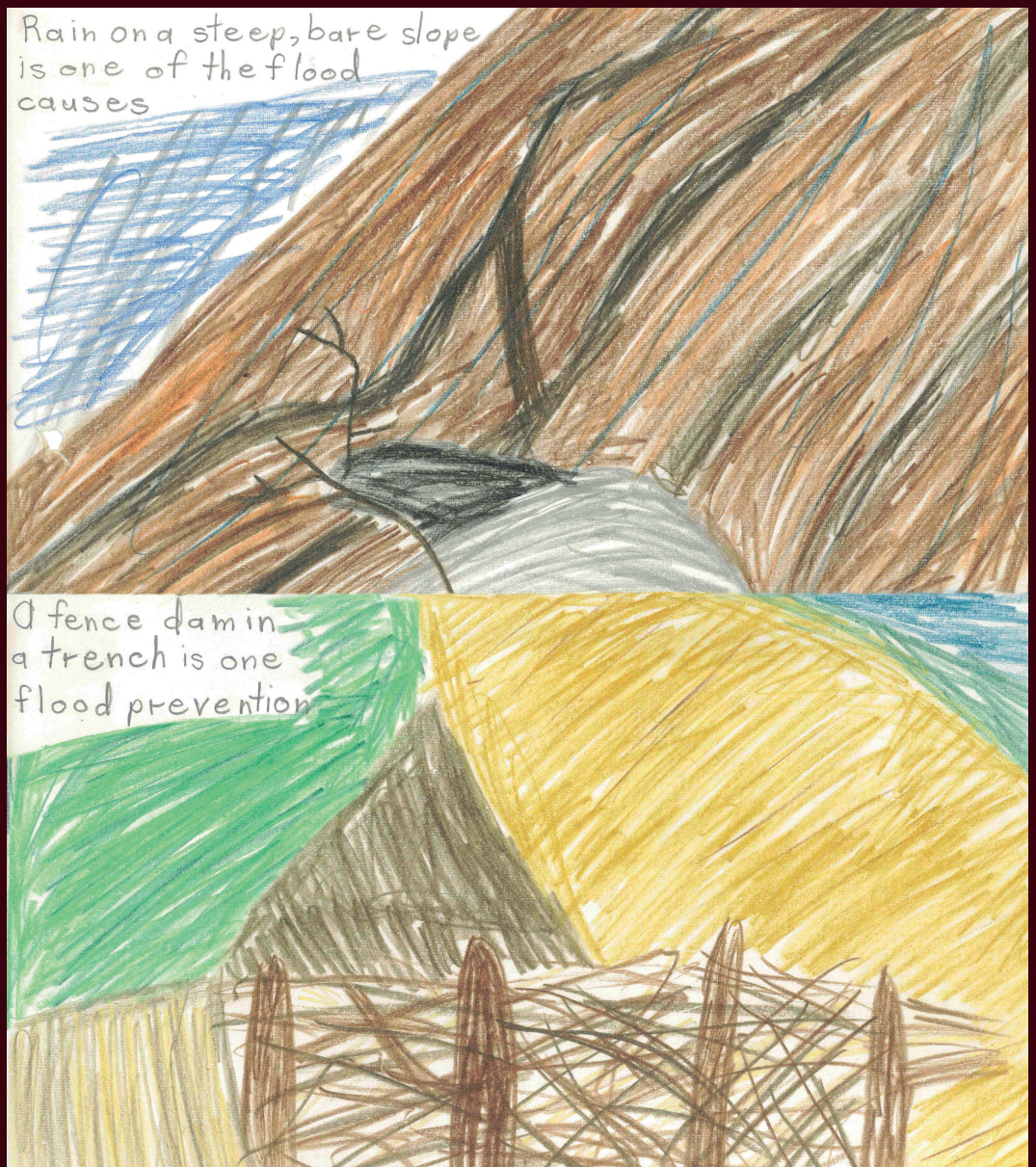
McDONALD INSTITUTE CONVERSATIONS

Inspired geoarchaeologies: past landscapes and social change

Essays in honour of Professor Charles A. I. French

Edited by Federica Sulas, Helen Lewis & Manuel Arroyo-Kalin



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Essays in honour of Professor Charles A. I. French

Edited by Federica Sulas, Helen Lewis & Manuel Arroyo-Kalin

with contributions from
Michael J. Allen, Andrea L. Balbo, Martin Bell, Nicole Boivin, Christopher Evans, David Friesem, Kasia Gdaniec, Lars Erik Gjerpe, Michael Gill, Martin Green, Ann-Maria Hart, Robyn Inglis, Martin Jones, Gabriella Kovács, Helen Lewis, Johan Linderholm, Roy Loveday, Richard I. Macphail, Caroline Malone, Wendy Matthews, Cristiano Nicosia, Bongumenzi Nxumalo, Innocent Pikirayi, Tonko Rajkovaca, Rob Scaife, Simon Stoddart, Fraser Stuart, Federica Sulas & Magdolna Vicze

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On the cover: *Hand drawn illustration by Charly French, aged around 10 years old. Courtesy of Kasia Gdaniec.*

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Mike's (BSc, PhD, MCIfA, FLS, FSA) research and geoarchaeological interest was originally based around the analysis of colluvium and land snails, including in the South Downs, Dorchester, Cranborne Chase, Stonehenge and Avebury in particular; these were the subject of both his undergraduate and PhD research. He has combined a career dominated by commercial archaeology with involvement in university research projects and as a staff lecturer at Sussex, Bournemouth and Oxford Universities. He was Environmental Manager at Wessex Archaeology for twenty years and for fifteen years has run his own geoarchaeological consultancy from a purpose-built bespoke lab, where he is involved in research designs and coordination of environmental archaeology from fieldwork to publication. Projects have been as diverse as intertidal zone research and Maltese prehistoric temples. His interests now lie principally in landscape archaeology and the development and creation of landscapes through prehistoric human intervention. He has worked with – and still is working with – Charly French in Cranborne Chase, the Stonehenge Riverside Project, and both recent Avebury landscape projects. He is vice-president of the Conchological Society, and as founding editor of the Prehistoric Society Research Papers has seen ten peer-reviewed volumes through to publication.

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Following his PhD at the University of Cambridge (2008), Andrea conducted geoarchaeological research at the Spanish Research Council (CSIC) and at the University of Hamburg. Since 2019 he has been employed at the ALIPH Foundation for the protection of heritage in conflict areas, based in Geneva, where his main focuses are the linkages between climate change, conflict and cultural heritage protection, and the role of documentation and ICT in cultural heritage protection. Co-founder and CEO of Platform Anthropocene Ltd., Andrea leads the development of a comprehensive interdisciplinary web repository on the Anthropocene. He also maintains university teaching in archaeology, heritage and human-environment interaction and acts regularly as a scientific evaluator, rapporteur, and monitor for the European Commission.

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Christopher was the executive director/director of research of the Cambridge Archaeological Unit (CAU), University of Cambridge until 2021. Having worked in British archaeology for over forty years – with his initiation to Fenland archaeology coming at Fengate – following on from the Haddenham Project, he co-founded the CAU with Ian Hodder in 1990. He has directed a wide variety of major fieldwork projects, both abroad – Nepal, China and Cape Verde (the latter sometimes involving Charly) – and in the United Kingdom. A fellow of the Society of Antiquaries of London, in 2018 he was elected a fellow of the British Academy. He has published widely, including monographs arising from both his own landscape projects and those of earlier-era practitioners in the CAU's 'Historiography and Fieldwork' series (e.g. Mucking in 2016). Together with Tim Murray, he edited Oxford University's *Histories of Archaeology: A Reader in the History of Archaeology* (2008).

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Kasia works as an archaeological curator at Cambridgeshire County Council, advising local planning authorities on managing change to the historic environment, and scoping investigation programmes for developers and commercial archaeologists that promote both academic rigour and public engagement. Her particular interests lie in the technical difficulties of preservation *in situ* as a long-term archaeological management technique, the ceramic traditions of Neolithic and Bronze Age Britain, the evolution of the East Anglian fens and the adaptation of local communities to their changing environments, and the history and legacy of post-medieval fen draining schemes and how this shapes current competing land use and environmental pressures.

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Lars has a Masters and PhD in archaeology from the University of Oslo, with a thesis on Iron Age settlement and property rights in southeastern Norway. He has directed several large-scale heritage management excavations for the Museum of Cultural History at the University of Oslo, mainly targeting Iron Age burials, settlements and agricultural remains, while including other periods and relics. As a result, he has been editor and main author of publications on cemeteries (*Gravfeltet på Gulli*, University of Oslo 2005) and Iron Age settlements. Interdisciplinary cooperation and environmental archaeology, including archaeometric analysis (e.g. seeds, charcoal and soil), have been an integrated part of these projects. He has also been editor for the journal *Primitive tider* and academic editor of Trond Løken's 2020 *Bronze Age and Early Iron*

Age House and Settlement Development at Forsandmoen, South-western Norway. Currently, he is a member of the steering committee for large-scale heritage management excavations at the NTNU (Norwegian University of Science and Technology).

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Martin began a fieldwalking survey as a lad on Cranborne Chase in the latter 1960s. Following experience gained on a number of field projects, he began excavating independently in the region in 1976. He joined Richard Bradley's and John Barrett's Cranborne Chase Project the following year, contributing four site excavations to *Landscape, Monuments and Society* in 1991. He continued independent fieldwork in the early 1990s in collaboration with Mike Allen, in particular on the Fir Tree Field shaft which revealed a remarkable sequence of deposits dating from the late Mesolithic to the Beaker period, and worked with Charly French on the Upper Allen Valley Project 1998–2003, contributing four further site excavations to *Prehistoric Landscape Development and Human Impact in the Upper Allen Valley, Cranborne Chase, Dorset* (2007). Since that time, he has continued independent research, also in collaboration with Josh Pollard and Southampton University, on the Dorset Cursus, on Down Farm and in the Knowlton environs whilst continuing to increase the biodiversity on his small farm. He was made an FSA (Fellow of the Society of Antiquaries) in 2004 and received an honorary Doctor of Science degree from Reading University in 2006.

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Robyn is a geoarchaeologist interested in the formation of the archaeological record and its impact on our understanding of Palaeolithic dispersals. After receiving her BA in Archaeology and Anthropology from Cambridge, she gained her MSc in Geoarchaeology from Reading. Her PhD in the McBurney Laboratory focussed on the micromorphological reconstruction of sedimentation at the Haua Fteah, Libya, and its implications for understanding human/environment interactions. From 2011–8 she led geoarchaeological survey in Saudi Arabia to further understand the Palaeolithic occupation of the Red Sea littoral and its role in hominin dispersals, first as part of the DISPERSE project at the University of York, and later as a Marie Skłodowska-Curie Global Fellow (University of York and Macquarie University). She now works in research development at the York Environmental Sustainability Institute, University of York, and is an Honorary Research Associate in the university's Department of Archaeology.

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Martin was the first George Pitt-Rivers Professor of Archaeological Science at the University of Cambridge. He works on archaeobotany and archaeogenetics, in the context of the broader archaeology of food. In his earlier career he explored the development of agriculture in later prehistoric and Roman Europe, after which he was very much involved in the development of biomolecular approaches within archaeology. These he applied to research into the spread of farming of both major and minor crops across Asia, most recently in the context of the Food Globalization in Prehistory Project. His latest project is exploring the co-evolution and Eurasian biogeography of crops and bees.

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Helen is an associate professor at University College Dublin School of Archaeology. Her background is in archaeology and anthropology (BA University of

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Johan trained in archaeology and chemistry, specializing in soils and archaeology (BSc and MSc Umeå University). His PhD dealt with soil chemical aspects on settlement organization over time and general human impact on soils. He has been working with research and contract archaeology in several large projects over the last thirty years, mainly in Scandinavia but also in Gibraltar, Italy, France and the UK. Currently he holds a position as associate professor at Umeå University and is conducting research related to reflectance spectroscopy at the Environmental Archaeology Laboratory (MAL), University of Umeå.

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Richard trained in geology and geography, specializing in soil science (BSc Swansea University). An MSc in pedology and soil survey (Reading University) prepared him for a soil science PhD on podzol development on heathlands (Kingston Polytechnic). An English Heritage-funded archaeological soil contract at the Institute of Archaeology (University College London) provided further training and international research opportunities were developed, including working with the Soil Survey of England and Wales and Macaulay Institute, UK, the CNRS, France, and the Soprintendenza, Italy. This led to the publication of *Soils and Micromorphology in Archaeology* (with Courty and Goldberg; Cambridge University Press 1989), the founding of the International Archaeological Soil Micromorphology Working Group, and training weeks at UCL. As a result, *Practical and Theoretical Geoarchaeology* (Blackwell 2006; Wiley 2022) and *Applied Soils and Micromorphology in Archaeology* (Cambridge University Press 2018), both with Goldberg, were written. Macphail is a recipient of the Geological Society of America's Rip Rapp Award for Archaeological Geology (2009), and is a fellow of the Geological Society of America. He is also the 2021 co-awardee (with P. Goldberg) of the International Union of Soil Sciences Tenth Kubiëna Medal for Soil Micromorphology. The paper included here also reflects more than two decades of research across Scandinavia.

