Similarly, the structure of these forests, including the occurrence of natural clearings

and openings, reflected the spatially variable disturbance regime, including factors like wind-throw, animal activity (particularly beaver), disease, and snowfall. Indeed, the most well-known Holocene vegetation event in northern Europe, the 'elm decline' of around 5300 BP, is now commonly regarded as being due to disease and progressive forest clearance by Neolithic farmers. These allowed the beetle vector, *Scolytus scolytus,* to spread, transforming local outbreaks in to a pandemic (Clark and Edwards 2004; Edwards 2004). It is also clear that Neolithic woodland was not stable, with increasing evidence of mid-Neolithic woodland regeneration in England (Brown 1999), Scotland (Tipping 1995, 2010, 2012), and Ireland (O'Connell and Molloy 2001). At present it is not clear if this was due to declining fertility, agricultural decline, or climatic perturbations, but all these hypotheses are testable. There is also pollen, charcoal, and phytolith evidence of middle Neolithic woodland management, or so-called agro-sylvo-pastoral systems along the middle Rhone Valley (Delhorn et al. 2009). This evidence is clearly of relevance to our views of the mobile or semi-sedentary nature of early Neolithic farmers (Bogaard 2002, 2004), population densities, and their connections to the land and with other groups (Edmonds 1999).

Lake and Wetland Settlement

One of the most climatically sensitive aspects of the archaeological record is lake and wetland settlement, which, due to high precision dendrochronology dating and good preservation of organic remains (seeds and animal bones), has great potential for investigating the impact of short climatic fluctuations on Neolithic economies and societies. Studies of lakes in the Alpine foreland have shown a remarkable correlation between climate proxies such as the ^{14}C calibration curve and palaeoeconomic data, suggesting that during phases of wet-cold climate wild resources like game were more intensively exploited (Schibler et al. 1997; Hüster-Plogmann et al. 1999; Arbogast et al. 2006; Schibler and Jacomet 2009). Whether this is a result of decreased cereal yields or some other cause is as yet unknown. Even more archaeologically important is that there is *no correlation* between these phases and 'cultures' as defined using pottery (Fig. 2.3). This suggests a disconnection between changes in material culture and changes in food procurement.

Catchments, Valleys, Sediments, and Settlement

European river valley environments span a vast range of topographic and altitudinal settings, encompassing glaciated alpine mountain torrents, terraced river corridors, and extensive low-relief alluvial and estuarine settings on the coastal fringe. Neolithic communities were present in many of these settings, becoming well established in estuarine

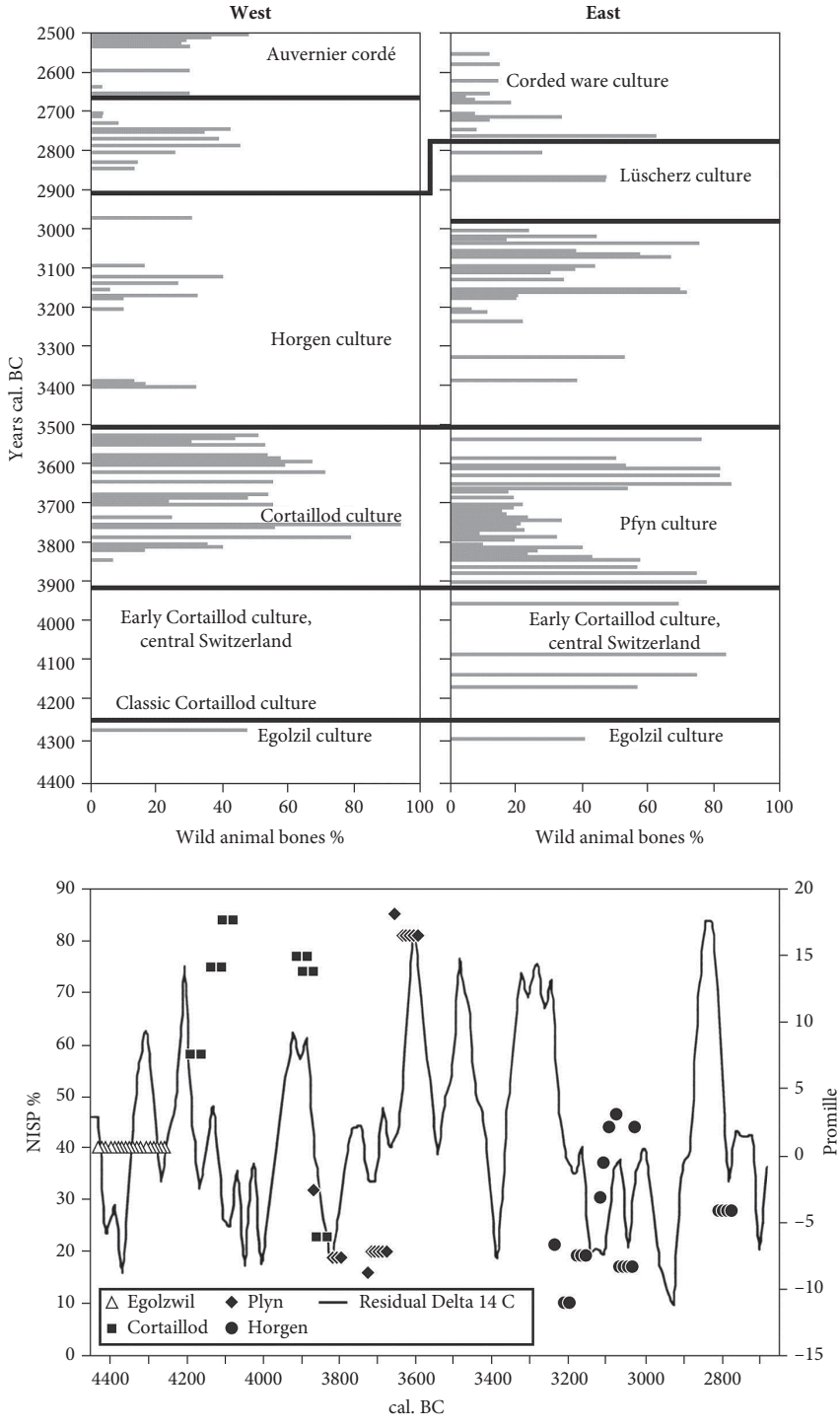

FIG. 2.3. Dendrochonologically dated wild animal bone frequencies and cultures from eastern and western Swiss Neolithic lake villages.

Adapted from Schibler (unpublished) by permission.

environments (see below) and extending into relatively high elevation upland localities. Indeed, palynological studies suggest that localized cereal cultivation was occurring from early Neolithic times at altitudes of up to nearly 2,000m above sea level in the alpine valleys of France (Argant et al. 2006; Martin et al. 2008), Switzerland (Welten 1977), and Italy (Pini 2002). In general, however, it is the valley floors in the middle and lower reaches of European river systems that were especially important for Neolithic settlement, offering well-defined and frequently navigable routeways. The Danube and Rhine systems were particularly influential in the dispersal of Neolithic culture across Europe (Roberts 1998; Dolukhanov and Shukurov 2004; Davison et al. 2006). River valleys also offered ready access to freshwater, a rich array of resources, and in many cases low-relief, free-draining Pleistocene river terraces relatively free from flood-risk. Archaeological evidence of Neolithic settlement and especially ritual activities are widely documented on Pleistocene terrace surfaces, for example in valleys of the Trent catchment in the English Midlands (Knight and Howard 2004; Brown 2009a, 2009b), the middle Rhone valley in France (Beeching et al. 2000; Delhon et al. 2009), the Upper Odra basin in Poland (Zygmunt 2009), the Chienti basin in Italy (Farabollini et al. 2009), and the well-known site of Lepenski Vir on the Danube in Serbia (Borić 2002). In both northern and southern England, early Neolithic settlement was apparently initiated from river valley floors and estuarine and coastal lowlands, before late Neolithic and early Bronze Age expansion on to higher elevations and upland terrain hitherto unoccupied or utilized for subsistence activities (e.g. Thomas 1999; Waddington 1999; Garrow 2007; Passmore and Waddington 2012). As well as proving attractive for settlement, fertile and well-drained soils developed on Pleistocene sand and gravel terraces and low-relief catchments developed on loessic plains were favourable localities for pioneering early Neolithic agriculture (which is hence rarely detected on regional-scale pollen diagrams derived from upland peats; cf. Brown 1997, 2008). Although Mesolithic communities are widely thought to have manipulated the early Holocene woodland cover (Brown 1997), the early–mid Holocene temperate forests of Europe seemingly experienced little or no detectable soil erosion (e.g. Bork et al. 1998; Seidel and Mackel 2007). The arrival of Neolithic agricultural systems, embracing both domesticated livestock and arable cultivation, introduced a deliberate process of woodland management, clearance, and tillage that lowered landscape erosion thresholds, thereby creating the first significant possibility of impacting on river catchment sediment and hydrological systems.

The considerable interest in exploring the geomorphological impact of early farming is therefore not surprising. The impact of land-use changes on geomorphological activity in valley systems may be reflected in a variety of contexts, including hillslope erosion and gully development, sedimentation in colluvial and alluvial settings, river channel incision, and elevated water tables (Foulds and Macklin 2009; Fuchs et al. 2010). However, our ability to detect Neolithic land-use activities in the landform and sediment archive of river valleys faces several challenges. These include the often fragmentary preservation (or removal) of sedimentary archives by later erosion, difficulties in establishing accurate chronological controls, and the potential for complex and possibly

multiple phases of sediment erosion, transfer, and storage occurring downslope/downvalley of landscapes hosting Neolithic activities (e.g. Lewin and Macklin 2003; Houben et al. 2006; Brown et al. 2009).

These difficulties are perhaps most readily addressed in relatively small catchments or sub-catchments, where archaeological and palaeoenvironmental records can be compared to landform and sediment archives in the immediate vicinity (Hoffmann et al. 2007), and where the potential for intermediate sediment storage and reworking is greatly reduced. Such studies have reported evidence of late Neolithic valley colluviation, as well as alluvial fan and (or) floodplain alluviation linked to the onset of deforestation and localized arable cultivation for localities in Britain (e.g. Brown and Barber 1985; Evans et al. 1993; Bell 1983; French et al. 1992; Collins et al. 2006; see also review by Macklin 1999), western France (Macaire et al. 2006), loess-covered valleys in southern Germany (e.g. Kalis et al. 2003; Lang 2003; Hoffmann et al. 2007; Fuchs et al. 2010), and Poland (Klimek 2003). Neolithic catchment disturbance has also been inferred from accelerated rates of inorganic sediment accumulation in some lake sediment records, including sites in Britain and Ireland (Pennington 1978; Edwards and Whittington 2001), Germany (Zolitschka 1998), and the French Massif Central (Macaire et al. 2010).

A broader perspective on Neolithic interactions with river environments may be obtained from countrywide reviews and comparisons of Holocene valley floor development throughout Britain (Johnstone et al. 2006; Lewin et al. 2005; Macklin et al. 2006, 2009; Brown et al. 2013), Spain (Thorndycraft and Benito 2006), Poland (Starkel et al. 2006), Germany (Hoffmann et al. 2008; Fuchs et al. 2010), and France (Arnaud-Fassetta et al. 2010) (Fig. 2.4). By exploiting the growing number of published and well-dated catchment landform and sediment records and adopting an increasingly robust approach to selecting, interpreting, and analysing ^{14}C-dated colluvial and alluvial sequences (cf. Johnstone et al. 2006; Macklin et al. 2009), these studies indicate that the geomorphological impact of anthropogenic land-use change is seldom widely evident until the marked intensification of woodland clearance and agricultural activity from the Bronze Age and later periods. Rather, Neolithic channel and floodplain environments experienced relatively little direct human intervention, often maintaining a cover of alder-dominated woodland and wetland habitats (e.g. Knight and Howard 2004; Tipping 1998; Thorndycraft and Benito 2006) amidst meandering (e.g. Starkel 2002; Dambeck and Thiemeyer 2002) or anastomosing (Knight and Howard 2004; Brown 2008) channel systems.

However, countrywide and sub-continental scales of analysis show periods in the early–mid Holocene which experienced broadly synchronous phases of accelerated fluvial activity, and which have been linked to the emerging record of periodic shifts to a cooler and/or wetter climate (Figs 2.2 and 2.4). Macklin and Lewin's (2008) synthesis of the British, Spanish, and Polish records identified four such phases in the Neolithic, centred on 7590 BP (Spain, Poland), 6790–6820 BP (Britain, Poland), 5540–5640 BP (Britain, Spain), and 4840–4860 BP (Britain, Spain, Poland). Enhanced Neolithic flooding was also evident in Poland at 8400, 6250, and 5920 BP, and in Britain at 4520 BP. In German parts of the Rhine, Danube, Weser, and Elbe catchments, Hoffmann et al.

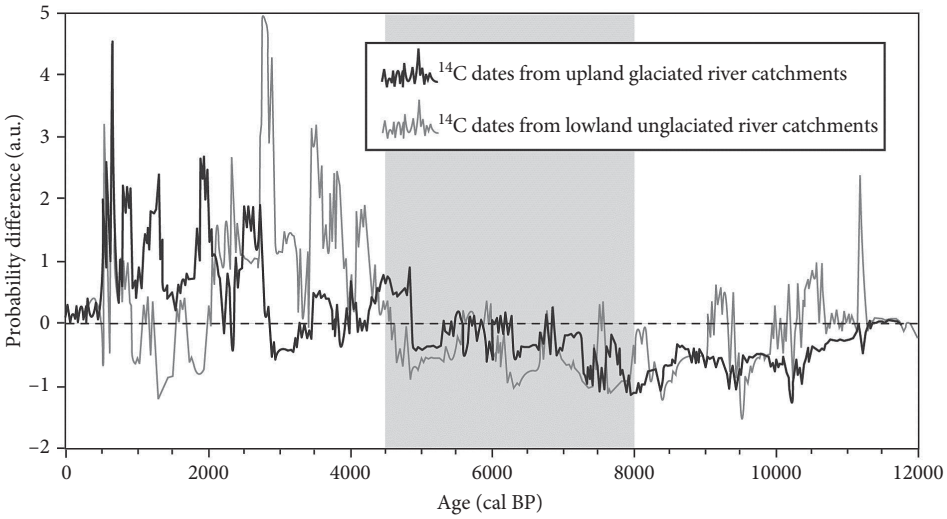

FIG. 2.4. The probability density function of alluvial radiocarbon dates for upland and lowland river catchments in Great Britain during the Neolithic.

Adapted from Johnstone et al. (2006).

(2008) also found broadly corresponding phases of accelerated Neolithic activity centred on 7475 and 5640 BP respectively. An additional early Neolithic activity phase at 8200 BP appeared largely confined to colluvial systems in smaller catchments. The 8.2k event is also evident in French catchments as a period of enhanced frequency and/or magnitude of flooding in the middle Loire, and as increased fluvial activity in the Durant and southern Alps; a similar pattern of activity occurs *c.* 6300 BP, although the record from the southern Alps suggests valley floors here were incising at this time (Arnaud-Fassetta et al. 2010 and references therein).

Both Hoffmann et al. (2008) and Arnaud-Fassetta et al. (2010) found Holocene fluvial activity phases in German and French valley floors, respectively, to show only limited correlation with those identified by Macklin and Lewin (2008) in British, Spanish, and Polish records. This is considered to reflect, at least in part, differing approaches to the classification of ^{14}C dates and the analysis of frequency distributions, but for Arnaud-Fassetta et al. (2010) this contrast in the intensity of fluvial activity between mid-latitude European rivers and those in northern and southern Europe hints at a sub-continental tripartite division of European hydrosystems during the early–mid Holocene.

Current research agendas focusing on multiple scales of analysis (both spatial and temporal) and the quantitative modelling of fluvial system response to environmental change will refine our understanding of these issues (e.g. Arnaud-Fassetta et al. 2010; Hoffmann et al. 2010). What is clear from current evidence is that Neolithic land-use activities were rarely sufficient to promote detectable changes to channel and floodplain environments in the middle and lower reaches of larger European catchments. However, Neolithic communities were accustomed to flood hazard and the inherent rhythms of

river channel adjustments, especially with respect to meander migration and occasional channel cut-off. During phases of cooler and/or wetter climate they also witnessed a change in the frequency and magnitude of flooding, alongside a change in the rate and possibly the style of channel and floodplain development.

Changing Coastlines and Coastal Communities

Europe has a strongly maritime character, with heavily indented coastlines and many large peninsulas, offshore islands, and archipelagos. Few areas of Neolithic Europe would have been far from contact with their nearest coastline, even if that contact was an indirect one through trade or exchange over hundreds of kilometres, as evidenced by the movement of the marine bivalve *Spondylus* shell ornaments from the Aegean to Neolithic sites in central Europe (Chapman and Gaydarska, this volume). Coastlines also played an important role as sources of marine food, raw materials, and items of value or decoration; as a medium of communication, travel, and trade by sea; and as sources of inspiration for myth and metaphor.

Marine environmental conditions cover an immense range, from the Arctic to the Mediterranean and from exposed Atlantic coastlines to the protected and tideless basins of the Baltic and the Black Sea. Productivity generally follows a north-west–south-east gradient. Shallow areas of continental shelf, mixing of the water column by tides and storms, and upwelling currents ensure high levels of marine fertility on north Atlantic and North Sea coastlines, and an abundance of marine mammals and fish. The extensive intertidal flats of large river estuaries and inlets support large beds of bivalve molluscs, and rocky shorelines have relatively abundant supplies of limpets and other gastropods. The Mediterranean is much less productive, with limited tidal movement and clogging of major river estuaries by rapid sediment accumulation, although all types of marine resources are available, from top predators such as monk seals and tuna fish to molluscs. Least productive is the eastern Mediterranean, where temperature gradients trap nutrients at a depth beyond the reach of photosynthesis. The Baltic and Black Sea are intermediate, with little tidal movement, but inflow of nutrients from the surrounding land.

Although agriculture is generally regarded as the dominant mode of production, marine resources continued to be widely exploited. Palaeodietary reconstructions based on stable isotope measurements of human skeletons in parts of Britain and Denmark suggest that marine foods were ignored by some Neolithic people in coastal regions (Richards and Hedges 1999). However, the interpretation of the evidence is controversial (Bailey and Milner 2002; Milner et al. 2004, 2006; Hedges 2004; Richards and Schulting 2006), and archaeological sites show continuing exploitation of fish, sea mammals, and shellfish throughout the coastal regions of Britain, Scandinavia (Clark 1983; Lidén et al. 2004; Milner et al. 2004), south-west Europe (Boyle 2005; Milner et al.

2007), and the Mediterranean (Jacobsen 1968; Tagliacozzo 1993). Submerged Mesolithic and Neolithic fish weirs discovered in Denmark show that the Neolithic examples, as at Nekselø, extended several hundred metres out from the seashore and were larger and stronger than their Mesolithic counterparts (Fischer 2007). For many farming communities in coastal regions, marine resources could provide an important alternative during periods of the year when agricultural products were in short supply (Deith 1988; Milner 2001, 2002). Settlements in northerly regions beyond the range of reliable crop agriculture would always have depended on the sea for a major part of their livelihood.

Seafaring played an important role in fishing and sea-mammal hunting, trade, and population movement. At least one pathway of agricultural dispersal into Europe followed the northern shorelines of the Mediterranean, implying seaborne movements. Occupation of Mediterranean islands and the British Isles required the use of seaworthy boats to import crops and animals and exchange raw materials, even if, as now seems likely, Neolithic colonists were not the earliest seafarers in Europe (Anderson et al. 2010). The distribution of megalithic tombs has been linked in some areas to the seasonal movements of migratory fish (Clark 1977). Dugout canoes and skin-covered frame boats were already used in the Mesolithic. The earliest timber-planked boats are recorded from the Bronze Age, but were probably also built in the Neolithic, with the sail most probably in use by the late Neolithic in the eastern Mediterranean (Broodbank 2010).

Much of what might be learned about Neolithic coastal environments may be missing because of sea-level change (Pirazzoli, 1991). At the LGM, 20,000 years ago, the sea level was over 100m lower than present and additional territory amounting to some 40% of the current European landmass was exposed on the continental shelf. The loss of territory as sea levels rose with the melting of the ice sheets after 16,000 years had profound effects on the ecology, demography, and social geography of prehistoric Europe, offset to some extent by climatic amelioration and the opening up of new hinterlands. These changes were especially dramatic in shallow areas such as the North Sea (Coles 1998; Flemming 1998, 2004; Gaffney et al. 2009), with their biggest impacts during the late Upper Palaeolithic and Mesolithic. The eustatic (glacial meltwater) contribution to sea-level change was completed with a final sea-level rise of about 15m between 8,000 and 6,000 years ago according to global estimates from deep sea records (Lambeck 1995, 1996; Lambeck and Chappell 2001; Siddall et al. 2003), which overlaps with the early Neolithic in southern Europe.

Additional geological processes affecting sea-level change likely affected Neolithic coastlines more widely. These processes include coastal subsidence or uplift at a local or regional scale in response to tectonic and volcanic effects, particularly in the eastern Mediterranean, and isostatic rebound or subsidence of coastlines following the melting of the ice sheets, particularly in northern Europe. Geophysical models provide estimates of crustal movement (Lambeck et al. 2006; Peltier and Luthcke 2009), but precise changes can only be established by dating local palaeoshorelines, using evidence of submerged archaeological sites, shoreline biomarkers, or sediments such as peat (Shennan and Andrews 2000; Stewart and Morhange 2009). All these sources show that changes of relative sea level continued to occur in many areas during the Neolithic, with variable

impacts depending on local topography and bathymetry, and that an important part of the coastal Neolithic in many regions now lies submerged on the seabed, as for earlier periods (Benjamin et al. 2011).

The most dramatic isostatic effects were in regions close to centres of glaciation. In Scotland and northern Scandinavia there was coastal rebound, with coastlines lifting as much as 200m in northern Norway. Around the southern rim of the North Sea and the southern Baltic, there has been ongoing subsidence, with a corresponding loss of coastal territory and settlements. In Denmark and along the Baltic shoreline of northern Germany, Mesolithic and Neolithic settlements are now submerged in several metres of water (Fischer 2004; Harff et al. 2007). Partially or totally submerged settlements and megalithic sites have been recorded on both the Atlantic and Mediterranean coastlines of France (Geddes et al. 1983; Prigent et al. 1983; Cassen et al. 2011). In the Bulgarian sector of the Black Sea, Neolithic sites submerged by tectonic subsidence have been recovered (Filipova-Marinova et al. 2011). In the eastern Mediterranean, the pre-pottery Neolithic B site of Atlit Yam, Israel, was a coastal village practising farming and fishing and is now submerged in 11m of water (Galili et al. 1993). A Neolithic site on the Aegean island of Aghios Petros, Greece, is partially submerged (Flemming 1983), and recent underwater surveys at Bova Marina on the Calabrian coastline of Italy have drawn attention to the loss of a significant increment of land during the early Neolithic (Foxhall 2005). These changes would also have modified the ecology and configuration of resources available on the local coastline, removed land of potential value for livestock and agriculture, and perhaps influenced Neolithic cosmologies and perceptions of landscape.