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Wendy is a specialist in Near Eastern Archaeology and geoarchaeology, focusing on micromorphology of the built environment and long-term perspectives on sustainability (MA Edinburgh 1984; PhD Cambridge 1992, 'Micromorphology of occupational sequences and use of space in a Sumerian city'). She was a research associate and fellow of the McDonald Institute (1993–2000) and is an associate professor in Archaeology at the University of Reading, following a semester as visiting lecturer at UC Berkeley. She was a member of the *Çatalhöyük* team and steering committee, Turkey (1993–2017). She co-directs the *Central Zagros Archaeological Project* investigating the Neolithic of the Eastern Fertile Crescent, Iraq, Iran (2007–), and has conducted research in Syria and Bahrain. She has co-supervised twenty-two PhD students and teaches modules on past, present and future sustainability; micromorphology; and Mesopotamia. She co-designed a new prehistory gallery at the Slemani Museum with Iraqi and Reading colleagues, with sustainability as a central theme.

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Francis has studied the archaeology of the Fens since 1971. His major excavations in the region took place near Peterborough at Fengate, Maxey and Etton. In 1982 his team's survey of fenland drainage dykes revealed the timbers of a waterlogged Bronze Age timber platform and causeway at Flag Fen, which was opened to the public in 1989. He was a member of Channel 4's long-running series *Time Team*. He has written many popular books including *Seahenge* (2001), *Britain* BC (2003), *Britain* AD (2004), *The Making of the British Landscape* (2010), *Home* (2014), *Stonehenge* (2016) and *The Fens* (2019). His most recent book is *Scenes from Prehistoric Life* (Head of Zeus 2021).

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Tonko is chief research laboratory technician in geoarchaeology at the University of Cambridge. Involved in archaeology since his childhood, he held posts of archaeological site director and museum curator in Serbia (pre-1994) before moving to the UK to specialize in the late Upper Palaeolithic archaeology of ex-Yugoslavia via an MPhil (2004) at the University of Cambridge, and a PhD at the University of Ljubljana (2017). After four years at the Cambridge Archaeological Unit, he took up the post of geoarchaeology technician at the Department of Archaeology in 2008, and since then he has been working at the McBurney Laboratory of Geoarchaeology. He has directed and managed several archaeological projects, field and laboratory training in the UK and eastern Europe. He has authored several volumes and articles, including a monograph on preventive archaeology in ex-Yugoslavia published by Belgrade's Institute of Archaeology (2019) and a manual of archaeological excavation (co-authored with J. Appleby, 2015).

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Rob is a visiting professor of palaeoecology and environmental archaeology at the University of Southampton, and an honorary research associate of the McDonald Institute for Archaeological Research at the University of Cambridge. His first degree was in geography with geology, and an interest in the Pleistocene led him into palynology. He investigated the Late and Post-glacial vegetation changes of the Isle of Wight for his PhD (King's College London). Subsequently, he worked at the Institute of Archaeology, London, and the Ancient Monuments Laboratory at English Heritage. As a freelance palaeoecologist, he has continued to work across southern and eastern England, along with international studies in Italy, Turkey, Peru and Chile.

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Simon and Caroline have been engaged in the research of ancient landscapes for nearly forty years, with a

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Introduction

Over the past three decades, geoarchaeology has opened exciting new avenues for understanding the past. From reconstructing changing climate and people's ways of living to tracing societal development and resilience, geoarchaeological research is capturing dimensions of the past at an unprecedented level of detail. This advance stems from new conceptual frameworks and new methodological developments for retrieving and interpreting past records from soils and sediments at multiple spatial and temporal scales. Soils and sediments provide a resourceful archive on past environments, resource use, and settlement lifeways over time. From these records we can infer information on past environmental and climatic conditions, subsistence strategies, cultural practices and choices, and how these changed over time: from charting the long-term evolution of prehistoric landscapes to mapping seasonal household activities. This volume brings together examples from across the globe to illustrate how studies of soil archives are transforming approaches to the past.

When the McDonald Institute was established in 1990 at the University of Cambridge, geoarchaeology was one of the priority fields for the new Cambridge research and teaching environment. A trust to develop the legacy of Charles McBurney and nurture what would soon become a defining feature of archaeology in Cambridge and the UK was bestowed upon a young, Canadian-born and British-trained field archaeologist named Charles Andrew Ivey French. Three decades later, after numerous publications, hundreds of students taught, countless field and lab-based projects successfully completed, and dozens of specialized PhD fellows trained, 'geoarchaeology in action' has reached maturity, and the McBurney Laboratory has become a beacon of geoarchaeology research and teaching in the world. The research begun in the McBurney has proliferated into dozens of *inspired geoarchaeologies*, and spread worldwide.

This volume is a celebration of these achievements, reflecting the outputs and successes of the laboratory under Charly French's leadership, presenting a range of reviews and case studies that illustrate various geoarchaeological strands, methods, and applications. These scholarly contributions follow French's own *Geoarchaeology in Action* (Routledge 2003) and *A Handbook of Geoarchaeological Approaches to Investigating Landscapes and Settlement Sites* (Oxbow 2015), being presented in an accessible way to engage the ever-growing community of students and scholars working on archaeological topics. The authors are drawn from Charly's previous graduate students, postdoctoral researchers, and collaborators, all experts in their given fields. The volume provides a comparative overview of the range, potential and application of geoarchaeological approaches with a focus on advancing concepts and methods in geoarchaeology, and the study of peoples and landscapes, and lifeways.

These key themes are examined through exemplary reviews and case studies that illustrate how geoarchaeological approaches can deliver new human histories, expand our ability to access the past, and contribute new applied research to present and future challenges. The variety of places, periods, and the crossing of disciplines is a deliberate choice that best reflects the geoarchaeological research and teaching Charly French developed at Cambridge and spearheaded across the globe. Traditionally, geoarchaeology volumes tend to focus on geomorphological and micromorphological applications. This edited volume takes a very different approach to respond to an increasingly diversified practice. Over fifteen chapters, the geoarchaeology celebrated in this volume presents the research and perspectives of scholars from academic and professional sectors who offer integrated accounts of different approaches to the study of the past, where analysis of soils and sediments goes together with the

Figure 0.1. *Charles McBurney Laboratory for Geoarchaeology. The thin section facility (B5) with the shelf full of soil micromorphology blocks drying ahead of processing; August 2022. Image: Federica Sulas.*

study of plant and animal remains, historical records, ethnographic observations, and human practices from the macro- to the nanoscale.

To set the spirit of this volume, six short pieces offer personal accounts that illustrate the ways in which Charly's teaching and research have impacted personal and professional lives within and beyond academia. Reflecting on this impact, these accounts highlight the development, contributions and diversification of geoarchaeology at Cambridge over three decades, and also illuminate paths going forward. These are followed by chapters, a combination between reviews and research results, organized into in two parts.

Archaeology, if you like

The section sets the conceptual agenda of the volume and gives voice to diverse theoretical geoarchaeological frameworks through a number of critical reviews of the development of geoarchaeology from the early 1980s to the present. These chapters frame the intellectual context(s) through which the ideas and implementation of the case studies presented in the second part were developed. In reviewing practices and methods, contributors engage with the potential and challenges of multi-scale analysis to examine and interpret the past captured in soil archives across different environments, landscapes, sites, and single contexts. Working with and across disciplines, geoarchaeology's growth in scope and impact has a bearing on field practices and training (Sturt). It is through the integration of multiple techniques to access the diverse records preserved in soil archives that we can appreciate how geoarchaeological approaches are transforming knowledge of the past. Especially significant are the contributions to issues and contexts that are notoriously difficult to address in archaeology: scale (Inglis; Allen), fluvial and wetland environments (Balbo; Nicosia, respectively). In these

and other contexts, integrating soil pollen analysis and soil micromorphology has unique potential for resolving ever-present challenges in archaeology, such as taphonomy and vegetation history (Scaife). Approaches to sampling and thin section making for archaeological soil micromorphology are currently diversifying to satisfy an ever-growing application in both academic and commercial sectors. A final contribution to this section summarizes the experience and expertise developed by the McBurney Laboratory over the years in devising ad hoc practical and technical protocols for sampling and processing thin sections from archaeological and landscape contexts from across different environmental and cultural settings (Rajkovaca).

Peoples, landscapes and lifeways

The second section presents case studies and new approaches to investigating landscape evolution and social development across different environments, periods, and cultures. Chapters address topics such as climate and environmental change, human impact on the environment, landscape transformation and resilience, the impact and identification of land-use histories, settlement change, building and burial practices. They do so by engaging with new developments in extracting and detecting human footprints in buried soils and archaeological sediments, charting taphonomic processes, the use of ethnography and experimental archaeology, and defining preservation conditions. A common theme unfolding through different case studies is the significance of understanding the nature and pace of such impacts for archaeology and, critically, as a matter of wide contemporary relevance. The case studies demonstrate the unique capabilities and tools of geoarchaeology to identify, model and predict the nature and impact of climate and environmental changes (Evans), as well as the impact of land use and settlement on landscapes and ecologies (Stoddart & Malone; Macphail *et al*.; Sulas *et al.*). Chapters examining earthen architecture (Friesem; Kovács & Vicze) showcase how soil micromorphology can capture and expose factors, processes and patterns of building, use, maintenance, and degradation in building contexts. Case studies examining Bronze Age barrows (Lewis & Hart) and earthworks (Green *et al*.) reveal the deep understanding of local soils and environmental conditions ancient societies employed to create their burial and ritual landscapes.

The long gestation of this volume occurred through the outbreak and spread of a global pandemic, which has put extraordinary burdens on all. Nonetheless, it has been a pleasure and a privilege to put together this volume which is really the result of a collective effort, perseverance, and patience of all who have contributed to it. We are most grateful to all the contributors for going the extra mile to bring this volume together, always cheerfully no matter the challenges. A special note of thanks goes to Kasia Gdaniec for much help and support all the way through.

Our thanks extend to the McDonald Institute Monograph Series editorial staff: the series editors, Cyprian Broodbank for supporting this editorial project throughout, and Matt Davies for bringing it to publication; Emma Jarman for guiding us through the publication process; and Ben Plumridge for his formidable job in producing the volume at record time. Two anonymous reviewers offered competent and helpful comments to refine and improve the volume.

Cambridge, London & Dublin
9 September 2022

Federica Sulas, Helen Lewis &
Manuel Arroyo-Kalin

A biographical sketch of Charly French, geoarchaeologist

Helen Lewis, Federica Sulas & Manuel Arroyo-Kalin

At the time of writing, Charles Andrew Ivey French was Professor of Geoarchaeology, Director of the McBurney Geoarchaeology Laboratory, and Fellow of St Edmund's College at the University of Cambridge. Charly obtained his BA in archaeology at University College Cardiff, and his MA and PhD in environmental archaeology at the Institute of Archaeology, University College London (Fig. 0.2). Before coming to Cambridge as Lecturer in Archaeological Science in 1992, he worked for a long time doing palaeoenvironmental research and excavations at the Fenland Archaeological Trust, where he became Assistant Director. At Cambridge, he developed the McBurney Laboratory as its founding director into a world-class geoarchaeology laboratory (Fig. 0.3) and attracted students and researchers from around the world to do geoarchaeology at the Department of Archaeology. During his tenure, Charly was Director of Studies for Archaeology and Anthropology at Fitzwilliam College, was promoted to Senior Lecturer in Archaeological Science, Reader in Geoarchaeology, and Professor of Geoarchaeology, and served as Head of Department/Division of Archaeology and Acting Head of Archaeology and Anthropology. In 2009 he won a Pilkington Teaching Prize for his contribution to the development of practical teaching at the University of Cambridge. A biography of Charly has been published elsewhere (Arroyo-Kalin 2020), so here we wish to reflect on the impact that Charly had on the world of geoarchaeology as a mentor, teacher, and colleague.

In an age of assessing impact, one wonders how numbers translate into knowledge development, critical mass and thinking. Nurturing a new generation and inspiring a following are major contributions. Many of Charly's students went on into academia, government or private archaeological firms (Fig. 0.4). From his PhD students alone, there are to date: professors (3), associate professors (6), lecturers (2), a director of a department of archaeology, senior research associates (2), directors of research in CRM (2), post-doctoral researchers (8), research associates (3), free-lance geoarchaeologists (2), a senior field archaeologist, and research and education consultants for national research councils (2). Many of the post-doctoral researchers who spent time in the McBurney Laboratory have likewise gone on to have impressive academic and other professional careers. We have tried to collate a list of Charly's postgraduate students and post-doctoral researchers in Tables 0.1 and 0.2, but are sure that we have left people out – people who we didn't realize were working with him, some MPhil students and post-docs that he advised more informally, shorter-term post-docs, or more recent students. We apologize to those who are missing.

Charly's research projects have been truly global in scope (Fig. 0.7), and his list of collaborators would cover several pages – he has surely contributed greatly to the metrics for 'impact indicators' universities have to collate these days. His official CV, while long, is characteristically minimalist – it lists grant-funded projects in the Aguas Valley (Spain), Bronze Age Europe (pan-European), New Mexico and Montana (USA), Cranborne Chase, Stonehenge, Avebury, Must Farm, Aldborough (UK), Upper Teijo River Valley, Southern Patagonia and Tierra del Fuego (Chile), Rio Ica (Peru), Aksum (Ethiopia), Cape Verde (Fig. 0.5), Benue Valley (Nigeria), African farming systems (pan-African), Mediterranean farming systems (Fig. 0.6), European farming innovation, Vlasac and Drenovac (Serbia), northwest India and the Indus Valley, the Channel Islands (UK), Malta, Bosnia, Herzegovina, several projects in Italy, heritage in archaeological sciences – but these are all on top of his (barely hinted at in the CV) prolific geoarchaeological consultancy projects, advisory positions, associations, student advisory work, conference papers, PhD examinations, etc. Many

Figure 0.2. *Charly measuring soil particle size using the hydrometer method at East Karnak, Egypt,* c. *1976–7 (see French 1981, in the publications list on pp. 15–26). Image courtesy of Kasia Gdaniec.*

of the projects represent links he has developed with his graduate students and colleagues at Cambridge, and in his career in UK archaeology.

To get a better sense of the scope of his research, you really need to look at his publications, reports and conference contributions. We have collated a list as complete as we could manage of his written work (see pp. 15–26), thanks largely to Kasia Gdaniec and a lot of internet trawling. Just glancing through the list gives a sense of the range of his research interests and contributions, and we feel that his impact is especially symbolized by the seemingly innumerable collaborators with whom he has worked. Hundreds of project and consultancy reports (grey literature) are not listed here, however; they are largely ignored except maybe by funding agencies, CRM companies and county council archaeology offices. Adding all of his reports would at least double the amount of writing represented by this bibliography. We have added what we could find listed online.

Some memories from Helen Lewis

When I arrived at Cambridge in 1992 and I went to meet Charly for the first time, coming out of his office was his first official PhD supervisee, Allan Morton, an archaeology grad student I had known from the University of Toronto. What a small world! Charly's office was full of very well organized boxes, and I expect it likely remained so throughout his tenure. I could not start my PhD until 1993 in the end because of finances, but Charly took care of me even though I wasn't 'officially' there – he helped me get a job with the Cambridge Archaeological Unit, which I kept up

Figure 0.3. *The opening of the Charles McBurney Laboratory for Geoarchaeology with the then HRH Prince Charles and Lord Colin Renfrew. Image courtesy of Kasia Gdaniec.*

part-time through much of my PhD, and which gave me invaluable field and post-ex experience and connections that I needed to do my research (plus friends and cash, of course). In 1993 when I began my PhD – the first archaeological soil micromorphology PhD to start at Cambridge, the McBurney Lab had a new home in the then-new McDonald Institute buildings, had a technician (Julie Boreham), a post-doc (Wendy Matthews), and several MPhil students who would stick around to do their doctoral research there as well – Melissa Goodman, Gillian Wallace, Karen Milek, Nicole Boivin – and later many, many more. It was so quiet at first, and I had to book time on Wendy's fancy new microscope because we didn't have much more equipment then. By the time I left after several years of post-doc grants with the Wyke Down Project, the lab had several top-of-the-line microscopes, a gorgeous macroscope (that I have yet to find the money to replicate in my post-McBurney life), and was churning out dozens of 'mammoth' thin sections every year. The lab adopted several other researchers as members, some from within the department, some from elsewhere – in my first while there these were Jen Heathcote, Laurence Smith and Jianjun Mei. In the early days it was a small and enthusiastic group, mostly focused on geoarchaeology and micromorphology of soils and sediments, but with a bit of a sideline in materials studies. By the time I left in 2002, the lab was well-established and burgeoning with interesting research, with a full complement of graduate students and researchers. To my mind, Charly's contribution to the development of international geoarchaeology is based there, in that lab; beyond his own excellent research, articles, international projects and funding, to me his true impact has been through teaching and supporting the research of young geoarchaeologists from all over the world.

Figure 0.4. *Charly and Fraser Sturt at the Dorset Cursus, England, 2000. Image: courtesy of Kasia Gdaniec.*

Charly was very involved with the field and laboratory research of some of his students, where he could be – for one thing, he had to teach most of us how to do many of our practical approaches, because many of us

Figure 0.5. *Charly relaxing at a seaside bar near Alcatrazes, Santiago Island, Cape Verde in 2012, accompanied by: Jose Silva Lima, Jaylson Monteiro, Francisco Lopez Moreira, Richard Newman, and Mike Allen. With the fieldwork leading to the discovery of Cape Verde's hitherto 'missing' second early Portuguese settlement – Alcatrazes – Charly and Mike's palaeoenvironmental programme was the first such survey undertaken on the islands in conjunction with archaeological investigations (see Evans* et al. *2017, in the publications list on pp. 15–26). Image: Christopher Evans.*

Figure 0.6. *Charly augering at Las Plassas, Sardinia, Italy, 2015, in the olive orchard of Oscar Cancedda, then deputy mayor of Las Plassas. The orchard is located on a slope overlooking the valley and the mediaeval castle of Las Plassas, a focus area of the Sa massaria project (see Serreli* et al. *2017, in the publications list on pp. 15–26). Image: Federica Sulas.*

did not come from a geoarchaeological background, or at least not from a micromorphological background. From Charly I learned how to make mammoth thin sections, how to sample, and how to describe and interpret thin sections. But I also learned by visiting sites with him, what he looked for in the field, what he thought was going on. This learning continued well into my post-docs on Cranborne Chase, when I got to excavate and survey with him – Charly was (and surely still is) an amazing field archaeologist. For those of us who were lucky enough to get him out to their field projects, he contributed enormously to our understanding of the landscapes in which we were working – not to mention, he did a lot of heavy physical labour and driving (thanks Charly!), often in his e-type. He also introduced those of us working in the UK to so many people; he shared his network, and through him I was able to build my own links, get access to sites and data, and develop my research and my career. Despite that, he was a very hands-off supervisor in my experience. He didn't write a lot of comments on my drafts, but he did make one that made it possible for me to finish my writing finally. The few words that were the key to organizing my dissertation were something like: 'Maybe this should be two chapters?' This led to me having a eureka moment, and getting the thing together and submitted.

A gift to archaeology, by Federica Sulas

Many individuals can shape today, but very few create futures. Charly created futures for archaeology, and for so many of us, inspiring, nurturing and sustaining all, whether in academia or not. His mentoring and research have been enriching knowledge, communities, and individuals for decades. And this does not end either in a particular year or at Cambridge. I cannot think of a continent where Charly's footprints haven't transformed knowledge and impacted individuals, and local communities.

By the time I reached Cambridge in the fall of 2004, the McBurney was a vibrant, very busy universe within and beyond the West Building of the Department of Archaeology at Cambridge. The basement lab with the thin section facility and Charly's office above it were refugia of quietness, inspiration, guidance, and peace of mind, especially needed when Michaelmas pulls

freshers in all directions – from lectures to pub crawls, and whatnot. On the top floor of the West Building, the microscopy lab was a place of study, exchange, support, and laughs, populated when I was there by Manuel Arroyo-Kalin, Ann-Maria Hart, Karen Milek, Miranda Semple, Andrea Balbo, Fraser Sturt, Heejin Lee, and visiting researchers such as Cristiano Nicosia, amongst others. Most are now furthering geoarchaeology across sectors, as showcased by some of the chapters in this volume.

In the basement lab, Charly would inspect newly arrived samples, teaching us what to look for and what to do with them: from unpacking to cover-slipping, through the wonders of capturing the past in thin section. By my first Michaelmas term, I had learned that Charly's office was always open to all. 'Come innn...', the voice would come through the door to let you in any time and no matter what for. Among my personal life-changing drop-in meetings, I recall sitting in that office, pondering whether to do a PhD in geoarchaeology or not. Half-way through an MPhil degree, Charly's teaching had captured all my aspirations, and I was greatly enjoying my very first micromorphology study. Charly had kindly offered me 'to have a go' at describing thin sections from an Iron Age site recently excavated by the Cambridge Archaeological Unit (CAU) at Sawston. I was loving it and dreaming to do the same for my study area. Yet, I had no 'science' background whatsoever – none from my Oriental Studies degree; the only pH I knew of was that of cleaning soaps! Indeed, risky to say the least to think one can move swiftly from brown earths of southern England to the Ethiopian highlands. 'It will be fine, you can do it,' he said. Frankly, I did not believe him then and for years to come. As ever, he was right: a few years later, he walked me from his office to the Registrar to submit my thesis. Some months later, I was back in that same office to face Helen Lewis and Paul Lane for my viva.

More than personal memories, these recollections also reflect aspects of the distinctive spirit of geoarchaeology under Charly's leadership: the openness and commitment to furthering study of soils and landscapes from within and beyond archaeology. It takes an open tenacity (and some guts) to follow this route, when a lot of geoarchaeology was emerging from natural/environmental sciences. By inspiring curiosity and a sense of adventurous, always scrupulous learning, Charly established a gentle, unassuming path to connect and reflect across disciplines as much as environments, cultures, past and present. Swinging between practicals in Quaternary Sciences – only part of a fruitful collaboration Charly sustained with the

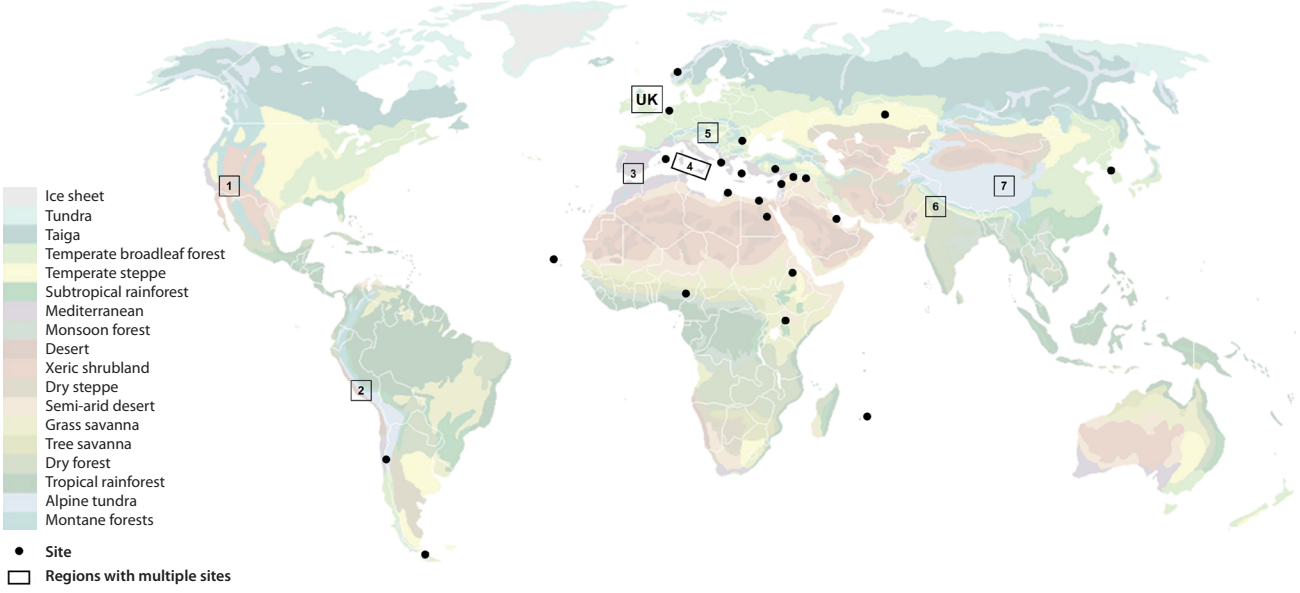

Figure 0.7. *Main sites and site regions covered by Charly French in his research. As illustrated by the list of publications (see pp. 15–26), Charly's work encompasses a great variety of biomes and equally diverse cultural contexts. Ongoing archiving of completed projects by Petros Chatzimpaloglou lists staggering numbers of sites investigated to date: over 1,400 sites in the UK, over 600 sites in Europe, and a few hundred more across the rest of the world (P. Chatzimpaloglou, pers. comm., August 2022). Site regions include: 1) Rio Puerco, New Mexico; 2) Ica Valley, Peru; 3) Almeria, Spain; 4) central Mediterranean (Sardinia, Sicily, Malta and Gozo); 6) northwest India; 7) eastern China. Basemap by Ville Koistinen, used under CC BY-SA 3.0, Wikimedia Commons. Image: Federica Sulas.*

Department of Geography – and Professor Renfrew's lecturing on archaeological theory, the McBurney provided the glue and strength to expand and transform geoarchaeology from within archaeology. There was a sense of collegiality and mutual learning well beyond the lab. Charly would take us to visit CAU digs across Cambridgeshire but also send us 'away' with slides to learn from and with others. I took my slides to Richard Macphail at UCL, Paul Goldberg at Boston, and George Stoops at Ghent, all to discuss and reflect on the description and interpretation done under Charly's supervision and with assistance of senior PhDs and postdocs at the McBurney.

That geoarchaeology was by no means limited to academics and professionals. Like Helen, I was fortunate enough to share quite a fair bit of fieldwork, and some extra-curricular teaching, with Charly. On these occasions, I experienced first-hand how engaging with local communities is as important as sampling and thinking in (geo)archaeology. I have seen this over and over again, whether surveying Aksum's countryside in Ethiopia, talking to farmers and mayors in rural Sardinia, or lecturing in Aarhus (Denmark). Genuine intellectual curiosity, a human touch and a special sense of fellowship were always there. I have wondered whether this magic set of skills is the key to his extraordinary ability to read complex landscapes, bond to people irrespectively of their position or culture, and make the soil speak clear and loud, all at first sight as he did, for example, at Aksum. Archaeologists had been working there for no less than a century, some devoting most of their long careers to investigating the rise and fall of the Aksumite Kingdom. It took just over a week of surveying, inspecting sections, talking to farmers, archaeologists, geologists, and others at Aksum, for Charly to figure out the main landscape sequence. Four years later, mostly spent at the microscope between buried soils and phytoliths, my PhD could only add details and nuances to that sequence. This is but one example of how moving within and beyond one's focus – research area, topic, discipline, or task – can and does make all the difference between exploring and *reading* the past down to the present. Nothing less is the reach and depth of geoarchaeology by Charly French. So much fun and reward come from learning to read.

Grazie, Charly!