More dramatic effects have been claimed in the Black Sea region by Ryan et al. (1997), who used the sedimentary record on the seafloor to infer a catastrophic flood event 7,200 years ago, supposedly resulting from the overtopping of the Bosphorus sill by sea-level rise in the Mediterranean. This in its turn is supposed to have caused widespread dislocation of low-lying settlements on the shores of the Black Sea and triggered the dispersal of farming communities into south-east Europe. However, the geological evidence and the likely human consequences are now not widely accepted. Between 20,000 and 7,200 years ago the Black Sea was a freshwater lake and the water level fluctuated through an amplitude of 90m or more in response to the variable inflow of water from the rivers to the north. However, the sedimentary record in different parts of the basin produces conflicting interpretations about the pattern and timing of these changes, and the re-connection with the Mediterranean may have been more gradual than implied by the 'flood' hypothesis (Yanko-Homback et al. 2007). Overall, the loss of land locally in different areas of Europe, even if not as sudden as claimed for the Black Sea or as extensive as the Mesolithic inundation of the North Sea Basin, most probably had cumulative effects that were recognized within the lifetime of individuals, and the collective memory and oral traditions of many coastal societies likely incorporated stories recalling an earlier time of more dramatic land loss. The marked concentration of megalithic tombs and monuments at the coastal extremities of Britain, in the Orkneys, the Isles of Scilly, and in many other coastal regions of Scotland, Scandinavia, and western

Europe—some intended to be viewed from the sea rather than from land—attests to the powerful influence of Neolithic seascapes as an arena for day-to-day subsistence, a place of danger, a source of myth, and perhaps the ultimate resting place of the ancestors (Westerdahl 1992, 2005; Phillips 2004).

Empty and Symbolic Spaces—High-Altitude Environments and Skyscapes

Until recently it has generally been assumed that in the mountainous parts of Europe Neolithic archaeology was restricted to valley floors and the lower slopes (Bocquet 1997). Recent work in the French western Alps at Les Ecrins National Park and the Hauts Ubaye Massif has shown Neolithic activity as high as 3,000m altitude (Walsh and Richer 2006; Mocci et al. 2008; Richer 2009). High alpine grasslands or 'meadows' were not empty spaces and had symbolic/ritual importance (as suggested by rock art) possibly related to their utility for summer hunting (Richer 2009). The environment does not only comprise climate, soil, and vegetation, but includes aspects such as skyscape and subterranean spaces, both of which vary spatially. Monument construction is testament to a growing human interest in, and desire to record, astronomical phenomena (Hoskin, this volume), alongside many other cultural stimuli. Neolithic monuments aligned on astronomical events like midsummer and midwinter sunrise include wood or stone circles and rows, isolated megaliths, and some henges and long-barrows. These Neolithic structures appear to be geographically restricted to northern Europe and this could at least partly relate to variation in the seasonal skyscape, which is a function of latitude (i.e. seasonal variations in the setting/rising positions of the sun and moon). Whilst other factors are clearly also important, both environment and latitude must play a part in the ritualization of the external environment. In wooded areas of moderate relief, the skyscape is only viewable in gaps or clearings and the use of distant horizon markers implies a clear line of sight from the viewing location (Brown 1997, 2001). This association of open, or cleared, areas with Neolithic monumental landscapes (or ritual complexes) appears to hold and the augmentation or manipulation of natural events may have ritual and social importance (Evans et al. 1999; Brown 2001). Studies around Stonehenge on Salisbury Plain, England, suggest partial clearance by the time both Stonehenge and Durrington Walls were being built (Allen 1995). The same is true for ritual complexes on Cranborne Chase in England (French et al. 2005; French et al. 2007) and possibly southern Brittany (Scarre 2001). A fascinating aspect is the extent to which the ritualization of natural phenomena may have been a formative part of tradition, as, for example, with the recent suggestion that the banks and ditches of cursuses monumentalized the tracks of small tornadoes through woodland (Meaden 2009). These environmental phenomena, constraints, and opportunities need to be considered in any attempt to regionalize Neolithic traditions. We also need to explore the possible

effects of natural events on the perception and ideology of later Mesolithic and Neolithic peoples (Larsson 2003) in what was still a fundamentally natural vegetation cover until human activities became the dominant driver in the late Bronze Age (Odgaard and Rasmussen 2000).

Linking Environmental Change, Cultural Transformations, and Cognition

Humans do not experience or record climate, but rather daily and seasonal weather, along with the occurrence of extreme events. There is little doubt that early farming communities would have been highly susceptible to extremes of weather including droughts and floods, and the increasing trend towards food storage through the Neolithic, the Bronze Age, and beyond is generally seen as insurance against shortages given sedentary conditions and an increasing population (Halstead 1999; Rosen 2007). Indeed one of the most common Neolithic features across Europe is the storage pit, often found in remarkable numbers (Garrow 2006).

Whilst droughts and floods are the most obvious climatic hazards, others exist even in the relatively benign environment of Mediterranean Europe. These include volcanic eruptions in tectonically active areas, such as southern Italy, Anatolia, and the Greek Isles. Tephras (volcanic ash layers) are known from this period (Table 2.2) and many more fine tephras in the marine record (Lowe et al. 2007) are of high potential for improving environmental chronologies in southern Europe. Likewise, Iceland is the source of tephras found in mires in Scotland, northern Ireland, northern England, the Baltic States, and Scandinavia (Barber et al. 2008; Pilcher et al. 1996; Hang et al. 2006; Boygle 1998). However, even in the Mediterranean there is as yet little evidence for an eruption causing major population dislocation comparable to the Bronze Age Minoan civilization or Roman Pompeii. Essential to that narrative are perceptions of risk along with power, wealth, and opportunity, all of which would have to be included in any model of response at the societal level and below.

One approach to linking environment and human actions in the landscape is through modelling, now common in natural sciences like geomorphology. Modelling has moved away from normalizing, rational, and optimizing economic models towards humans as 'agents' endowed with behavioural attributes, even perceptions, expressed in a logical rule-like fashion. Spatial modelling has in the past largely ignored perception, presenting a 'theoretical model of the culture-environment interaction that takes no account of the cultural preconceptions and consequent constrained interpretations that social actors bring to their physical environment before they interact with it' (Wheatley 1996, 76). Environmental reconstruction can include how past environments looked, felt, and even smelled but, just as with geographical information systems (GIS), environmental

models should only be seen as a 'screen on which to project behavioural and cognitive data' (Maschner and Mithen 1996, 302) and part of a wider cognitive approach to archaeology (Renfrew and Zubrow 1997). Parallels exist with recent developments in ecology and geography, where agent-based modelling (ABM) models the behaviour of organisms in the face of changing local conditions (e.g. fishing, Kirby et al. 2004) and incorporates non-normative and humanistic data within an environmental framework (Bithell and Macmillan 2007).

So far, applications include modelling food acquisition (hunting, gathering, basic agriculture) and the resultant soil erosion on limestone terrain around middle Neolithic settlements in southern France (Wainwright 2007), modelling change in the Anasazi culture in northern Arizona (Dean et al. 2000), and Mesolithic hunter-gatherer dynamics in the British Isles (Lake 2000). These studies have included the integration of a digital elevation model (DEM), palaeoenvironmental data, and—crucially—agents with rules of behaviour, agricultural or foraging capabilities, locations, and reproduction/mortality. The crucial point is that modelling does not seek to 'explain' the past or provide just another narrative, but to explore the construction of cultural interaction by challenging existing theories, demanding specification, and throwing up new questions. ABM is part of constructing culture from the bottom up, rather than generalized theorizing from the top down. In it, agents can be autonomous, goal-oriented, reactive, situated, cognitive, social, and capable of reproducing. Consequently, emergent properties can arise (Mithen 2000), a theme currently being explored in geomorphology and ecology (Harrison and Dunham 1999; Slaymaker 2005).

Conclusions

Many of the recent advances in environmental and Quaternary science—such as in sediment-based dating (Brown 2011), bio-markers (e.g. Jacob et al. 2009), soil DNA (Hebsgaard et al. 2009), and multi-element sediment scanning—greatly increase the potential to test competing hypotheses in prehistory. This is particularly pertinent as environmental change is commonly seen as rather less important to human society in Neolithic Europe than during the Bronze Age, Classical, and Medieval periods. This belief is partly a function of the longer time-scale and the dominant domestication-based narrative of Neolithic modernity (Renfrew 2007). This is changing for many reasons, such as the awareness of early domestication and agriculture in other regions (Bellwood 2005) and the remarkable advances in archaeogenetics, which are driving a more contingent, episodic, and non-purposive picture of domestication and agricultural adoption (Zohary et al. 1998). Environmental change has an essential role to play in replacing a functional meta-narrative with regionally differentiated, locally mediated, changing human–environment relations, at least in archaeology. Cognate disciplines such as Quaternary Science, however, appear to be developing in an opposite direction with new meta-narratives of global scale. For instance, Ruddiman's 'early Anthropocene'

hypothesis sees the reversal of the expected Interglacial CO_2 and methane trend due to agriculture, particularly rice cultivation in the tropics, effectively forestalling the geological trend towards cooler conditions during the late Neolithic after *c*. 8000 BP (Ruddiman 2005). There is also a rise in deterministic connections between climate and cultural change. As Tipping (2012) has observed, we need to 'stop rejecting deterministic arguments because they are unpleasant, but instead test them, reject them, or revise them' (cf. Coombes and Barber 2005). Both the spatial variation in local climates and climate change must have been a component in cultural and social change, especially in early agriculture or 'Neolithisation' in Europe, but the questions are to what extent and in what ways. The answers can only come from integrated studies of environmental proxies with high-precision archaeological chronologies. This is why the re-dating of Neolithic monuments in Europe is a major advance (Whittle and Bayliss 2007). This will lead to a better integration of social agendas with landscape creation, a theme so actively promoted within environmental archaeology by John Evans (Evans 1975; Allen 2009). We also need to take on board some elements of the post-processual critique of environmental archaeology and work toward a more in-depth, sensual, and embodied view of the external environment of Neolithic agents in the landscape.

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Movement of Plants, Animals, Ideas, and People

CHAPTER 3

MOVEMENT OF PLANTS, ANIMALS, IDEAS, AND PEOPLE IN SOUTH-EAST EUROPE

JOHANNES MÜLLER

The domestication and adaptation of local environs were important to the movement and mobility of plants, animals, ideas, and people during the Neolithic and Chalcolithic of south-east Europe, but much also depends on social processes, including inter-group relations and the 'domestication' of human behaviour caused by Neolithic economies and ideologies. Population size is especially significant given the necessity to manage subsistence and raw material supplies around domestic sites, and indeed even perhaps a vital precondition for the mobility of people and animals, the spread of new items and customs, and the development of novel ideas. Once started, this movement will be affected by exogamic marriage practices, village alliances to organize transhumance, and the needs and opportunities to gain raw materials. Given these preconditions and social processes, it is hardly surprising that mobility and innovation varied greatly throughout the Neolithic and Chalcolithic, and whilst as archaeologists we observe such processes on a sub-continental scale, regional case studies are often more helpful in explaining this change. The spread of the Neolithic production sphere and ideology during the early Neolithic, the population pressure of late Neolithic society, and the introduction of copper metallurgy during the Chalcolithic constitute three aspects of mobility which will be described, explored, and questioned in the context of one regional case study.

Neolithization in South-east Europe: Movement and Internal Mobility

For nearly a century, different archaeological schools have debated the Neolithization of south-east Europe, repeatedly emphasizing the diverse and complicated processes involved

(Lichter and Meric 2005; Spataro and Biagi 2007; Perlès 2001; Reingruber 2008). Whilst the introduction of domesticated plants and animal husbandry are economic proxies for the earliest stages of Neolithic societies, new ideologies, which develop a changing lifestyle, are linked to the introduction of novel goods and novel symbols in south-east Europe.