Through the looking glass, by Manuel Arroyo-Kalin

The prelude to my encounter with Charly started in the field, at the site of Tres Arroyos, in Tierra del Fuego, Chile. Then just past my undergraduate years, my brain started to implode when I witnessed the excavation of multiple overlapping hearths in terminal Pleistocene deposits: which archaeological specialists, I wondered, studied hearths? When I arrived in Cambridge in late 1998, my self-imposed goal was studying hearths as artefacts. Charly would have caught wind of that draft because he became my supervisor and I was introduced to archaeological soil micromorphology. It was more than I had bargained for. In those early years, two epiphany moments with Charly are strongly etched in my memory: one was a lecture where Charly used the words 'soil horizon'. At the end of it, I nose-dived to the front of the room and asked – 'can you explain to me what a soil horizon is?' The answer still haunts me: Charly's big grin and a 'well, it is very, very complicated...' I was hooked: I read about soils and anthrosols – Limbrey, Birkeland, Eidt, Sombroek – and become aware of Amazonian dark earths (*terras pretas*). Learning the technique was slow: Charly, my lab mates in the McBurney lab, and the late George Stoops, all played a part. The second epiphanic moment came later, when I first heard Charly show microscopic features from buried soils preserved under barrows. Charly's continued reference to dusty illuvial clay coatings finally made sense: features that signalled processes than indexed soil forming pathways which we do not observe today. For me it was a Wow! moment: it transformed geoarchaeology from characterization and interpretation of deposit stratigraphy to an approach to archaeology that hones in on landscapes and their processes. I remember saying so to Charly later – he just stared back at me, another grin, never too keen on formulations, perhaps somewhat puzzled that I hadn't caught his drift until then.

At the time I had already embarked into the PhD long-haul: while initially focused on the ethnoarchaeology of current hunter-gatherers (and how they might produce occupation signatures on Amazonian soils), through mishaps and many fortunes I ended up studying pre-colonial Amazonian dark earths. At the time I had little knowledge of Amazonian archaeology so, other than seeing Charly carve out soil blocks in the fens, much of my geoarchaeological puzzle consisted of *terra preta* and the corner pieces Charly had put into my head: where soil horizons conditioned by human occupation? What was the variability of deposits across large areas? Did the B horizon bear features of (overlying) past human history? Could we identify buried surfaces? I remember summarizing my initial micromorphological findings during a seminar in Cambridge and I recall Charly congratulating me in his understated way. Back then, many archaeologists in Amazonia saw the potential of landscape history but geoarchaeological attention on *terras pretas* was in its infancy. Since then, these anthrosols have become a centrepiece: as human feedback into the soilscape and

as proxies of major demographic change in precolonial Amazonia. Today a number of students study *terra preta* profiles using soil micromorphology. But the pieces came together bit by bit, mentored by someone whose initial path had been field archaeology and whose curiosity led him to think about archaeology as the study of past environments.

In those years, Charly was often unfazed by the identification of inclusions in thin section yet always fascinated by process, even if conveyed rather unceremoniously. Lessons transpire slowly and my writing-up years were, as I said, a long and painful haul. One upside was that between field seasons to the Amazon basin I was fortunate to secure some funding to reconnect to the archaeology of southern Patagonia. Charly (and Rob Scaife) joined me and my colleagues from the Instituto de la Patagonia on a number of field seasons in Magallanes, Chile. This was my first true encounter with Charly in the field and, characteristically, it was peppered with good humour and the excitement of getting one's eye into the landscape: landscape development, landscape sequence – the scale and scope of Charly's geoarchaeological sights are always expansive. Yet, one of his core lessons is that we can tackle this breadth by asking the right questions and poking around in the right places. We did nearly go down a rabbit hole another time: during a short trip to the Isle of Herm, where Charly invited me to help during my unemployment days after the PhD viva, we were perplexed by some parabolic-shaped scours on large sand fields. Should we auger through them and save time? Maybe not? We couldn't make up our minds and, in the end, didn't. Later we learned (from the Tourist office) that there had once been a golf course right there: they were sand traps, golf bunkers! What a laugh, like many other times! We potted around and augered some more and – sure enough – we soon identified a Neolithic buried land surface. Another laugh. Thanks for all your support Charly!

Table 0.1. *Representative list of PhDs and MPhils who had Charly French as supervisor or advisor (compiled by Helen Lewis and Federica Sulas, with thanks to Kasia Gdaniec).*

PhDs		
1995	Allan Morton	Archaeological site formation: experiments in lake margin processes.
1998	Helen Lewis	The characterisation and interpretation of ancient tillage practices through soil micromorphology: a methodological study.
1999	Nicky Milner	Seasonality information from the incremental growth of the European oyster for Ertebølle sites in Denmark.
2000	Gillian Wallace	A microscopic view of Neolithic lakeside settlements on the northern rim of the European Alps.
2002	Nicole Boivin	Archaeological science as anthropology: time, space and materiality in rural India and the ancient past.
2003	Melissa Goodman-Elgar	Anthropogenic landscapes in the Andes: a multidisciplinary approach to precolumbian agricultural terraces and their sustainable use.
2004	Emma Jenkins	Environmental reconstruction, the use of space, and the effect of sedentism on microfaunal communities: case studies from Pinarbaşi and Çatalhöyük.
2004	Gianna Ayala	Landscape/land use change in north central Sicily: a geoarchaeological approach.
2007	Ann-Maria Hart	Gauging preservation: the effects of oxidising conditions in soils on the preservation of archaeological material data.
2007	Fraser Sturt	Landscape and land use change between 6000 and 2200 BC on the eastern fen edge.
2007	Karen Milek	Houses and households in early Icelandic society: geoarchaeology and the interpretation of social space.
2007	Andrea L. Balbo	The geoarchaeology of Polje Čepić (Istria, Croatia): the Last Glacial and Holocene population of a Mediterranean karstic wetland. (advisor)
2008	Gabriella Kovács	Geoarchaeological investigation of Százhalombatta-Földvár Bronze Age tell settlement in Hungary.
2008	Manuel Arroyo-Kalin	Steps towards an ecology of landscape: a geoarchaeological approach to the study of anthropogenic dark earths in the central Amazon region, Brazil.
2009	Jung-Youn Woo	Power and social change in Korean Middle Bronze Age mortuary practice: burials, houses, and contexts.
2010	Federica Sulas	Environmental and cultural interplay in highland Ethiopia: geoarchaeology at Aksum.
2010	Mary Ownby	Canaanite jars from Memphis as evidence for trade and political relationships in the Middle Bronze Age.
2011	Stefania Merlo	Contextualising intra-site spatial analysis: the role of three-dimensional GIS modelling in understanding excavation data. (advisor)

Table 0.1 *(cont.).*

2011	Heejin Lee	The agricultural land use dynamics associated with the advent of paddy rice cultivation in Bronze Age South Korea.
2012	Cleantha Paine	Micromorphological and isotopic investigation of Gravettian contexts in the Czech Republic.
2012	Robyn Inglis	Human occupation and changing environments during the Middle to Later Stone Ages: soil micromorphology at the Haua Fteah, Libya.
2013	Yijie Zhuang	Geoarchaeological investigation of pre-Yangshao agriculture, ecological diversity and landscape change in north China.
2014	Sayantani Neogi	Geoarchaeological investigations of Indus settlements in the plains of northwestern India.
2014	Sean Taylor	Prehistoric landscape change on a Cycladic island: the late Quaternary soil record and terrace systems.
2015	Paul van Pelt	Pyramids, proteins, and pathogens: a cultural and scientific analysis of Egyptian Old Kingdom pyramid mortars. (advisor)
2015	Kathryn Hall	All the live-long day: developing time-space maps to structure archaeological and palaeo-environmental data relating to the mesolithic-neolithic transition in southern England.
2016	Katheryn Boulden	A bioarchaeological reassessment of land-use practices from the Neolithic to the Roman period in central southern Britain using stable isotope analysis and machine learning methods.
2016	Ivana L. Ozán	Environmental and climatic changes for the last 2000 years in the Pampean Region: The impact of human actions. (external supervisor, University of Buenos Aires)
2017	Eduardo Machicado-Murillo	Evaluating human impact in Pre-Columbian Amazonia: the geoarchaeology and micromorphology of settlement and drained field agriculture in San Ignacio de Moxos (eastern Bolivia).
2017	Charlotte Rowley	Examining early Mesolithic lifeways at Flixton Island: integrating forensic and scientific applications for the study of ephemeral sites. (external advisor, University of York)
2019	Pedro Goncalves	Landscape and environmental changes at Memphis during the dynastic period in Egypt.
2020	Petros Chatzimpaloglou	Geological reconnaissance and provenancing of potential Neolithic lithic sources in the Maltese Islands.
2020	Alessandro Ceccarelli	Ceramic traditions and ceramic landscapes of the Indus Civilisation: investigating the technologies and socio-economic complexity of rural pottery production in Bronze Age northwest India. (advisor)
2020	Matthew Dalton	Reconstructing the use and conception of pharaonic domestic space in Nubia: geoarchaeological investigations at Amara West (~1300–1070 BC).
2021	Bongumenzi Nxumalo	The role of hydrological changes in the demise of Iron Age state societies in southern Africa: an integrative study of Mapungubwe, South Africa.
2021	Jeremy Bennett	Managing the agrarian environment in prehistoric Malta and Gozo. (advisor)
2021	Huiru Lian	Water and early city development in southeast China: geoarchaeology case study of the ancient Liangzhu city.
2021	David K. Kay	Unsettled settlements. Continuity and change in the Marakwet habitation of the northern Elgeyo escarpment, northwest Kenya, from *c*. 1850 to the present-day.
2022	Malcolm Connolly	Living near permanent water in the upper Murray-Darling Basin implications from the micromorphology of buried soils near artesian springs.
PhDs in submission/examination (August 2022)		
	Michael Lewis	Social transformations and modes of ceramic production during the fourth–early third millennium BC in the Shahrizor Plain and Bazyan Valley, Iraqi Kurdistan: a geochemical and petrographic study. (Advisor)
	Ian Ostericher	Human-environmental interaction, Holocene landscape development & sustainable pastoralism in the forest-steppe, Tarvagatai River Valley, Bulgan Aimag, Mongolia.
	Joanna Walker	Human-environment interactions in the Indus civilisation: reassessing the role of rivers, rain and climate change in northwest India. (Advisor).
	Kyra Kaercher	Production and consumption of Middle Islamic ceramics (1000 – 1500 CE) in western Asia: regional practices in an interconnected world. (Advisor)
MPhils		
1995	Gallian Wallace	The investigation of the faunal record from late Neolithic midden deposits at Etton landscape: refuge habitats in a lowland floodplain.
1995	Becu Benedicte	Micromorphological analysis of ditch dwellings at Les Vivers (France), a rural settlement.
1996	Nicole Boivin	The micromorphological analysis of a Hellenistic to Roman period occupation sequence from the Souks site in Beirut, Lebanon.

Table 0.1 *(cont.).*

1997	Maria Kousoulakou	Problems of identifying infilling process in sunken-floored buildings: a case study from Botai, Kazakhstan.
1998	Pat Marsh	Formation processes in 'dark earths.'
1999	Manuel Arroyo-Kalin	Earth, karst & fire: an investigation of the Palaeolithic combustion features and remains from the site of Pupićina Peć, Croatia.
2000	Brian T. Pittman	The archaeological signature of mobile pastoralism in the southern Levant: a geoarchaeological approach.
2001	Ann-Maria Hart	The effects of groundwater table on iron movement in buried soils: a case study of the lower Great Ouse at Over, Cambridgeshire, England.
2002	Geraldine R. Slean	Identifying changes in the palaeoenvironment from the Late Horizon to the Colonial Period in the Andes: an examination of the Lucre Basin.
2003	Claudia Cyganowski	An intersite comparison of Middle Kingdom Lower Egyptian Marl C fabric.
2003	Tracey Pierre	Mitochondrial DNA analysis of a former Na-Dene linguistic enclave in southern British Columbia: the Nicola.
2004	Anne De Vareilles	Analysis of micromorphology samples from the Iron Age and Romano-British site Marcham/Frilford.
2005	Heejin Lee	A geoarchaeological investigation of hill-top structure at Mokarta and Monte Polizzo near Salemi, Sicily.
2005	Federica Sulas	Archaeology at Aksum, northern Ethiopia: a critical overview.
2006	Lisa M. Kimball	Managed midden or not: a micromorphological case study of Stanton St. Bernard, Wessex, England.
2006	Sarah Lyne	A micromorphological analysis of tannour ash from Tell Brak and Tell Hamoukar for the assessment of fuel types.
2006	Giedre Motuzaite Matuzeviciute	Reconstruction of the changing archaeological environment through the application of soil analysis methods: a case study of a submerged Bronze–early Iron Age lake dwelling site in eastern Lithuania.
2007	Lindsay Friedman	An isotopic investigation of the human remains from the late Roman cemetery at Babraham, Cambridgeshire.
2008	Boriana Boneva	A paleodietary investigation of three Neolithic north-eastern Adriatic sites using light-stable carbon and nitrogen isotopes.
2008	Alyssa Trimmer	The impact of site formation processes and the preservation of agricultural signatures in three typical English soil types in thin section.
2008	Jingwei Wu	An archaeobotanic investigation of the macroremains from Cis-Baikal region.
2009	Kathryn Hall	Geo-archaeological characterisation of a Viking-age occupation surface from the Brough of Deerness, Orkney
2009	Matthew Dalton	Geoarchaeological approaches to social space in prehistoric western Cyprus.
2010	Gary Marriner	Geoarchaeological investigations into the late glacial and early Holocene in northern Bosnia and Herzegovina.
2011	Kate Boulden	Soilscapes of space and place during the Neolithic/Bronze Age of Cranborne Chase: a case study from Ashley Park Farm, Damerham, Hampshire.
2012	Patrycja M. Kupiec	Transhumance in Iceland: a geoarchaeological approach to interpretation of seasonal occupation at Pálstóftir and Þorvaldsstaðasel shielings.
2012	Daisy E. Spencer	Multi-proxy evidence for the detection of agricultural practices and land use: a case study of 2nd millennium BC evidence from Over, lower Great Ouse Valley.
2012	Barbora Wouters	A micromorphological approach to early medieval towns and trading places: the case study of Viking-age Kaupang, Norway.
2014	Maria A. Garcia Villamil	Use of plant resources by Middle Preceramic fisher-hunter-gatherers: an integrated approach to 7,000 year old deposits in a shell midden at the mouth of the Ica River, Southern Coast Peru.
2014	Leanne Zeki	A GIS approach to modelling movement during the Late Intermediate Period in the Ica Valley, Peru.
2015	Ian D. Ostericher	Midden composition, extent and implications for Neolithic settlement at Stonehall Farm, Orkney.
2015	Conor McAdams	Geoarchaeological investigation of a buried structure at Taċ-Ċawla, Gozo.
2015	Akshyeta Suryanarayan	Gauging the preservation of the cultural horizon at Must Farm: a multi-method study.
2015	Bethany Whitlock	Micromorphological and archaeological approaches to characterising changes in the use of space at Sangayaico, Peru.

Table 0.2. *List of selected post-doctoral researchers mentored by Charly French, affiliated scholars and visiting scholars and students at the McBurney Laboratory (alphabetical order).*

Araújo Gomes, João	Visiting graduate student (2015–6), Lisbon	
Arroyo-Kalin, Manuel	Visiting researcher (2009–10), Durham University	Geoarchaeology in the central Amazon
Balbo, Andrea L.	Visiting researcher (2009–10), IMF-CSIC, Barcelona	Geoarchaeology of shell middens, Tierra del Fuego
Beresford-Jones, David	Postdoc (2015–7), McDonald Institute	Origins and intensification of agriculture
Boivin, Nicole	Affiliated researcher (2005–6), Leverhulme Centre for Human Evolutionary Studies, Cambridge	Neolithic South India
Bunbury, Judith	Affiliated researcher (2015–8), Department of Earth Sciences, Cambridge	Saqqara and Memphis (ceramics and faince); Egyptian waterscapes
Cannell, Rebecca	Visiting researcher (2017), University of Oslo	Geoarchaeology of Viking sites
Cardineau, Carlos	Visiting researcher (2011), University of Madrid	Tsunami hazards in Spain
Cereda, Susanne	Visiting graduate student (2016–7), University of Vienna	
Chatzimpaloglou, Petros	Laboratory Assistant (2020–2), McBurney Lab	Soil micromorphology archive.
de Souza, Tatiane	Visiting researcher (2017), University of São Paulo	
Friesem, David	Postdoc (2016–7), Independent Scholar (2018–9)	Tropical micro-archaeology, related to 'hunter-gatherer' use of space.
Heathcote, Jen	Affiliated researcher (2000), University College London	Greater Ouse Valley Project
Kenny, Henry	Affiliated researcher (2015), Heritage Gibraltar	One River Project
Lane, Kevin	Affiliated researcher (2014–7), Heritage Gibraltar/CONICET, Buenos Aires	One River Project
Lee, Heejin	Affiliated researcher (2015–7), Korea University	Micromorphology of prehistoric rice farming, Korea
Lewis, Helen	Postdoc (1999–2002), Affiliated researcher (2002–6), University of Oxford, University College Dublin	Wyke Down Project; Knowlton Environs Project
Lisá, Lenka	Affiliated researcher (2006–7), Brno University	Micromorphology of loessic sediments on Gravettian sites
Madella, Marco	Affiliated researcher (2006–10), ICREA and IMF-CSIC, Barcelona	North Gujarat Project
Marriner, Gary	Affiliated researcher (2014–5), UCL	Geoarchaeology of Palaeolithic Northern Bosnia
Matthews, Wendy	Postdoc (1993–6), Affiliated Researcher (1996–2000)	Tell Brak, Syria; Saar, Bahrain
Moffat, Ian	Postdoc (2017)	
Murillo-Machicado, Eduardo	Affiliated researcher (2018–21), Cambridge Archaeological Unit	
Nelson, Anna	Visiting researcher (2003–4), Scott Polar Institute	
Neogi, Sayantani	Postdoc (2015–7)	Two Rains Project
Nicosia, Cristiano	Visiting PhD, University of Milan (2006–7)	Micromorphology at Fondo Piavani, Italy
Orijmie, Emuobo	Postdoc (2016–7)	
Ozán, Ivana L.	Visiting PhD (2006–7), affiliated researcher (2014–7), CONICET, Buenos Aires)	Micromorphology of hunter-gatherer occupation in Patagonia
Paine, Clea	Affiliated researcher (2014–5)	
Periman, Richard	Affiliated researcher (2003), USDA	
Posada, William	Visiting graduate student (2014–5), Bogotà	
Pullen, Sandy	Postdoc (2015–6)	One River project; ancient land and water use along the Rio Ica, south-central Andes
Puy, Arnald	Visiting PhD (2011), University of Barcelona	
Roughley, Corinne	Affiliated researcher (2015–7), Hughes Hall, Cambridge	

Table 0.2 *(cont.).*

Sabah, Nawrast	Visiting researcher (2016), Mosul University; affiliated researcher (2017–8), University of Basra	Mesopotamian marshland stratigraphy and climate change during the Quaternary
Salamanca Mateos, Juan Carlos	Visiting graduate student (2016–7), Madrid	
Save, Sabrina	Visiting researcher (2018–9), Amélie études environmentales et archéologiques, Troyes, France	
Scaife, Robert	Affiliated researcher (2010), University of Southampton	
Shahack-Gross, Ruth	Visiting researcher (2010), University of Tel Aviv	Archaeological soil micromorphology
Shang, Xue	Visiting researcher (2016–7), University of Chinese Academy of Sciences	
Singh, Ravindra	Affiliated researcher (2018–9), Banaras Hindu University	TwoRains Project
Smith, Laurence	Affiliated researcher (1993–8, 2003–10), McDonald Institute	Amarna, Sudan, Ethiopia (ceramics)
Stratford, Dominic	Visiting PhD (2015), University of Witwatersrand	Micromorphology of Neanderthal-period cave sites in South Africa
Sulas, Federica	Affiliated researcher CSIC Barcelona (2011), University of Pretoria (2012–3), ISEM CNR (2014–5), UrbNet Aarhus University (2016–9)	Geoarchaeology of Iron Age landscapes in southern Africa; historical ecology of Sardinian farming, Italy
Taylor, Sean	Postdoc (2015–7)	Geoarchaeology of Malta and Gozo
Wallace, Gillian	Affiliated researcher (2017), International Office, University of Cambridge	
Zhang, Hai	Visiting researcher (2011), Beijing University	
Zhuang, Xijie	Affiliated researcher (2015–7), University College London	

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Personal accounts

Picking my way along the catena path with Charly
Kasia Gdaniec

After a lifelong masterclass in pedogenesis (and other things), I should be a brilliant soil scientist by now but I am a bad scholar and lack both microscope and patience for the observation of the minute. What, though, might it say about me that I am enthralled by and attracted to those who possess these and the talent to read landscapes from the silent evidence within them: how they evolved, were altered – deliberately or unintentionally – by human agency, erode, and how we stand to lose the ability to prosper and grow if we do not nurture and curate the essential elements of earth and water? After nearly four decades with Charly, I realize there is still so much to learn. Like so many that he has taught and worked alongside, I have benefitted so much from his deep understanding of site formation processes, his talent for reading the earthen architecture of monuments, abandonment and resurrection of settlements, and appreciation of the varied wetland environments in which we worked together.

Early days

Before our introduction, Charly and I crossed paths frequently. First, he was spotted most Saturdays asking, *sotto voce* in an unfamiliar accent, for alarming quantities of cheese from the cheese stall at Peterborough market opposite the slipper stall where I had a Saturday job. Seeing my shy interest, the Slipper King made it his mission to find out where in the world he came from, him not being from round here, having ruled out the various burrs of the British Isles. Collaborating with the Cheese Queen, he learned that Charly was from Canada and may soon return if his work permit did not materialize. We overlapped in the same pubs, and, apparently, he often turned his petrol head when driving passed my family home, as my father kept a well-stocked garage of tools, grease guns, oils and unguents, ramps and paraphernalia for mending cars and motor bikes – and hosted a stream of young men mending a motley collection of their first or second vehicles. Eventually he became one of those young men and could enter Alojzy's Garage too.

Our friendship started when working at Etton causewayed enclosure in the early 1980s, one of the best Neolithic sites under excavation at that time and part of a group of sites around the Maxey Quarry and in the landscape around the causewayed enclosure that were excavated by Francis Pryor's Welland Valley Project team, formed after Fengate for the Maxey excavations. Nestled in a low-lying series of anastomosed palaeochannels (see, I did listen) in the alluviated floodplain of the Lower Welland river system, my first exposure to archaeological excavation not only involved the discovery of wonderful Neolithic objects, including rare preserved organic artefacts, and their arrangements in the enclosure ditch circuit, but also introduced a basic understanding of geomorphological principles and the characteristics of palaeorivers and buried landscapes. The team of Dutch and UK students from Manchester, Reading and Glasgow and their visiting professors, doctoral researchers and the core WVP team provided a heady mix of opinionated characters, interpretive or methodological argument and much hilarity, totally addictive and stimulating to an impressionable newbie. Francis instigated a theoretical approach to site interpretation and artefact studies, Maisie the study of organics and woodland management, Miranda: faunal remains, Dave: surface scatter analysis (and top jokes), Harptree: excavation style and acknowledgement of the fact that the Romans existed to a team of prehistorians, Charly: large-clean-sections-are-best and applied soil sampling and environmental analytical techniques, including mollusc analysis, which were at the heart of his doctoral thesis.

He was keen to ensure consistency in context descriptions and that all section drawings followed the Soil Survey's illustration system using bars of silts or clays, stippled with sand dots representing loams, silty clays or clayish silts, figuring lenses of unwashed, erosion or dumped materials, annotated with charcoal, artefacts and other inclusions – read those and you don't need context sheets, only a matrix. Using this method you really look at and interpret the fills you dig, question the sections you cut. Charly's training sessions in recording ensured that we observed and understood soil mechanics, formation processes, how river systems work and the consequences of their clogging or management, the characteristics of various depositional sequences and how to capture this information in distinctive section drawings, sadly no longer seen in commercial archaeological scenarios today. This is a lamentable loss of field technique, the reintroduction of which would initiate a nuanced understanding of contexts and their formation by excavators who now largely draw only their profiles, and also apply a critical selection approach to what should be sampled, why and how. After our long collaborative partnership, I am a county-mounty bore on this subject and in turn he has learnt a lot about Cambridgeshire's commercial projects through prolonged discussions at the dinner table, without ever having stepped foot on them.

To hone his specialism, Charly became a gun for hire – undertaking soils, snail and micromorphological analyses for a series of excavations run by the British Museum and English Heritage, supported by his old friends and mentors, Richard Macphail and Snails (John) Evans, often partnering Rob (Scaife)'s pollen work and publishing small articles and site monographs. Endless nights were spent sorting and counting millions of minute molluscs from Winterton Roman Villa or hand grinding and mounting the narrow gauge micromorph slides on our Victorian dining room table – now relegated to the garden, it still bears the scars. As deadlines loomed, I occasionally helped sort the snails with one of his various long mounted needles (what the heck is that all about?!) as a labour of love, but always managed to find something else to do after a stint of eye-boggling work. Charly, though, was fastidious and very grateful to those little molluscs that enabled Geoff Wainwright to sign annual letters of recommendation for him to remain in the UK as a 'very particular specialist', dubbed the Black Prince of Snails in his Fengate days.

Cars and the man

Those that know him well know of Charly's love of old cars – a passion that developed in Canada, where his family and their friends had owned a mixed series of British sports cars, saloons from the American Big Three, and German performance cars. He willingly became the maintenance monkey and curator of Francis's old long wheel-based Land Rover but given the uncertainty of being able to stay and legally work in the UK after completing his thesis, cash in hand being the payment method in those days, he decided to invest in his own classic car, should he ever need to convert it into payment for HMRC. Occasionally, he would turn up at Etton in a gleaming white BMW 2002 Tii, being sure to park it well away from the spray of gravel from passing trucks and showing old friend and fellow petrol head Rob Scaife where to safely park his Porsche or beloved vintage Beetle when visiting the site! Avoiding the licking cows on the Nene flood bank at Flag Fen was another trick – they, having developed a taste for Turtle Wax and glass polish, would crowd around his white car, perhaps thinking it was a massive salt lick! Such cars don't get you very far on the bumpy fen roads though, so as WVP morphed to Fenland Archaeological Trust and the projects expanded to include the SW Fen Dyke Survey and the Flag Fen excavations, a series of ex-Post Office vans followed to drive over the roddon swells and massive potholes in the fen lanes and farm tracks. The BMWs were sold and he, at last, bought his dream car – an Old English White E-type Jaguar. After long digging days, nights that weren't spent counting snails or cutting soil blocks were spent under the long bonnet, squashed into the tiny boot to repair upholstery, or polishing his new beauty. Charly doesn't sing or whistle, he can't often name that tune, but the purr of a DB5 or E-type, the roar of a Corvette and the deep-throated growl of a V8 engine is the music that turns his head and pumps his heart.