The domestication of cereals started at around 10,000 BC in the Near East, whilst the domestication of sheep, goat, and cattle took place later at around 8000 BC in the southern Levant (cf. Guilaine, this volume; Lichter 2007). Without discussing the reasons behind these processes, the outcome is clear—the domestication of animals and plants was linked to the domestication of humans, with a sedentary existence, the exploitation and over-exploitation of local environments, and a rapid demographic growth resulting in the expansion of the new lifestyle, as well as perhaps to changes in ecology and climate. The following movement of people, plants, and animals started on a slow but impressive scale in north Mesopotamia.

Rapid Neolithization in Cyprus and Anatolia gave rise to new settlement agglomerations (Peltenburg et al. 2000; Peltenburg and Wasse 2004; Knapp 2008; Özdogan 1997). Within a favourable environment, the clusters of Neolithic hamlets and villages shaped agricultural core areas: tell settlements were founded, cereal cultivation and animal husbandry practised, and surrounding raw materials exploited for tool manufacture.

The subsequent 'Neolithic wave' took two forms. One was westward via the marine world of the Mediterranean, the other was by 'terrestrial' drift across south-east Europe and central Europe (Price 2000; Bocquet-Appel et al. 2009). Even though there is now some consensus about the time scale and direction of these processes, the character of change is still much debated. In regard to south-east Europe, one viewpoint emphasizes the step-by-step introduction of Neolithic economy and ideology along Epipalaeolithic and Mesolithic communication networks, with the consequence that the introduction of different Neolithic elements differed spatially. According to this interpretation, Neolithization is largely perceived as the acculturation of foraging communities as they select Neolithic elements and integrate them without major social changes in their economic system and society (e.g. Chapman 1994a, 135; Kotsakis 2001). Another viewpoint envisages 'leap-frogging colonization' whereby small groups of people move into agriculturally suitable core areas in south-east Europe, which then become central spots for further regional developments (e.g. Biagi et al. 2005). The Neolithic therefore 'arrives' as a package along with a new people, both being distinguishable from those with a forager background (if still present and not depopulated by new germs and epidemic diseases). Others emphasize both viewpoints with the arrival of new groups and the acculturation of fishers and foragers as these communities interact. The archaeological evidence certainly points to a mosaic of social changes and movements which differed from region to region (Budja 2005; Whittle 2004).

In the Aegean at no later than 6500 BC some elements of the Neolithic appear (Perlès 2001, 94). Domesticated wheat and sheep are known from Knossos on Crete and perhaps some sites in Thessaly and the Argolis, whilst a few contemporary sites still indicate a Mesolithic way of life. Obviously, networks linked small fishing and foraging communities to the farmers of Anatolia or the east Mediterranean. The distribution of Melos obsidian indicates such a network between Anatolia and the Aegean (Fig. 3.1). In spite

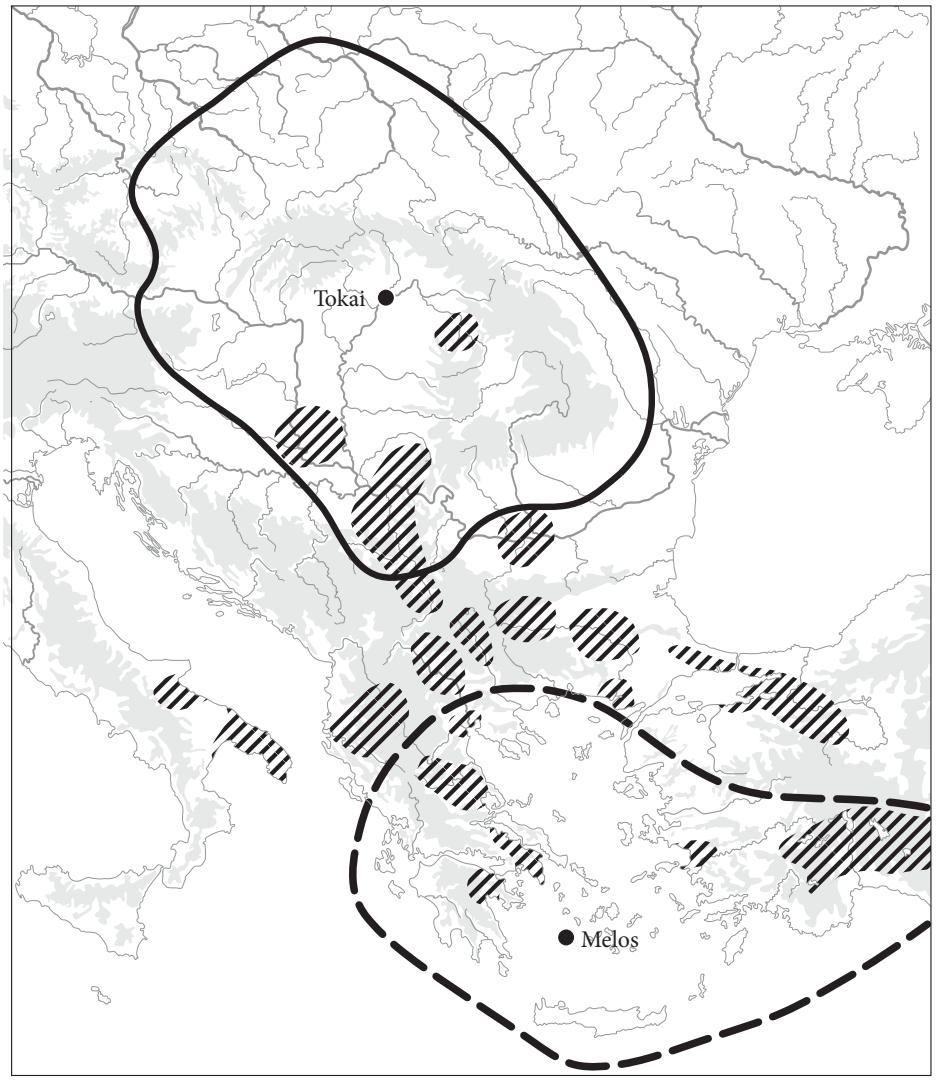

FIG. 3.1. Early Neolithic networks in south-eastern Europe: obsidian from Melos and Tokai alongside major clusters of Neolithic mainland settlement before 6100 BC

(drawing by Holger Dieterich, Kiel).

of these new plants and animals, fundamental changes in economic and social life did not occur. Rather, they represent the integration of new customs, items, and subsistence strategies into traditional daily routines and practices via the wider interaction networks of coastal societies.

A hundred years later this had changed (Reingruber 2008). Thrace and the Marmara region produce settlements where fishing and farming were the main elements of the subsistence economy, and throughout Thessaly, Macedonia, and the Marmara region the entire package of Neolithic innovation appears (Perlès 2001, 121). In small patches

of the landscape, both fertile and near the sea, farming communities established a new way of life, in some cases through the acculturation of foragers (e.g. on the islands), in other cases through the immigration of whole farming communities. This change of lifestyle was associated with new occupation patterns across landscapes, best illustrated by the occupation and inland colonization of Thessaly by Neolithic groups. The ecological conditions of the fertile basin favoured small-scale agriculture. Neolithic occupation started around 6300 BC with a clear spatial (political) division of the plain by various communities, which established permanent settlements. As a result, settlement mounds (tells) were established, the land division supported equal numbers of inhabitants at each site, and the population density rose to about 30 persons per square kilometre during the early Neolithic. Without further analyses, the characterization of these Thessalian processes is difficult. Nevertheless, two arguments speak against clear links to the local Mesolithic. First, there are no typological and economic similarities. Second, the absence of late Mesolithic remains points to a sparse foraging population before the arrival of Neolithic communities.

The 'newcomers' (but where exactly did they come from?) introduced a new economy, a new social order with new political institutions, and a new lifestyle. Small rectangular houses of mud-brick, brick clay, or timber-and-daub were home to single households and these were agglomerated in small villages of up to 100 inhabitants (Müller 2007), often forming impressive tells through their continuous use. This repeated occupation of one place for domestic purposes shows that settlements had become places of memory and tradition. Domesticated sheep, goat, cattle, and emmer and einkorn wheat were herded or planted in increasingly open landscapes. Different cooking and storing techniques are indicated by the introduction of both coarse pottery and nicely decorated fine pottery. The household mode of production is bound into village life and communal endeavours like field systems and the herding of the flocks. The deposition and recycling of waste demands the spatial organization of activity areas (at least within the settlements). Social organization is more complicated, perhaps even stratified. Some individuals were buried within the settlements and the majority of burials are without grave goods. House altars and figurines signal a well-established sacred sphere (Chapman and Gaydarska 2007; Hansen 2007). While from an archaeological viewpoint these societies are not linked with foraging precursors, connections to the Anatolian Neolithic exist in material culture and social organization. Similarities in ornamentation, in the subsistence economy, and of arranging villages and local environs back the idea of Anatolian people moving in. In this sense, the introduction of the ceramic Neolithic into south-east Europe has to be seen as an innovation, founded on the movement of small groups of mobile individuals into new environs. This seems to be true in spite of the lack of aDNA evidence.

Instead of a 'Neolithic wave' which reached Europe and 'flooded' south-east Europe, further Neolithization took place in stages (e.g. Banffy 2004). It was detained in northern Macedonia until 6100 BC for reasons as yet unknown. Interaction, communication, and mobility took place within the Aegean-Anatolian sphere, but not further north. Yet from around 6100 BC it took only a few generations for the Neolithization of most of the

Balkans, the Carpathian Basin, and other regions of south-east Europe (Biagi et al. 2005; Bocquet-Appel et al. 2009).

The sudden establishment of early Starčevo-Criş-Körös communities saw the introduction of the Neolithic way of life in fertile core areas. Whereas material culture still shows no links to foraging groups, the variation of sites and cultural environs gets more diverse. In some areas the creation of tells is observed, in others not. Short-lived domestic sites with shifting households shape more and more of the domestic sphere. The composition of lifestock gets more varied—beside sheep and goat, cattle husbandry becomes more important. The variation of cereals also increases. Other aspects of material culture demonstrate dissimilarities. Ceramic design still followed shapes and decoration patterns already visible in the Aegean-Anatolian area, but regional diversity was increasing (e.g. Schubert 1999). Within generations, regional styles had developed which might be seen as proxies of local and regional communication and interaction spheres.

The transformation of the south-east European landscape during the Neolithic is clearly linked to questions about the degree of mobility within and between existing networks and the creation of new networks. The development of diverse Starčevo-groups with a similar record of the regional material culture as from *c.* 5800 BC underlines the adaptation of local environs and the forming of local and regional communication spheres. Cross-cultural links are difficult to detect. Apart from the introduction of houses and objects similar to those in the south, independent developments are obvious. This is linked to inner colonization and the establishment of new groups. Both depend very much on the demographic development of societies, thanks to successful adaptations of local and regional environs as well as successful social organization. The development of late Neolithic societies in south-east Europe is a clear continuation of these processes.

The flow of items and resources would have been necessary for production and reproduction, and indicates the interaction spheres of early and late Neolithic communities in south-east Europe. For instance, the early and late Neolithic communities of the Carpathian Basin were dependent on raw materials which were available in the Bükk mountain range or the Bihar mountains, sometimes more than 100km away (Raczky et al. 1996; Kaczanowska and Kozłowski 1994). Local communities probably arranged expeditions, such as to the Tokay obsidian sources, where material was collected for use elsewhere. Similarly, flint material was only available in remote areas, but was nonetheless transported to the main settlements. Thus, the necessities of the subsistence economy and of tool production were responsible for some kind of mobility to areas surrounding the Carpathian Basin. In some cases, hundreds of kilometres had to be overcome to gain such materials, furthering contact with other groups and other societies.

The long-distance exploitation of raw materials may have been complemented by another form of mobility on a comparable scale—long-distance transhumance. Whilst there are many methodological difficulties with identifying such transhumant activities, early Neolithic Adriatic Impresso societies are a good example.

Impresso—an example of transhumance

The Adriatic Basin is mainly formed by the Dalmatian eastern Adriatic coast below the Dinaric limestone mountains and by the Italian coastline below the Apennines. Early Neolithic communities with a distinct type of impressed pottery are found here in both Dalmatia and Apulia. These transadriatic societies were integrated into a network of interaction: they were connected to local late Mesolithic foragers, including those in the Dinaric Alps, but also to early Neolithic groups, namely Starčevo-Criș-Körös communities (e.g. Müller 1994, 205–227; Spataro 2002), in the central Balkans. Yet the Adriatic Impresso is a purely Mediterranean phenomenon, and as such contrasts with continental development. The infiltration of Impresso pottery patterns into the Balkans via the Neretva route highlights the differences between the two: it resulted in Impresso-decorative patterns on pots with Starčevo organic tempering, hence reflecting the integration of Adriatic elements into an otherwise purely Starčevo production sphere.

There are more than 50 sites with Impresso pottery, ranging from the Trieste Karst at the border of northern Italy, to the Albanian river Mat in the south. Whilst open settlements cluster in fertile *terra rossa* plains distant from the sea, cave sites are distributed at altitudes of 1,000m in the Dinaric mountain range. The mountain range offered the potential for gathering or hunting, but also for herding in plateau areas. In contrast, the coastal zone displays *Flysch* valleys between limestone ridges, covered by *regosols* or mineralised *terra rossa* areas. Near rivers and the rare karstic springs, it was of great potential for farming, including cereal cultivation. The coastal islands possessed huge marine resources (Müller 1994, 50–71).

There is some evidence for the differing function of Impresso sites (Müller 1994, 50–71). Early Neolithic open settlements are concentrated in agricultural core areas like Istria and central Dalmatia, and more specifically on the border of the *terra rossa* plains near a water source. By contrast, most cave sites are distributed on karstic soils in the high mountain range, but interestingly near deeper valleys, which in some cases possess the potential for agricultural activities. Bone analysis confirms the distinction between open settlements and what may be upland herding camps. According to different authors (e.g. Mlekuz 2005; Schwartz 1988), domesticated sheep and cattle, along with a respectable percentage of domesticated pig bones, were found on the open site of Smilčič, whereas at the cave sites of Gospodška pecina and Odmut domesticated pig bones are nearly absent, suggesting their use as herding places (in the case of the huge dominance of domesticated animals) or even hunting camps (in the case of the dominance of wild animals) by 'lowlanders'.

Thus, the subsistence economy of Impresso communities adapted to the potential of the eastern Adriatic environs: there are permanent agricultural settlements in coastal areas and base camps in the higher Dinaric range for transhumant herding purposes (and perhaps fishing camps on peninsulas and the islands, too). As the transhumant sphere of Impresso groups overlaps with the site catchments of Castelnovian Mesolithic groups, signs of social interaction between them are hardly surprising (Fig. 3.2): there

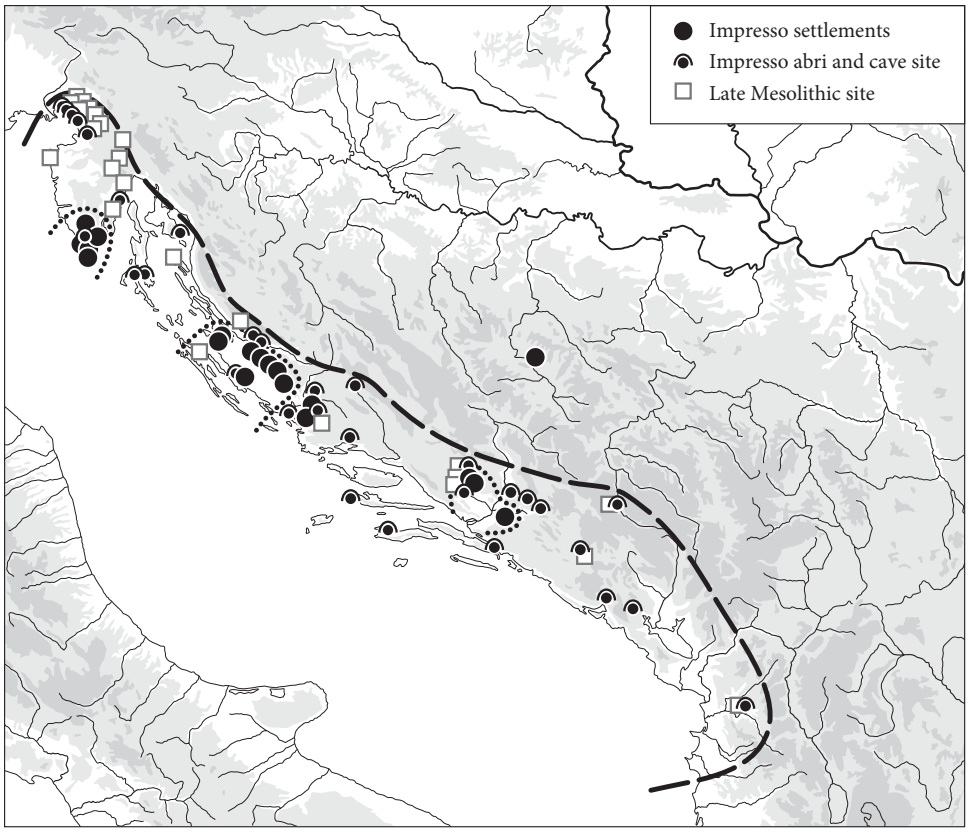

FIG. 3.2. Transhumance and communication: the Dinaric example of early Neolithic farmers and Mesolithic foragers. Boundaries of agricultural core areas are marked by the dotted line and transhumant activities by the broken line.

(drawing by Holger Dieterich, Kiel).

is goat (Odmut), cattle (Crvena stijena), and pottery from Mesolithic sites, albeit with no matching Mesolithic elements on Impresso sites. There may have been a special kind of interaction between foragers and farmers. If we look closely at their distribution, late Mesolithic sites are absent from the core areas of Impresso open settlements, and only found in regions with Impresso 'base camps' for hunting and herding. Communication between communities with two totally different economic systems most probably only took place in certain areas.

The inter-relation between the continental Starčevo and the Adriatic Impresso sites is less important. There are significant differences in the temper material and decorative patterns of the two ceramic traditions and figurines do not occur in Dalmatia (Müller 1994, 212). Only the communication route along the Neretva produced a special situation in Bosnia, with Odmut and Obre both yielding Impresso and Starčevo material. Here at least, the ideological differences between central Balkan communities and the Impresso groups—best demonstrated by the latter's failure to use Starčevo ritual artefacts—were perhaps overcome by common economic interest.

Mobility and Demography: Late Neolithic Butmir

Mobility is also highly dependent on factors such as population size and population density. If local environs are not large enough to satisfy subsistence demands, parts of a population have to become mobile for at least some of the year in order to gain access to other ecological zones. Group size and mobility is also closely linked to marriage behaviour and personal inter-relations: with villages limited to about 200–300 inhabitants, exogamy was required for the population to successfully reproduce.

Group size and population pressure are likely to have played a key role in the development of agricultural core areas during the Neolithic and Chalcolithic. Yet interpretation is problematic, with models of emigration and immigration dependent on estimated population growth, the intensity of interaction, and social classification or identity. Even where we know all these variables, a detailed reconstruction of demography as a proxy for mobility remains difficult (Müller 2007). Given the lack of proper archaeological data and problems with spatial analysis, demographic reconstructions are rare. Nevertheless, research on late Neolithic settlement size and population density in the Butmir occupation of the Bosnian Visoko basin of the central Balkans (Fig. 3.3; see Hofmann et al. 2007) exemplifies the possibilities and the consequences of such efforts for the discussion of mobility and movements.

Survey and excavation have focused on the settlement mound of Okolište, which lies 30km north-west of Sarajevo at the river Bosna. Within the three basins in which settlement is focused ('Siedlungskammern') are 34 sites with Butmir ceramics (5300–4700 BC). The Visoko basin has a size of 110 sq. km and lies 400–410m above sea level. It is formed by Pleistocene river terraces and para-brown soils. Miocene mountains up to 1,000m (marl and sandstone with rendzinas) encircle the basin. Survey and prospection have discovered further late Neolithic tells from the area.

The evidence here has certain advantages for calculating population density. It is possible to establish the organization and household density of the latest settlement horizon at Okolište, and the duration of occupation and approximate number of houses at other late Neolithic sites across the Visoko basin and around Kakanj (e.g. Peric 1995) can be calculated. Most of the Visoko sites came to an end around 4800–4700 BC.

The Okolište tell is 3.5m high and 7.5ha in size. During at least the latest settlement horizon it had geometrically organized house rows and a huge defensive system of three ditches, one rampart, and a palisade built during Butmir II (4800–4700 BC), all of them surrounding 3.5ha. The contemporaneousness of the houses is very probable, with their ceramics of Butmir IIb character and most of the C14 dates belonging to 4800–4700 BC. A minimum of 200 houses can be extrapolated from the excavated evidence. They were destroyed in a huge, disastrous fire.

Elsewhere, domestic sites like Obre II—excavated in the 1960s (Benac 1973; Gimbutas 1974) and recently investigated by geomagnetic survey—are 2–3ha in size with an

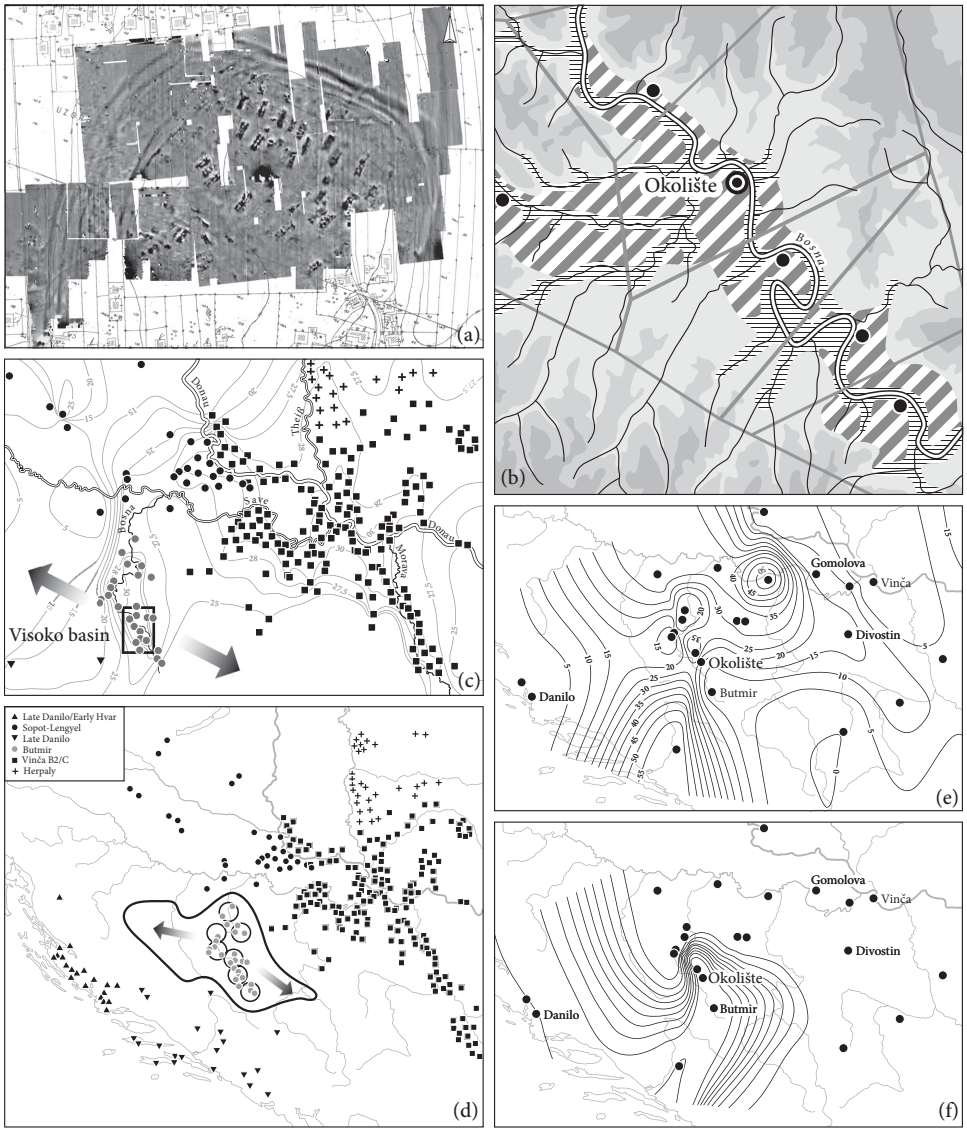

FIG. 3.3. Okolište, the Visoko basin, and the reconstruction of local and regional late Neolithic mobility: a. Okolište; b. Visoko basin with domestic sites and arable land (hatched); c. estimated population densities in late Neolithic middle Danubian area and Bosnia (isolines, person/km^2) and suggested herding activities of the Visoko communities into unpopulated mountain ranges (arrows); d. the estimated herding area of late Neolithic Butmir agricultural core areas; e. the percentage of late Neolithic impressed pottery; f. the boundary between arrowheads (Adriatic) and sling shots (Danubian) in the Neretva-Bosna area.