Cambridge

By the nineties, we both needed a little more security in our lives and as commercial archaeology was newly reforming how we all worked, it was time to decide if he should stay in the field or to follow an academic career. Great friends were doing the same and he found it hard to meet them and compete at interviews. I had already moved to Cambridge to join the Cambridge Archaeological Unit and work on the college and Fenland Project sites then underway. A lucky conversation with Martin Jones after one department party led me to hear that a new post in environmental archaeology had been advertised and that the closing date was two days away. There were no mobile phones in those days but I had enough change in my purse to call Charly from a public phone box to get him to polish up his CV and letter of application and get it to Cambridge pronto. The stars aligned and the job to develop the Charles

McBurney Laboratory for Geoarchaeology was, after a short nail-biting period, his! It opened in 1994 and, supported by two great colleagues: Julie Miller and Tonko Rajkovaca – also a co-researcher – Charly and his students mapped and explored past landscapes and supported wide ranging research projects from local 'backwaters' to World Heritage Sites across the globe, often bringing geoarchaeological study to countries for the first time.

Geoarchaeology is a niche subject, but, without doubt, fundamental for the study and interpretation of human landscapes in which people did things and transformed their spaces. Without it, and dating the horizons of change, things have no anchor in time or space and the place in which they occurred has lost a human connection – landscapes and the mysteries of their genesis will remain truly buried.

Having camped, walked miles and developed extraordinary stomach muscles in lands ranging from the deserts of Egypt and desertified lands of Almeria and Yemen, to the Kazakhstan steppe to the wetlands of the English fens, from Tierra del Fuego to the terraces and irrigated landscapes of Ica Valley in Peru, the Ethiopian Highlands, Sardinia, Sicily, Malta and Greece, to the buried valleys of the Indus River or the tells in Turkey and Syria to Dorset, Wiltshire and Scottish funerary landscapes and to the Neolithic settlements in Serbia, Croatia and Bosnia, research projects conducted with friends and colleagues, Charly juggled family time with us. Never sure if he would be around at the start of school terms or school holidays and how we'd plan our family getaways, our sons became unmoved about Dad's frequent journeys, though Theo's friends, wondering what he did and not being familiar with soil science, thought instead that he might actually be a spy! Hugh just wanted him to bring back knives (an essential part of Charly's field kit that captivated his interest). Family camping was, however, definitely out of the question. Instead, we doubled up family escapades with project work, met and spent time with his wonderful colleagues in pretty places in doing so – including Fede who has generously masterminded this festschrift. Thank you.

Geoarch as art

Many archaeological projects have associations with artists: sometimes to allow them to enter new interpretive areas or to capture the methods of archaeological investigation and analysis in various ways. Charly and his work have been used to showcase the art of micromorphology, during his beloved work in Cranborne Chase and at Durrington Walls during the Riverside Project, where his slides and the making of the slides were sketched, sampling equipment was figuratively used in collages, or Charly working at the microscope was sketched as part of a wider study of the archaeologists doing their thing.

More recently, Charly's soil descriptions were unexpectedly vocalized in Laura Wilson's *Deep, Deepen, Deepening* performance conducted in the Must Farm quarry at Whittlesey on a cold, blowy day in October 2019, introducing micromorphological terms and study to unsuspecting audiences that gathered for the live shows in the quarry and later screened during her

Figure 0.8. *Laura Wilson's* Deep, Deepen, Deepening *performance. Image: 'Incantation' by Kasia Gdaniec.*

exhibition in Norwich Castle. On a purpose-built brick 'stage' with the thirty-metre-deep varved Oxford Clay quarry face as a backdrop, twelve actors arranged in two rows, dressed in fluorescent industrial dungarees and standing at 'lecterns' formed of brick hods balanced on their handles, some emphasizing selected words only, slowly incanted Charly's soil micromorph descriptions in the round of certain contexts and clay cakes analysed from the Late Bronze Age palisaded, piled settlement built over the Must Farm palaeoriver:

'... 25% microsparite 50–200 μm; 20% irregular zone pure clay; 25% microsparite, non-laminated, non-birefringent, <250 μm, gold, white, pale golden brown …'

Canadian connections: Charly's early days digging in the East Anglian Fens
Francis Pryor

This is going to be a personal account of the start of a long-lasting friendship. I don't want to write something analytical and biographical. Other people can do that. In the late 1970s and early 1980s, Charly was a graduate student. In those days, perhaps rather more than today, such students were a great resource for any archaeological project struggling to become established, because their research provided much-needed depth and academic credibility – and nobody paid any money. This might sound a little exploitative, but on the other hand it gave students a depth and breadth of experience that would prove invaluable later in their careers.

The discipline of archaeology was itself in a state of flux. My own pre-university background had been in botany, zoology and geology. My gut feeling was that prehistory was more a science than an art, although my Cambridge background in archaeology and anthropology had placed emphasis on its role as a humanity – a social science of the past. To be honest, we were all a bit confused and the obscure language of David Clarke's then-recently published *Analytical Archaeology* (1968) had, if anything, made this worse. Put another way, although we all believed passionately that archaeology was about more than flints and potsherds alone, visions of what it might become varied widely. At the same time, we were positive: archaeology was going to transform everyone's view of the distant past. But whatever our theoretical stance, we all agreed that our much-loved subject was more than a mere 'interest'; we *had* to make it relevant to the modern world.

If ancient sites were ever to come alive, you needed top quality scientific input. And that's where Charly French came in. Charly was an important part of our small team of highly motivated professional archaeologists, which had been examining sites threatened by the expansion of the ancient medieval city of Peterborough into one of Britain's last post-war New Towns. We began work in 1971 in a high priority area that would provide employment for the in-coming population. Fengate, as its Norse-derived name suggests, was the land along the city's eastern approaches, which lay along the western margins of the East Anglian Fens. Prior to 1989, contract archaeology was a struggle: all survey and excavation ahead of commercial development took place thanks to the goodwill of the developer. It was up to the archaeologists to find the funds to carry out their excavations. This was something Charly was well aware of and he was always at pains to make his academic research directly relevant to our projects.

I can't be absolutely certain, but I think Charly's name was first brought to my attention by my boss in Canada, the Chief Archaeologist of the Royal Ontario Museum (ROM), Dr Doug Tushingham, who had long been a friend of Charly's father, a most charming man who I got to know quite well. Goldie French was a distinguished historian and senior academic at the University of Toronto. I was employed by the ROM from 1969–78 and would return to Canada every winter, for at least six months, to direct the team writing-up Fengate.

Establishing what eventually became a tightly knit and long-lasting team of field archaeologists didn't happen overnight. Charly joined us in 1975, following the completion of his BA at Cardiff earlier the same year. His undergraduate research had been supervised by the great John 'Snails' Evans and I was aware at the time that molluscs might well prove to be the key to establishing a palaeoenvironmental succession in those drier, more alkaline, gravel-based soils around the deeper deposits of the peat fens. Charly proved my hunch to be correct. But even in those early days, his work was about far more than snails alone. Charly employed particle-size analysis and other techniques of soil science and geology to work out how the deposits formed in the various prehistoric features we were excavating. The publication of the Third Fengate Report in 1980 made quite an impact at the time because it proved beyond any doubt that there were elaborate Early Bronze Age field systems in lowland England (Pryor 1980). These ditched and hedged fields gave structure to a well-organized landscape of farms and small settlements. Some of the livestock management was quite intensive and there was no evidence for the rather episodic, almost casual pattern of extensive subsistence farming that we had

previously imagined. Charly contributed two major papers on sediments and snails from field boundary ditches (French 1985, 190–212). These showed that the ditches had probably been regularly maintained and would have been accompanied by a bank, on which, we were able to prove later, there would have been a hedge. Once maintenance stopped, the ditches filled in naturally through weathering and erosion. Charly also indicated that the abandonment of the ditches coincided with a known period of increased wetness, probably in the later Bronze Age/Iron Age transition of the early first millennium BC; in damp seasons, many would have held standing water in their lower levels.

I soon discovered that it was a huge privilege to have a soil scientist as a permanent member of the digging team. Frequently, Charly and I would crouch down in a ditch and he would take me through the primary, secondary and tertiary phases of infilling. I well remember when he pointed out standstill horizons in the upper secondary filling where darker, more organic and finer-grained soils had been able to form. After a few seasons of Charly's careful tuition I was able to identify the main (A, B and C) horizons of buried topsoils. Like most archaeologists I enjoyed 'reading' sections – spotting recuts and suchlike – but I had always had my doubts about the hard lines between different layers (or contexts as we have to call them now) that were then (and sadly still are) such a feature of so many excavation reports. If they weren't evident in the section, then why add them to the drawing? It seemed to me then (and indeed now) that these imposed lines would make future re-interpretation difficult, if not impossible. Sharp-eyed readers will spot a few hard lines in my First Fengate Report (Pryor 1974), but they had vanished from the Second, published in 1978 (Pryor 1978) – and this is entirely down to Charly's influence. He loathed hard lines! Charly's section drawings are an important feature of the Third and Fourth Fengate Reports (Pryor 1980; 1984), but it is probably fair to say they helped transform the later (1998) report on our excavations at Etton, a Neolithic causewayed enclosure on the edge of the Fens, in the Welland Valley a few miles north of Peterborough (Pryor 1998a). I personally think Charly's Etton ditch sections are some of the finest ever published.

I mentioned Etton because in many ways I think it marked the high point in our research around Peterborough. In the public eye it has been completely eclipsed by Flag Fen, which is understandable given that site's spectacular preserved timbers and the extraordinary discoveries by the Cambridge University Unit at Must Farm, a nearby site in the same landscape. Charly was a full-time member of the Fengate team in the summers of 1976 and 1977. Later that year he did a part-time MA in Environmental Archaeology at the London Institute of Archaeology (now part of UCL). In the autumn of 1978, fieldwork at Fengate ended and I returned to England from Canada to direct the Welland Valley Project, which was based around core members of the Fengate team, including Charly and Maisie Taylor (our specialist in prehistoric woodworking). While I worked in the office, writing and editing the Third and Fourth Fengate Reports (Pryor 1980; 1984), Charly, Maisie and other members of the team started at Maxey Quarry in the Welland Valley. This work was based on earlier, largely unpublished research in 1960–9, which members of our team (Charly again playing a prominent part) brought to publication in 1993 (Simpson *et al*. 1993). Our initial work was at Maxey Quarry, which featured an important series of prehistoric sites, including a double-ditched henge, a cursus, a substantial Iron Age settlement and scattered burials (Pryor & French 1985). In 1979 (while we were excavating at Maxey), Charly had begun an external PhD at the Institute of Archaeology. His doctoral research forms a major feature of the two Maxey Reports and his many subsequent papers detailed the variability and developmental sequence of prehistoric and later soils in the Welland Valley. Charly's studies of palaeosols in the Welland Valley were a key milestone in Fenland research and would also prove fundamental to the Etton Project (1982–7), which followed on directly from Maxey.

Etton was an earlier Neolithic causewayed enclosure that lay a short walk east of the Maxey excavations. Both sites were part of the same ritual landscape – indeed, the two were linked by the Maxey Cursus. Like the Maxey sites, Etton was threatened by the expansion of a large gravel quarry, which eventually destroyed most of it (about twenty per cent may still survive beneath the banks of a nearby river). Before we began work we realized that Etton would be very well preserved, both through waterlogging and by burial beneath thick layers of alluvium. But first the accumulations of alluvium had to be mechanically removed over large areas, to expose the buried soils below. Then disaster struck: we were told at very short notice that our excavation budget had been more than halved. We soon realized that we had no option but to do the mechanical work ourselves. I operated the 360 excavator and Charly drove the bulldozer that removed the upper layers of alluvium and my loose earth. It was, to put it politely, a time of some stress, but after three weeks' work we had completed the task. I might mention here that one of the reasons I asked Charly to do such a difficult job is that I knew he was a very accomplished mechanic, painter and

decorator. He had learned to be practical and hands-on in Canada and he never lost those skills, which are so essential for a good field archaeologist.

Charly's painstaking research into the sedimentary history of the various layers in the Etton enclosure ditch allowed us to frame an innovative research strategy. The conventional way of excavating such ditches was by means of separated transverse sections. We, however, were interested not just in how the layers accumulated, but in what happened while the ditches were still open. Maisie Taylor was particularly intrigued by the rich wood and organic deposits which lay along the ditches' lower levels. So, with Charly's help and encouragement, we opted to excavate entire lengths of ditch, separated by narrow transverse baulks. It was a strategy that transformed our understanding of Etton – and other causewayed enclosures.

In the same year that Etton began (1982), Charly started to supervise the South-West Fen Dyke Survey. This was the survey that discovered Flag Fen and many other important buried sites, ranging from the Mesolithic to the Iron Age. Dyke survey (in which the sides of drainage ditches, or dykes, are closely examined for archaeological remains) was a technique we had learned when I took the Maxey team on a short research/study/jolly tour to see friends and colleagues in the Netherlands. Charly's profound understanding of the detailed sedimentary sequences in the many regions and sub-regions of the western Fens and their margins made him the obvious person to manage, run, and write up the Survey, which is likely to remain a standard work of reference for a long time (French & Pryor 1993).

Charly's last major project in the area was the excavation of a Bronze Age barrow complex at Deeping St. Nicholas, on an 'island' in the Fens east of the River Welland, in South Lincolnshire (French 1994). This was a well-preserved site which was important because it clearly proved that the rich evidence for prehistoric life along the fen edge and margins of the lower Welland continued out into the deeper Fens. It also demonstrated that large areas of the Lincolnshire fen-edge, which are today buried beneath thick deposits of later marine silts, still possess enormous archaeological potential.