(drawing by Holger Dieterich, Kiel).

internal layout comparable to Okolište, but lacking its defensive system. About 50–150 contemporary houses for each settlement can be calculated using the house number/site size ratio at Okolište. Consequently, we are dealing with no less than 700 houses during the Butmir II occupation of the Visoko basin. Small house size (60 sq. m) suggests a household of about five people. The Visoko basin would therefore have a population of 3,500 at *c.* 4800 BC.

Botanical analyses from Obre II and Okolište indicate the growing of emmer, einkorn, barley, and millet (Kucan 2007; Renfrew 1974). Palaeozoological analyses prove the dominance of cattle at both sites (Benecke 2007; Bökönyi 1974, 66). Pedological and climatic data from the Visoko basin suggest it had similar agricultural productivity to central Europe (cf. Ebersbach 2003; Ebersbach and Schade 2004; Zimmermann 2002), and if we take into account several calorie requirement models, based on ethnographic archaeological research (Ebersbach 2002, 81, 107–121; Gregg 1988), 1.5ha of cultivated land and 50ha of pasture are necessary for a household of five people.

A total of 10.5 sq. km of cultivated land and 350 sq. km of pasture were required to feed the 3,500 inhabitants of the Visoko basin around 4800 BC. Figure 3.3 models settlement boundaries and the arable 'territory' of sites. It assumes an open landscape along the Bosna river without any non-arable areas between settlements. Only about 250 sq. km of pasture was within a day's march of these sites, so some kind of mobile stock farming in the surrounding mountainous areas would have been necessary. Such practices (cf. Ebersbach 2002, 158) have been ethnographically documented for south-east Europe during different periods under similar conditions (Beuermann 1967).

This modelling can go one step further. If the population density of the Visoko basin was similar to other Butmir core areas, then a population of *c.* 32,000 across the 1,000 sq. km of this cultural group's distribution can be extrapolated. Counting half the mountainous landscape between Butmir and other groups as belonging to the former gives a 'territory' of 18,000 sq. km, and accordingly, a general population density of 1.8 persons per sq. km (Fig. 3.3).

Whilst population density and land use indicate local mobility in the form of transhumance, other spheres of late Neolithic life were organized differently in respect to the movement of people, items, and ideas. Late Neolithic material culture illustrates a steady 'flow' of symbols and signs up and down the Bosna-Neretva communication route: a corridor of interaction is certainly demonstrated by late Neolithic impressed pottery, which was produced locally along the named route, but which shared a common design and decorative tradition. In this case, material culture exemplifies the linkage of local groups and perhaps even the sorts of contacts that social factors like marriage custom would generate. Interestingly, during both the early and late Neolithic the appearance of different ceramic types in Bosnia appears structured. The restriction of certain 'Adriatic' or 'Danubian' types appears to mirror political control over communication in this area of the Balkans and whether local institutions gave way or not to foreign influences on their own household units.

Whilst ceramic design mirrors the local constraints of social relations, and transhumance the regional organization of subsistence, late Neolithic weaponry shows an affiliation to political tradition. The contrasting distribution of arrowheads and sling shots cuts Bosnia in half, highlighting the complexity of boundaries and mobility in the late Neolithic world of the Balkans. This pattern in weaponry is transcended by the flow of other design types like impressed decorative patterns and by raw materials being found across both parts of Bosnia. Special flint materials were imported from the north into the Bosnian central zone. The economic, social, and ritual spheres of late Neolithic societies hence reacted quite differently to the spatial dimensions of communication and separation. In consequence, late Neolithic individuals in the Bosna valley were confronted with different types of mobility and different motivations for accepting and integrating foreign items and people into their local community.

Copper Age Developments

The introduction of copper metallurgy was to have a profound impact on the communities of south-east Europe and upon patterns of mobility. Whilst the reasons for its development are still a matter of discussion, its chronology and geographical spread can now be described (Lichardus 1991; Parkinson 2002; Strahm 1994; Todorova 1982). The earliest copper artefacts are known from Veselinovo and Karanovo III sites in Bulgaria and Vinča B sites in Serbia. Nevertheless, the first evidence of metallurgical working—including the full range of processes from smelting raw materials through to casting and the final making of copper artefacts—dates from 4800 BC onwards from Maritsa in Bulgaria, Vinča C in the central Danube, and Herpaly and Theiss in the Tisza region. The copper mines in Rudna Glava and Ai Bunar, probably set up already c. 5000 BC, symbolized the importance of copper production for Thracian and Danubian communities. This more or less industrial scale of copper production was to promote social differentiation within early Chalcolithic societies, especially during Vinča C/D and Kojadermen-Gumelnița-Karanovo (KGK) VI. Around 4500 BC, during KGK VI and Vinča D, important social differences are displayed at the Varna cemetery and by the spatial differences between houses on the settlement mound and much of the surrounding flat area at the sites of Pietrele and Czőshalom as a result of metallurgy (Hansen et al. 2004; Raczky et al. 2002).

The origins of the Chalcolithic in south-east Europe are unclear. Although metallurgy is known in Anatolia from around 6000 BC, evidence for its existence is limited (Pernicka et al. 1997). The role and quantity of Anatolian copper products in Çatal, Hacilar, and Ilipinar is in each phase small, and certainly much smaller than at the KGK VI and Vinča sites of around 4500 BC (Fig. 3.4). Contacts between Anatolia and south-east Europe are assumed, yet it appears that the 'idea' of metallurgy in Bulgaria

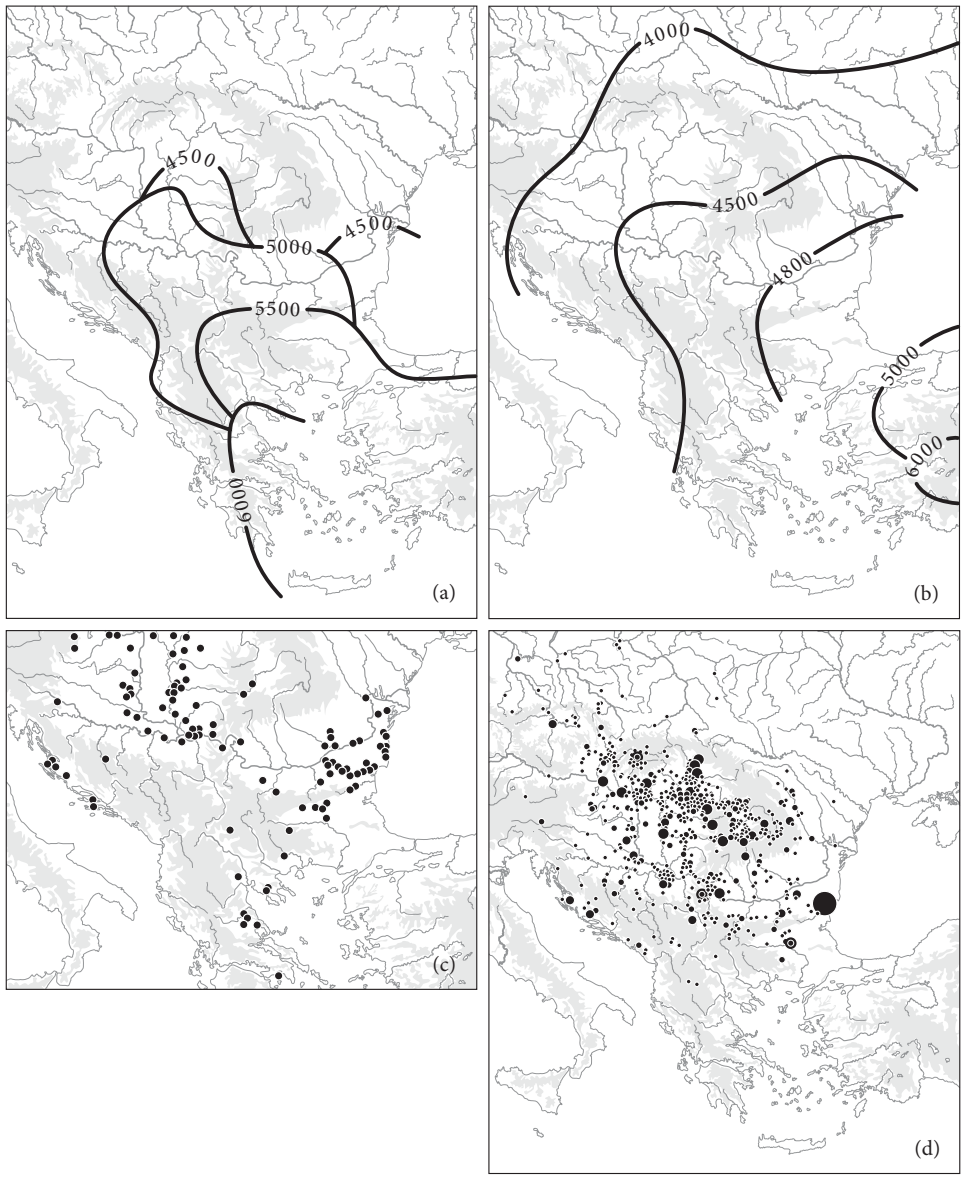

FIG. 3.4. Distribution of tell settlements (a), copper production (b), *Spondylus* artefacts (c), and shaft-hole axes (d) in south-east Europe. The lines are chronological estimations of their spread BC

(drawing by Holger Dieterich, Kiel).

and west Asia possibly differed. Early copper metallurgy in south-east Europe may have therefore emerged as an independent innovation. Beside regional ornament types, it appears mainly heavy copper axes were produced.

This innovation was accompanied by important changes in the social and political system. The symmetrical and rectilinear layout of concentrated occupation at tells is

not just a matter of planning, but also of social control (Chapman 1994b). Ovcarovo is one example of such a tell site. These organized settlements with defensive systems were linked to a change in the spatial organization of burial, cemeteries in the vicinity of sites replacing burial in the settlements themselves (Todorova 2002).

Social stratification resulted in a need to express social status (Müller and Bernbeck 1996), thereby enhancing the flow of goods, and especially exotic goods, in south-east Europe. Beside elaborate copper artefacts, gold and shell objects assumed different values, as illustrated by the grave goods of Varna (Müller 1997; cf. Fig. 3.5): gold objects were found in graves with the largest number of objects, whilst *Spondylus* and copper objects are associated with a second group of individuals. They are still richly equipped, but not as clearly linked to important supra-regional networks as those with gold and other objects. Here access to exotic and expensive objects like gold artefacts was restricted to elderly men, who had obviously monopolized social knowledge and controlled the exchange system.