Charly excavated the West Deeping barrows in 1991 and the following year he took up a lectureship at Cambridge. It was a very sensible decision: with such institutional support he would be able to broaden his interests and bring the potential of detailed soils and sedimentary research to an international academic audience – which of course he has achieved – and with resounding success.

Developing geoarchaeology: contextual analyses and the urgency of the sustainability agenda
Wendy Matthews

Charly French has made major contributions to the study of human-environment inter-relations over millennia and across diverse ecozones from Peru to Africa, Europe, the Mediterranean, Middle East and India. He has led and collaborated in a wide range of international projects and generously inspired and supported more than three decades of students and researchers at the University of Cambridge. In this review of analytical approaches in geoarchaeology in his honour, I examine the key contributions of multi-scale stratigraphic analyses in the field and in micromorphology to our understanding of context and reflexive practice in archaeology, with examples of Charly's leading role in these (French 2003; 2015). Contextual and reflexive analyses critically examine the circumstances and agency of past actions as well as current interpretations in order to investigate how decisions, actions and relations are enabled or constrained and impact different communities, the environment and more-than-human worlds (Hodder 2000; Robb 2010; Chesson *et al.* 2019). At the heart of Charly's research has been a focus on environmental change and human impact, particularly with regard to deforestation, agriculture, soil erosion, water availability, and desertification (French 2003). These foci are of increasing global importance given current environmental and social challenges and the urgency of the sustainability agenda, as expressed in the UN Sustainable Development Goals, for example (United Nations Statistics 2020). The regard here on Charly's contributions to fieldwork and research, therefore, examines the key contribution of contextual geoarchaeology to environmental and social issues through a personal account and reflection on the results from the NERC project in which Charly and I collaborated from 1993–6 and to our understanding of past, present and future sustainability. Whilst our collaborations seem like yesterday, the mists of time draw a veil and shape what we remember and recount, so many apologies to Charly and all concerned in advance for any inaccuracies and omissions.

One of the great strengths of micromorphology is that the resin-impregnated thin sections provide a durable archive that can be re-examined in the light of new research questions, theoretical approaches and analytical techniques. Like field sections, thin sections provide an intact record of the contextual relationships between diverse minerogenic, biogenic and anthropogenic materials and surfaces that can be reflexively re-interrogated after excavation and

analyses by multiple researchers, for the locales which they represent. It is partly with this reflexive potential in mind, that this review re-examines some of the field and micromorphological sections that we investigated three decades ago. The aim is to highlight how these archives can be used to continue to provide long-term cross-cultural perspectives and baseline data on the sustainability of past, present and future communities and human-environment interactions at the local and regional scales at which actions and impacts need to be evaluated (Jackson *et al*. 2018; Fisher 2019).

This reflection begins with an outline of the NERC project on early urban settlements in the Near East in which we collaborated and from which the case-studies in this review are drawn, as well as Charly's development of the Charles McBurney Geoarchaeology Laboratory. It then highlights Charly's key contributions to interdisciplinary contextual approaches and reflexive practices that critically examine the environmental context and impact of human communities and settlements and their sustainability. The three case-studies examine in turn: human-environment inter-relations through analyses of site context and environs; the context and impact of human actions within settlements and built environments through micro-contextual analyses in the field in thin section; and the sustainability, ecology and utilization of plants through integrated archaeobotanical approaches that include micromorphology.

These three research areas have become increasingly urgent over the last three decades. Since climate negotiations began in 1990, shortly before the start of our research, total fossil CO_2 emissions have risen sixty-two per cent and wetland, forest and biodiversity loss continue at devastating rates (United Nations Statistics 2020). In response, there is increasing research in archaeology on past, present and future global challenges to provide long-term regional perspectives on these, and inform current and future scenario planning (Kintigh *et al.* 2014; Jackson *et al.* 2018; Isendahl & Stump 2019).

The NERC project aims, objectives and case-studies

The case-studies examined here are drawn from the NERC-funded research project 'The application of micromorphology to the study of occupation sequences and the use of space in early urban settlements in the Near East', 1993–6 (NERC GR3/9559), led by Charly French and Martin Jones. I was the post-doc on this project, and the first of many who have had the great fortune to work with Charly. Charly joined the Department of Archaeology in 1992 as Lecturer in Archaeological Science, with extensive experience in field archaeology, geoarchaeology and micromorphology. I had just completed my PhD on the micromorphology of the use of space in the early urban settlement of Abu Salabikh in Iraq at Cambridge, supervised by Nicholas Postgate with generous support from Marie-Agnès Courty, then at the Institut National d'Agronomique Paris-Grignon, and Richard Macphail, UCL (Matthews 1992).

Our aim in the NERC project was to develop the application of micromorphology to high-resolution contextual analysis of the nature and formation of occupation sequences and uses of space in different environmental and socio-cultural contexts in order to inform on the ecology and socio-cultural practices of early urban communities.

Three case-studies were selected on a transect across major geobotanical zones in the Middle East, as defined by Zohary (1973; Matthews *et al.* 1997a). Çatalhöyük, in central Turkey, was selected to study settlement of a large long-lived Neolithic mega-site, *c*. 7000–6000 BC on the Konya plain, in a region of Xero-Euxinian steppe forest, in collaboration with new investigations led by Ian Hodder that were starting in 1993. Tell Brak was selected to study a major regional urban centre in the north Mesopotamian steppe in north-eastern Syria, in collaboration with excavations by David and Joan Oates and Roger Matthews. The periods investigated for that project spanned 3600–1800 BC. The smaller trading settlement of Saar on the island of Bahrain enabled study of a coastal site in the Sub-Sudanian vegetation zone, *c*. 2000–1800 BC. A major objective was to investigate plant taphonomy and use in collaboration with David Cutler and Timothy Lawrence, the Jodrell Laboratory, Royal Botanic Gardens, Kew, as plants are a vital resource and an indicator of activities that had proven to be particularly abundant and revelatory in micromorphological analyses at the early urban settlement of Abu Salabikh, Iraq (Matthews *et al.* 1994).

Development of the micromorphology and Charles McBurney Laboratory

Charly developed the micromorphology laboratory at the University of Cambridge through purchase and installation of key equipment during the NERC Project including the Brot thin section grinder-polisher and large cutting saw, with the enthusiastic technical assistance of Julie Boreham. It was also during this period that the McDonald Institute was completed and Charly founded the Charles McBurney Laboratory in November 1994, opened by HRH Prince of Wales, to create a world-leading centre for geoarchaeology and micromorphology with a wide range of specialist facilities and expertise.

Contextual analysis of human-environment inter-relations

Site context and environs

Charly has developed and nurtured a wide range of interdisciplinary field and environmental projects to study human-environment inter-relations and human impact (French 2003; 2015). In the field at each of the NERC case-study sites, Charly was always eager to head out to explore the site context and environs as a key step in multi-scale staged investigation and analysis of the local and regional environment and ecology, and landscape management and human impact (French 2015, 20).

At Çatalhöyük, Charly was quick to see the freshly cut ditches for a new large-scale irrigation scheme funded by the World Bank as a major opportunity to investigate how the environment around the site sustained the large long-term population at the site as well as the human impact on the environment, both of which were major aims of the Çatalhöyük project more widely (Fig. 0.9; Hodder 1996, 4). The ditch-sections extended over many hundreds of metres and had been cut to a depth of *c*. 4 m. On inspection by Charly, the ditch sections proved to reveal an intact sequence from the late Pleistocene through to the Holocene and the present day, and a palaeochannel, which was recorded and sampled by Neil Roberts and the KOPAL team, and sampled as part of the NERC project (Matthews *et al*. 1996; Roberts *et al*. 1996).

The records and samples from these extensive field sections provide an important complement to the intensive coring programme around the site conducted from 1994 by a range of researchers including one of Charly's later PhD students, Gianna Ayala (Ayala *et al*. 2017). The long transects through the landscape that these ditch sections provided are worthy of reconsideration in the light of current debates on the location and extent of wetland and cultivable land that was used to sustain the community at Çatalhöyük for more than 1,000 years (Roberts *et al*. 1996; Roberts & Rosen 2009; Ayala *et al.* 2017, fig. 1). The >1.5 km-long section 200–400 m to the south of Çatalhöyük is located in an area where there has not been much coring (Ayala *et al*. 2017). This section reveals the extent not only of Pleistocene lake marls and early Holocene dark grey sediments, but also the overlying grey silty clay sediments contemporary with the site (Fig. 0.9). The grey colour and extent of these silty clay sediments suggest that this area to the south, upstream, of the settlement at Çatalhöyük was at least periodically waterlogged (Gerrard 2000, 167) and may have supported wetland areas in places.

Wetlands provide biodiverse ecozones attractive to a wide range of species. The inhabitants at Çatalhöyük utilized a wide range of wetland resources. These resources included *Phragmites* reeds and sedges for containers, matting, roofing fuel and, potentially, human or animal food (Ramsey *et al.* 2016) as tubers, nutlets and young shoots have been identified at the site (Atalay & Hastorf 2006; Ryan 2013; Bogaard *et al*. 2017). Seventy-five per cent of the wild birds in occupation deposits at Çatalhöyük are of wetland species whose habitat preferences range from open water for diving to shallow water with a muddy bottom or dense stands of reeds (Russell & McGowan 2005, 108, table 3.3). The coring programme has revealed that the local landscape was topographically varied (Boyer *et al.* 2006, fig. 7; Ayala *et al*. 2017, fig. 5) and would have provided a range of niches for crop growing, including dry natural marl hummocks and 'margins of seasonal flooding' (Charles *et al*. 2014; Ayala *et al*.

Figure 0.9. *Cleaning an irrigation ditch section at Çatalhöyük. This is located 200 m south of the East Mound and examined by the KOPAL team after fieldwalking by Charly French. The section shows a post-Neolithic palaeochannel in the foreground and extensive exposures of late Pleistocene-Holocene sequences. Image: Wendy Matthews.*

2017; Bogaard *et al*. 2017, 21). Wheat was the dominant crop throughout occupation on the East Mound at the site, and stable isotope analyses have shown wheat was grown in wetter/better-watered parts of the landscape than barley (Wallace *et al*. 2015; Bogaard *et al*. 2017, 22). This ecological variability in landscape and crops grown combined with evidence of community-wide collaboration and exchanges of knowledge are likely to have provided mechanisms for risk management and sustainability in the short term, and capacity for adaptation, innovation and sustainability in the longer term through time as the landscape became drier (Hodder 2014; Bogaard *et al*. 2017).

Wider-scale field-research with Charly in the environs of Çatalhöyük enabled identification and sampling of outcrops of Neogene soft-lime approximately five kilometres away from the site. Micromorphological and subsequent SRS IR analyses proved that deposits such as these were the source of soft-lime used to manufacture the whitest wall and floor plasters at Çatalhöyük (Matthews *et al*. 1996, photograph 15.3; Anderson *et al*. 2014). In Building 5 this more distant soft-lime source was often selected to mark the first of around three to nine intra-annual interior whitewashes, probably in the spring, based on the absence/scarcity of soot on the surface in comparison to increases of soot on subsequent whitewashes within each annual cycle (Matthews 2005a, 367, fig. 19.9). Less-white lake marl was more routinely used for the base-coat plasters and white-washes after the first soft-lime coat. We can suggest, therefore, that the whiter, more exotic soft-lime sources were collected to mark symbolically the start of each new year in the Spring as the days warmed and lengthened and the landscape became more verdant and widely explored.

At Tell Brak, Charly mapped the environs of the 130-hectare site in collaboration with Tony Wilkinson during the NERC project (Wilkinson *et al.* 2002; French 2003), and later sampled the holloways that radiate from Tell Brak (Wilkinson *et al.* 2010). These holloways were traced over distances of more than five kilometres. Their high number and extent indicate the importance of a network of routeways and communications to the sustainability of major regional centres such as Brak (Ur *et al*. 2011). These holloways radiate from many tell site settlements in this region and continue to serve as routeways as well as conduits for water during flash flooding, as in many regions of the world (Bell 2020). Charly also identified depressions in the landscape that were likely to have been brick pits and may have served at least periodically as water-reservoirs, providing important sources of water in this steppic zone (Wilkinson *et al*. 2002). The development of the regional centre at Tell Brak from *c*. 55 hectares in 4000 BC to >130 hectares by 3400 BC has been charted through settlement survey by intensive fieldwalking and analysis of CORONA satellite imagery of the site and its hinterland (Ur *et al*. 2011). Further research has established that Tell Brak was sustained in part by intensification of agriculture through manuring, like many settlements in the region (T. Wilkinson 2003, 111–20), as well by extensification of agriculture by increasing cultivation of marginal land (Styring *et al*. 2017), both of which are key strategies in agricultural risk management (Marston 2011).