The extent of Copper Age societies and their exchange systems is represented by the distribution of copper shaft-hole axes and *Spondylus* artefacts. *Spondylus* artefacts are distributed all over south-east Europe and seem to assume a higher value the further they are from the Mediterranean and Aegaen, since in central Europe they are only found in the richest burials. Copper shaft-hole axes are widely known across the Carpathian Basin and as far away as southern Scandinavia (Klassen 2004).

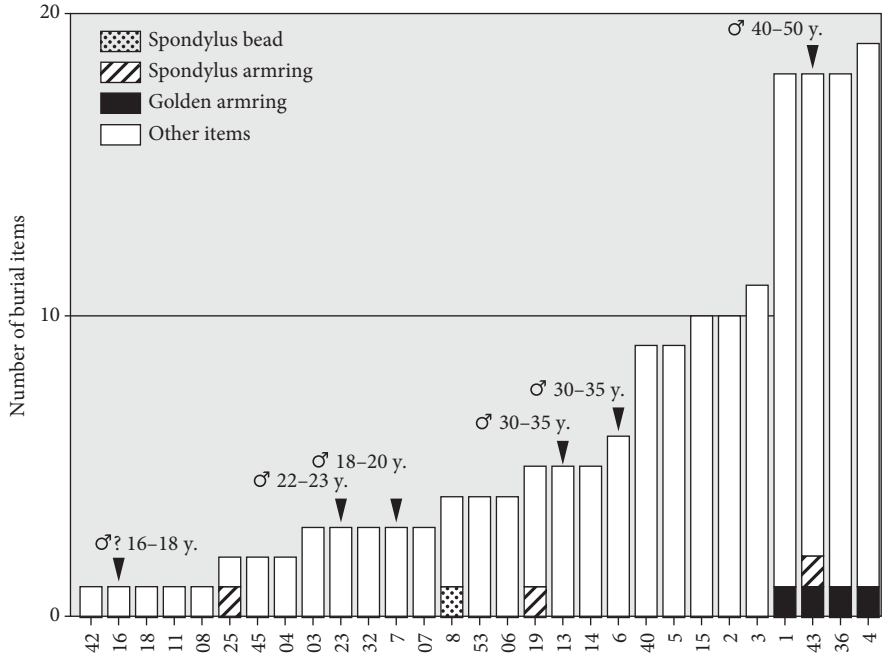

FIG. 3.5. The distribution of local and exotic items in burials of the central area of the Varna cemetery.

(drawing by Holger Dieterich, Kiel).

Continental north-west–south-east networks clearly functioned to link together different groups who themselves were at different technological levels. These networks are responsible for the distribution of ideas and the flow of goods between neighbouring villages and societies. Many innovations, which had already reached south-east Europe during the early Neolithic, are transformed during the Chalcolithic of northern regions. Figure 3.4 summarizes the major flows of some of these ideas and inventions, charting the distribution of tell sites, copper production, shaft-hole axes, and *Spondylus* shell products. New social orders are created in the Carpathian Basin, leading to independent regional developments like the Tiszapolgár and Bodrogkeresztur (Banffy 1991; Parkinson 2006).

Despite these typological similarities and the flow of items, the few demographic calculations available for the Chalcolithic do not indicate population rates much different from the late Neolithic (Müller 2007). There is little evidence for demographic pressure impacting on the movement of people. aDNA and strontium isotope analysis suggest the movement of local and regional cattle populations via herding networks, but if there had been a steady flow of items and animals it was not matched by human immigration (Bollongino 2006; Giblin 2009).

Tell sites were abandoned from the second half of the fifth millennium BC in the Carpathian region, and by about 3800 BC elsewhere in south-east Europe (Link 2006). The demise of the 'tell cultures' was not an abrupt event resulting from the invasion or influx of Pontic steppe populations. Rather, tells were abandoned individually and not as part of a synchronous process. New communication patterns arose, with a change in the range of strontium isotope values between tell and non-tell societies in the Carpathian Basin indicating that local populations became more mobile, perhaps because they were now part of less integrated social units (Giblin 2009).

Starting around 3800 BC, the Boleráz-Cernavoda III ceramic tradition linked the lower and middle Danube regions (Furholt 2008). The communication network integrates both these important spatial foci of Chalcolithic development. New innovations took place, but the absence of economic data makes it difficult to identify and describe the processes at work. Some time around 3500 BC the wheel and wagon were introduced across central and eastern Europe (Bakker et al. 1999; Maran 2004). This switch to the use of draught animals for traction must have been linked to economic transformations, and large quantities of spindle whorls point to the introduction of woolly sheep and changes in textile production.

It is difficult to identify the level of mobility associated with these innovations, but the Boleráz/Cernavoda III and Baden sequences mark the emergence of supra-regional archaeological groups united by distinctive similarities in material culture. Whilst it is possible to reconstruct mobility during the Neolithic and early Chalcolithic, the character and driving force of late Chalcolithic interaction is still poorly understood. What is clear is that these processes lead to new social inter-relations and the resulting exchange systems of tin bronze which characterize the Bronze Age.

Consequences

The mosaic-like introduction of farming subsistence strategies into south-east Europe enhanced the mobility of groups and interaction between them. Both the economic potential of different ecological settings and population sizes in agricultural core areas were responsible for Neolithic and Chalcolithic local and regional mobility. The demands of complex societies for ritual activity and social prestige items furthered long-distance barter. With the ending of tell settlements in south-east Europe, the spatial scale changed again to broader possibilities of regional movement due to less integrated social structures. Nevertheless, the agencies of supra-regional archaeological phenomena, starting at around 3800 BC, are still a matter of discussion.

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CHAPTER 4

THE NEOLITHIZATION OF MEDITERRANEAN EUROPE

Mobility and Interactions from the Near East to the Iberian Peninsula

JEAN GUILAINE

The spread of a Neolithic lifestyle throughout the Mediterranean basin was highly dependent on the same processes which permitted its emergence in the Near East. In the latter area, four chronological stages are evident in its establishment:

- Epipalaeolithic (12,000–10,000 BC): In Palestine and on the middle Euphrates, Natufians hunted gazelles and other types of game (boar, goat, deer, cattle), harvested wild cereals, and in some localities (e.g. Mallaha) experienced sedentism. They built partially subterranean circular houses with stone walls and with probably light superstructures. The dead were buried within the settlement or next to it. One animal was domesticated: the dog. A similar evolution is presumed farther east in Upper Mesopotamia (the Nemrikian) (Aurenche and Kozlowski 1999).
- Proto-Neolithic (10,000–8700 BC), Khiamian, and PPNA (Pre-Pottery Neolithic A): After the deterioration in climate in the Younger Dryas period, the development of permanent settlements continued. Houses remained circular and were often subterranean. Public buildings of probable ritual function occur next to individual habitations (the tower of Jericho, the subterranean buildings of Jerf el Ahmar, the monuments with megalithic steles at Göbekli Tepe) (Schmidt 2006). Crop cultivation emerged, although seeds had not yet undergone morphological changes (incipient agriculture). Hunting was still practised.
- Pre-Pottery Neolithic B (8700–7000 BC): During its early phase (early PPNB, 8700–8200 BC) wheat and barley assumed a morphologically cultivated form while the control of ungulates was reinforced in the northern Levant (pig, sheep, goat, cattle). From that time on, houses exhibit rectangular, sometimes elongated, multicellular plans (e.g. Çayönü). During the middle PPNB (8200–7500 BC) and

late PPNB (7500–7000 BC), animal domestication was finalized, although hunting remains an important subsistence strategy. Site variability was emphasized and very large major settlements exceeding 10ha in size occur (Abu Hureyra, Syria; Aïn Ghazal, Jordan). Anthropomorphic representations became increasingly frequent and ranged from small figurines to real statues (Yeni Mahalle at Urfa, Turkey; Aïn Ghazal, Jordan). Complex ceremonies were practised, indicating the social and religious organization of these communities (e.g. removal and plastering of skulls). Important distribution networks (obsidian from Cappadocia and eastern Anatolia, stone vessels and armrings, shells) are affirmed within this 'PPNB *koine*' (Bar Yosef 2006).

- Pottery Neolithic/PPNC (7000–6500 BC): The collapse of the PPNB *koine* is characterized by the dislocation of distribution networks and the emergence of regional cultural units. Various pottery styles appeared *c.* 7000 BC—Dark Faced Burnished Ware with impressed decorations from Cilicia to Lebanon, smoothed pottery in Anatolia (e.g. Çatal Höyük) or in the Balikh-Euphrates sector (Le Mière and Picon 1999)—whilst the Pre-Pottery evolution continued in other regions, like the southern Levant, before breaking up and being replaced in the latter area by the Yarmoukian ceramic culture *c.* 6500–6200 BC (Garfinkel 1999).

The emergence and development of the Neolithic in Cyprus

Epipalaeolithic groups established themselves on the island by 10,000 BC. On the only site dated to this period (Aetokremnos, on the peninsula of Akrotiri), their economy is based on catching birds, batrachians, and reptiles, on collecting shells, and perhaps on hunting wild boar. People's role in endemic fauna extinction (pygmy hippopotami and dwarf elephants) has been discussed (Simmons 1999 versus Binford 2000).

During what is the PPNA phase on the Near-Eastern mainland (10,000–8500 BC), poorly known human groups were present in Cyprus. Lithic evidence from Asprokremmos at Agia Varvara and Thrombovounos at Ayios Tychonas is similar to contemporary Near-Eastern assemblages of burins, obliquely truncated blades, blades with sickle gloss, and leaf-shaped projectile points (McCartney et al. 2007). The economic status of this population is not yet clear, but was possibly characterized by incipient agriculture and the hunting of some local species (e.g. boar).

Population growth seems to occur during the early PPNB (8500–8000 BC), as shown at Shillourokambos (early phase A), Kalavasos-Tenta (phase 5), and well 116 at Mylouthkia (Guilaine and Le Brun 2003). Architectural structures were built with wood and daub, as with the circular shelters and fenced enclosures at Shillourokambos (Guilaine and Briois 2006) (Fig. 4.1, 1 and 2). From now on, agriculture was based on domestic wheat

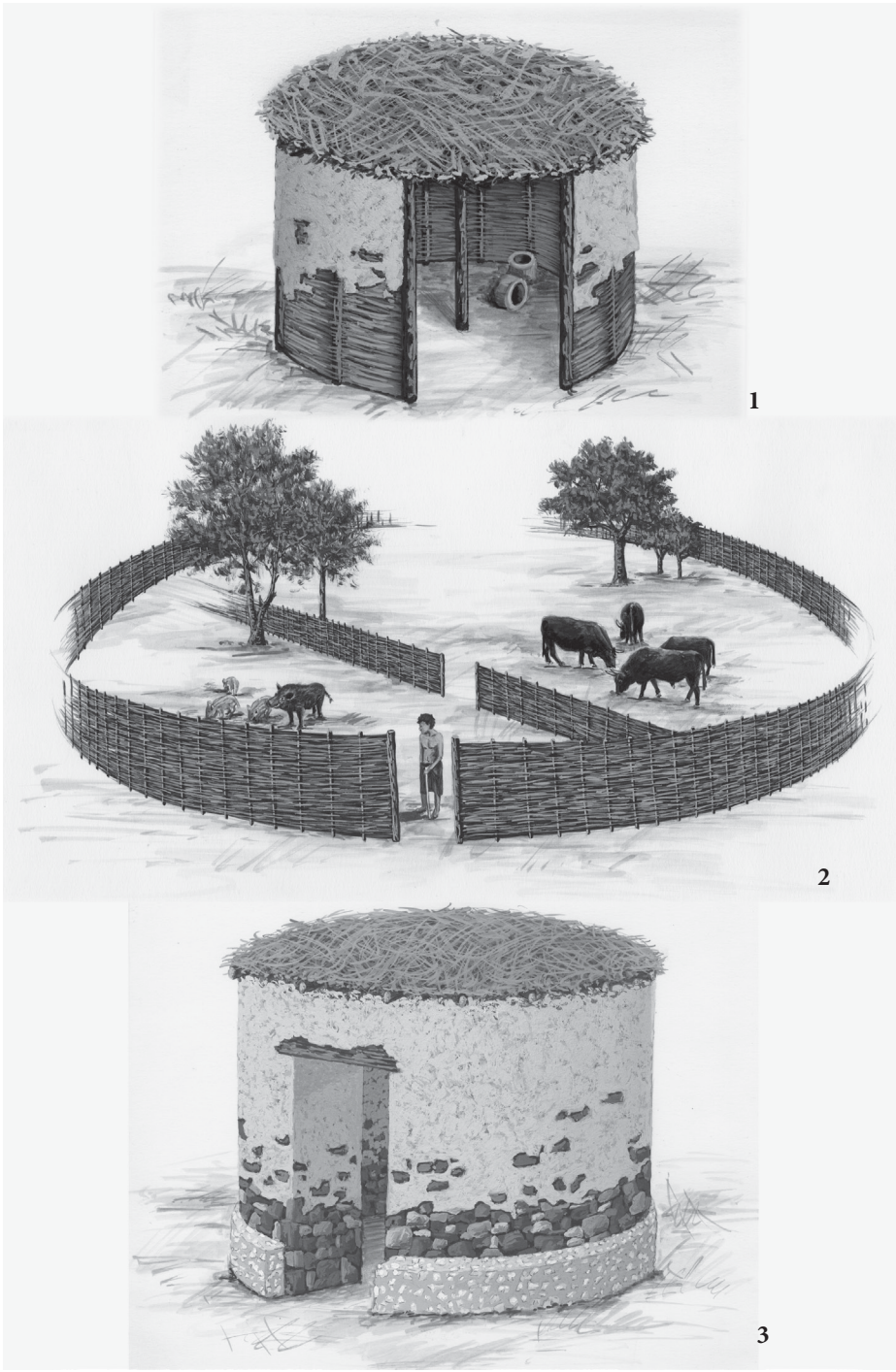

FIG. 4.1. Reconstruction of Parekklisha-Shillourokambos, PPN, Cyprus: 1. wood and daub shelter (*c.* 8400–8300 BC); 2. large fenced enclosure (*c.* 8200–8000 BC); 3. stone and clay house (Khirokitia culture, *c.* 7000 BC).

(Drawings by A. Jesionka).

(*Triticum dicoccum, Triticum monococcum*) and barley (Peltenburg 2003). Sickle blades have close counterparts on the mainland. Obsidian imports from the volcanic region in Cappadocia (Gollü dağ) became regular. Pig, goat, and cattle were herded, whilst hunting focused on wild boar. Wells were dug to exploit the ground water resources.

By 8000 BC, and during the middle and late PPNB, dwellings were built with resistant materials (limestone, hard rocks, mudbricks, clay), and floors were plastered (e.g. Ais Yorkis). Unlike in the Near East, house structures remained circular (Fig. 4.1, 3). Chipped stone industries made of high-quality translucent chert were inspired by PPNB traditions: bidirectional blade production is evident on naviform cores, composite sickles, and tanged projectile points (Byblos points). Stone vessels were made of limestone or volcanic rocks. Obsidian imports reached their peak (several thousand pieces at Akanthou on the northern coast). There is clear evidence for cereal cultivation. Sheep were introduced and exploited for milk, meat, and fur. The Mesopotamian fallow deer (*Dama mesopotamica*) was transferred to the island and became the main hunting resource. The cat was already tamed. The dead were sometimes grouped together, as in pit 23 at Shillourokambos, but before long individual burials became the standard.

Changes occured from 7500 BC. Obsidian imports became scarce and opaque cherts from Lefkaran sources were henceforth used to produce robust toolkits (picks, scrapers, and large blades used as sickles). This heralds the last stage of the Cypriot PPN or Khirokitia culture which reached its acme in the seventh millennium (Le Brun 1984, 1989, 1994). The eponymous site, located on a hillock, is enclosed by defensive walls. Stone vessels remained in use whilst pottery, which is widespread on the continent, was still ignored. Agriculture was based on einkorn, emmer, lentils, and to a lesser extent barley. Figs and olives were gathered. Goats, sheep, and pigs were the main meat sources, whilst cattle have more or less disappeared. Some sites (e.g. Cap Andreas Kastros) specialized in fishing for coastal (grouper, porgies) or seasonally migratory species (tuna).

The Khirokitia culture disappeared at the beginning of the sixth millennium or even from as early as the second half of the seventh millennium. This may be related to environmental crises at around 6200 BC, leading to subsequent aridification in the Near East. Population decreased markedly, not recovering until the fifth millennium with the development of the ceramic Neolithic Sotira culture.

The characteristics of the Neolithic diffusion in the Mediterranean: some theoretical considerations

Whereas the Neolithic colonization of Cyprus was early, the spread into the Aegean basin did not begin until the seventh millennium BC. This expansion raises the more general question as to why the Neolithic spread out of the Levantine region in the first place. There have been various hypotheses, none of which are totally satisfactory:

- The demographic pressure hypothesis—the strong increase in birth rates ensuing from village-based life and the adoption of agriculture resulted in too many mouths to feed and evacuation to neighbouring regions. The slowness of this initial spread (there are 2,000 years between the early PPNB, the main phase of domestication, and the appearance of the Neolithic in Thessaly) leaves this proposal unconvincing.
- The social stress hypothesis—the PPNB would have created differences in social status amongst Levantine communities. In order to avoid an overly rigid hierarchical society, the Neolithic colonizers escaped to a more egalitarian social system. It is impossible to verify this although there is hardly any evidence for very large Levantine settlements in the earliest Mediterranean Neolithic. It is also difficult to consider its ideological implications, although early farmers, strong in their new economic system and its attached values, could have spread it in a kind of religious proselytism (Cauvin 1994).
- The environmental hypothesis—climatic deterioration *c*. 6200 BC would have destabilized Near-Eastern PPNB populations and favoured a return to earlier mobility patterns and the practice of pastoralism (cf. Ain Ghazal during the PPNC/Yarmoukian transition). Some authors (Weninger et al. 2006) consider that the climatic crises would have forced populations to emigrate to Anatolia and Europe, but this is problematic. The radiocarbon dates seem to indicate that Neolithic communities were already established in south-east Europe by 6200 BC; therefore the climatic reversal is more likely to have disturbed a migration process which had already begun than to be the cause of it. On the other hand, it is attested that this event considerably weakened the last hunter-gatherer populations in the central and western Mediterranean. From Greece to the Iberian peninsula, evidence from stratified cave and rock shelter sites show a lack of deposits between the levels of the final Mesolithic and those of the first Neolithic (Biagi and Spataro 2000; Berger and Guilaine 2006). These gaps occur regularly over the last centuries of the seventh millennium, at the moment when Neolithic groups arrive in western mainland Greece and begin the colonization of the western Mediterranean. Could this deterioration in climate have forced autochthonous populations in the western Mediterranean to return to increased mobility or to split into very small groups? Or did erosion destroy a number of final Mesolithic sites? That these layers are not found in southern Italy, Sicily, Sardinia, Corsica, and from Catalonia and Andalusia, renders the analysis of possible acculturation processes of the local populations and the possible Mesolithic heritage of first village communities very difficult.

Further discussion is concerned with the characteristics of this diffusion. By contrast to the process of regular advance at 1 km/year proposed by A. Ammerman and L. Cavalli Sforza, there is the model of 'arrhythmic' propagation, characterized by sudden diffusions and marked by breaks activating further rapid expansions (Guilaine 2003) (Fig. 4.2). The breaks correspond to areas where a culture reaches the limits of

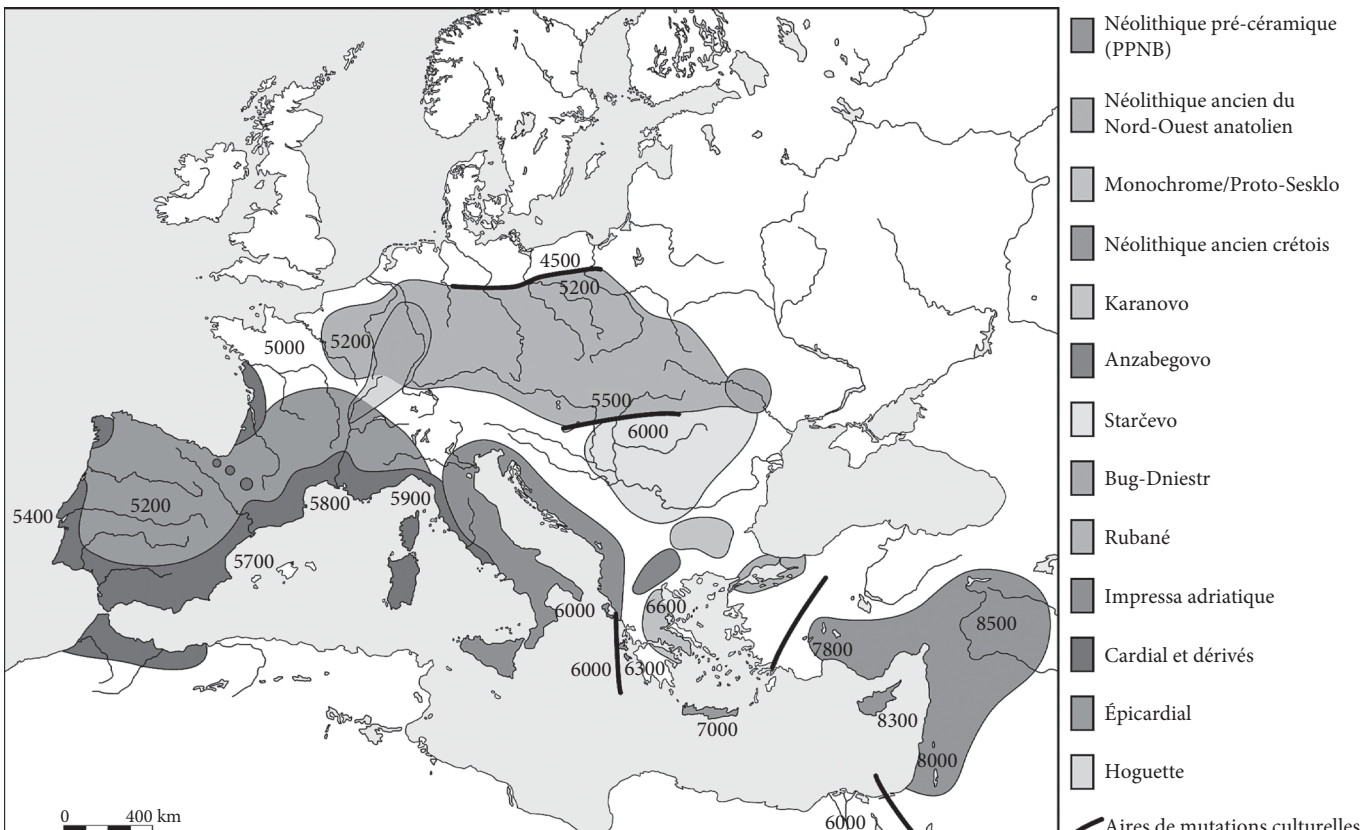

FIG. 4.2. Map showing the 'arrhythmic' diffusion of agriculture throughout Europe. The dates indicate the first appearance of agro-pastoralism in a given region. The black lines show the main cultural boundaries, corresponding to temporary breaks during propagation and the re-foundation of new cultures.