Reflexive fieldwork and on-site contextual analyses

With regard to on-site contextual fieldwork, Charly and I were part of the development of reflexive methodologies at Çatalhöyük by Ian Hodder and the site-team from the outset. In the first three years, in 1993–6, this included critically examining the categorization of data and disciplinary boundaries as well as multivocality, integrated interdisciplinary analysis and discussion of different material types and contexts (Hodder 1996). At Çatalhöyük, the initial field and micromorphological research was focused 'on the surface'. This included the mapping of Mellaart's previous excavations (1967) and cleaning of a total length of *c*. 160 m of field sections, which together provided a section through eleven metres of the mound (Matthews & Farid 1996; Matthews *et al.* 1996). These field sections and microstratigraphic and micromorphological analyses proved highly valuable both in familiarization with the materials, deposits and architecture of the site prior to large-scale excavations, and in examining the entire microstratigraphic histories of individual buildings and areas, as well as larger scale histories. The sections provided a reflexive window through which we could re-examine Mellaart's sequences and interpretations (Mellaart 1967). Microstratigraphic sequences observed in the field and in thin section enabled identification of the complex dynamic histories of buildings and provided evidence for the conduct of both everyday residential practices, such as food cooking and preparation, and more ritually focused activities, such as use of red ochre, white-washes, burial and wall-paintings (Matthews *et al*. 1996; Matthews 2005b). This suggested that the buildings were not shrines, as Mellaart (1967) had argued, but places of residence where the everyday and more highly charged symbolic aspects of life, such as burial, were demarcated both spatially and temporally by the selection of particular materials to create settings and embody specific events and interrelationships (Carsten & Hugh-Jones 1995; Hastorf 2001). The significance of surfaces was also later

explored by Charly's PhD student Nicole Boivin (2000) in comparative ethnoarchaeological research in India.

At all three sites we experimented with the placement of field-sections to examine how section-profiles can enable or restrict excavation, micromorphological sampling and microstratigraphic insights into the nature and extent of formation processes and activity areas. At all locations, sections provided high-resolution reflexive insight into continuity and change in activities and the built environment and social practices and relations, often at scales that were not detectable during excavation or spot sampling. At Tell Brak, microstratigraphic field sections were often recorded and sampled at the edge of excavations, or in half-sections through features (Matthews *et al*. 1997b; 2001). At Saar, we experimented with 'palaeolithic-style' excavation and sampling of two houses in alternate chequerboard one metre-squared grid squares, in collaboration with the excavators Shahina Farid, Martin Hicks, and Robert and Jane Moon (Matthews *et al.* 1997c, pl. 5; Matthews & French 2005; French 2015, 75–6, figs. 48–9). The results were surprising, in that the type of thickness and frequency of surfaces and overlying occupation deposits changed markedly within the space of one to two metres throughout these two- to three-roomed buildings. The findings enabled us to delineate the extent of a wide range of activities and to document the remarkable continuity in uses of space within each area, as well as post-abandonment activities. The clear definition and repetition of these actions and boundaries highlights the remarkable stability of the practices that they represent during the lifetime of a house, and thereby socio-economic roles and relations. This research highlighted the great value of sections not only as loci for sampling but also as part of reflexive microstratigraphic analyses in the field and during excavation. Field sections should therefore remain a strategic aspect of more open-area excavation, and sampling should include use of temporary working sections or plinths, for example, where larger sections are not possible.

Plant remains and ecology

In this last section, I would like to reflect on the important results from the NERC partnership with researchers at the Royal Botanic Gardens Kew, in order to highlight the value of micromorphology, phytolith and biomolecular analyses in integrated archaeobotany (Matthews 2010). Micro-contextual analyses of plant remains in thin section provided remarkable insights into regional variation in plant taphonomy and plant use for building materials, food and fuel, across the different geobotanical zones that we sampled. At all sites we established that plant remains were preserved not only as charred plant remains, but also as impressions of plant remains, phytoliths, ashes and melted silica. We also identified that both charred and non-charred dung remains were present, particularly at Çatalhöyük and Tell Brak. These results significantly enhanced our knowledge of the greater abundance and diversity of plant types, parts, and use at all three sites.

In the more forested regions of central Turkey, we established that the inhabitants at Çatalhöyük used a mixture of wood, grasses, reeds and animal dung as fuel, and identified an early example of on-site animal penning in Mellaart's Court 25/15 level X/VIII Level (Matthews *et al.* 1996, photographs 15.17–15.22), which has since been identified more widely within the site (Portillo *et al.* 2019). At Tell Brak, in the North Mesopotamian Steppe, grasses, reeds and dung were principal sources of fuel (Matthews *et al*. 2001). At Saar in Bahrain, we established that although only sixty-two grams of charred plant remains had been recovered by flotation of 6,800 litres of site deposits (Nesbitt 1993), plant remains were abundant at the site, preserved as date palm leaflets and fronds, which burn leaving little residual carbon but preserve as abundant phytoliths which were remarkably well-preserved in thin section (Matthews *et al*. 1997c; Matthews & French 2005, 327–8, fig. 10.7–10.8; Matthews 2010). These leaves and fronds are likely to have been readily available from date-palm groves and frequent trimming of fronds and as residues from palm mats, baskets and roofing.

Energy and fuel supplies are one of the most significant challenges to sedentary settlement globally, and, arguably, one of the reasons why hunter-gatherers in some regions and in the Palaeolithic had to be mobile: to avoid fuel scarcity (Henry *et al.* 2018). The results of our research revealed that at all three sites renewable sources of fuel were used. These renewable energy supplies and mixed fuel strategies would have contributed significantly to the sustainability and longevity of each of these sites, particularly where they were occupied for more than a millennium, as at Çatalhöyük (from 7000–6000 BC) and Tell Brak (from > *c*. 6000–1350 BC).

Conclusions

The NERC Project with Charly established that macro- and micro-stratigraphic analyses in the field and in micromorphological thin sections can significantly enhance our contextual understanding of: local and regional environmental change and human-environment inter-relations, of site formation processes and continuity and change in uses of space and social roles and relations, and of plant taphonomy,

abundance and diversity and utilization in diverse environmental and social contexts (Matthews *et al*. 1997a). Field and micromorphological archives and samples, moreover, provide enduring records that can be reflexively re-examined as research questions and analytical techniques develop and change, and the examples here were reviewed to provide new insight into the sustainability of ecological and social practices and strategies. The field and micromorphological sections from the NERC project spanned 7000–1800 BC and geobotanical zones in Turkey, Syria, Iraq and Bahrain. In particular, these case-studies re-examined the extent and importance of wetlands to early agricultural settlement at Çatalhöyük, the use of clay resources in the site environs, and the networks of communication, building material sources, and mudbrick pits and water management at Tell Brak. At Çatalhöyük we established the prevalence within buildings that were previously interpreted as shrines of both everyday and ritual practices. We also identified the diverse renewable energy sources used across the Middle East to sustain occupation at individual settlements over millennia. In relation to these examples, the global challenges today that require urgent action include: the implementation of strategies to reverse potentially catastrophic biodiversity loss by increasing and safeguarding wetlands as – although they only 'cover around 6 per cent of the Earth's land surface, 40 per cent of all animal and plant species live or breed in wetlands…[and] they are disappearing three times faster than forests' (UNEP 2021); the creation of sustainable networks, transport and built environments; and the development of renewable energy supplies and carbon capture to reduce global warming and pollution (UN 2020).

By continuing to re-examine field and micromorphological records and archival samples we can investigate both new questions and old chestnuts. Charly's legacy is certainly of a magnificent branching canopy.

An archaeology of the Anthropocene: uncovering lost landscapes with Charly French
Nicole Boivin

Sometime relatively early during my Cambridge years, I found myself driving through the countryside with Charly French. I can't quite remember how I ended up there, or what exactly we were doing. I recall that Charly had to go to some archaeological digs that were underway, and I had volunteered to go with him. I have vague memories of rain and friendly British excavators – perhaps in spite of the latter, the former was part of what led me not to do my archaeological research in the British countryside. The details have all slipped away, but what has stayed with me always is the way that Charly utterly transformed my understanding of the world around me that day.

I was at that time a student, I'm pretty sure it was my MPhil year from 1995 to 1996. I had joined Cambridge's archaeology course from the natural sciences, where I had studied things like cell biology, gene transcription and basic chemistry, and spent a lot of time in a white lab-coat. The world of archaeology was entirely new. So was the British landscape, as I had moved to Cambridge from Canada via Japan. The British countryside was lovely and quaint and full of gently sloping hills. It was nice to get out of the city, and to be out in nature, especially after three years of living in the fairly dense urban conglomeration that is greater Osaka.

But as we drove through the countryside, Charly started to point things out that were invisible to me. They lay below the surface, but somehow he could see them. Iron Age hillforts, prehistoric ditches, medieval pits. Hills that were not hills but rather ancient sites. Natural undulations that were not natural but the result of human activities thousands of years ago. Processes of erosion that were already ancient by the time something vaguely resembling English began to be spoken in Cambridge or anywhere else in England. When I started the journey, I saw a natural landscape on top of which humans were living; by the time I had finished, I saw the vague outlines of an extraordinary palimpsest that was neither nature nor culture but some indistinguishable melding of the two.

Many years have passed since then, and my memory has greatly blurred the details of that day. But I have recounted the story many times of how Charly fundamentally changed my perception of the world I lived in. The details have gone, but the fascination has not, and indeed the flame he lit that day has gradually grown brighter. I now have run my own archaeology department, and one of our core interests has been in exploring how humans have transformed the natural world. We draw on a broad range of methods – including geoarchaeology, the field that Charly introduced me to – in order to examine the diverse ways in which humans have reshaped the earth over many millennia.

While some of the ways we package things are a little different, the research we are doing is essentially a continuation of the ideas that Charly spent a research career developing. When we as archaeologists talk about the Anthropocene (Braje 2015; Kidder & Zhuang 2015; Ellis *et al*. 2016; Fitzpatrick & Erlandson 2018; P. Roberts *et al*. 2018; Boivin & Crowther 2021) or cultural niche construction (Boivin 2008; Clement

& Cassino 2014; Kluiving 2015; Boivin *et al*. 2016; Arroyo-Kalin 2018) we are talking about the processes Charly studied across so many decades – processes of landscape change caused by deforestation, erosion, desertification and other processes, many of them human-linked. He has unravelled these processes in many different regions of the world (e.g. French & Whitelaw 1999; French 2003; French *et al*. 2009; 2018; Zhuang *et al*. 2013; 2014; Friesem *et al*. 2016; Neogi *et al*. 2020), but nowhere more thoroughly than in the country that has become his adopted home, where he developed an intimate knowledge of English landscape evolution through time (e.g. French 2003; 2017; French *et al*. 2003; 2007; 2012).

We can draw on some of these long-standing research trajectories, together with new ideas and terms, to outline a set of key Anthropocene-related themes in archaeology, many of which Charly and his numerous students have been instrumental in developing. In a brief essay like this, I have space to only briefly summarize some major research trajectories and reference a few case studies. The archaeological research I touch on summarizes thousands of studies and many volumes and monographs – some key ones counting amongst Charly's prolific output. In the sections that follow, I outline a number of key ways that humans have altered global environments over the long term, shaping the world we live in today in fundamental and enduring ways.

Linking agricultural expansion and deforestation

As I write this in the midst of a global pandemic, it is hard not to be viscerally aware of the impact of modern-day deforestation. Covid-19, like other coronaviruses of recent times, almost certainly made the jump to humans as a direct result of tropical deforestation bringing humans and deeply stressed wildlife into closer and more regular contact (Afelt *et al*. 2018; Brancalion *et al*. 2020). Today, as many Western nations reverse century-long trends to increase forest cover, tropical forests globally are under more pressure than ever (Roberts *et al*. 2017; Roberts 2019) – indeed many countries that have undergone a forest transition (shifting away from deforestation) have simply displaced land use beyond their own borders (Pendrill *et al*. 2019).

As Charly's work first showed me several decades ago, deforestation is not, of course, new. In the British Isles the introduction of agriculture from the continent initiated a process of long-term deforestation (e.g. French 1990; 2003; French *et al*. 2012; Scarre & French 2013; Woodbridge *et al*. 2014), as did the expansion of farming across Europe more broadly (e.g. French 2003; Fyfe *et al*. 2015; N. Roberts *et al*. 2018). This trend accelerated in the Bronze Age in Europe, with the emergence of more intensive agricultural economies linked to increasing populations, trade and production (Kaplan *et al*. 2009; French *et al*. 2010; N. Roberts *et al*. 2018). Similar patterns are observed elsewhere. In Mesoamerica, pioneer agriculture was associated with pervasive forest clearance (Beach *et al*. 2006; McNeil *et al*. 2010). Agricultural expansion and population increase in China similarly led to a gradually increasing human footprint, with progressive deforestation a key component in the mid- to late Holocene (Shen *et al*. 2006; Ren 2007; Cao *et al*. 2010; Zhuang & Kidder 2014). The arrival of Iron Age communities into the Central African rainforest has also been linked to dramatic forest opening from human clearance (Garcin *et al*. 2018; Malhi 2018; Bayon *et al*. 2019).

Deforestation also followed human colonization of many islands globally during the Holocene (Argiriadis *et al*. 2018). Polynesian expansion across the Pacific appears to have been linked to extensive land clearance, though patterns and rates of deforestation likely varied substantially between islands. In New Zealand, high-resolution palaeoecological data reveals that extensive burning and forest clearance occurred within the initial decades after Polynesian arrival (McWethy *et al*. 2010; 2014). Revised chronologies suggest the same pattern of rapid, decadal-scale deforestation may also be true for Hawaii (Rieth *et al*. 2011). In Rapa Nui (Easter Island), however, deforestation appears to have been more gradual, and to have resulted from combined human and climatic shifts (Rull *et al*. 2015; Rull 2020). In the Mediterranean, the pattern is also variable between islands, with more rapid impacts suggested for Malta (Carroll *et al*. 2012) and more gradual changes on Corsica (Poher *et al*. 2017), for example.

Like today, ancient deforestation was linked to habitat fragmentation, erosion, and possibly climate change. Several researchers have suggested pre-industrial forest clearance and agricultural expansion were on a scale sufficient to generate climatically significant levels of carbon dioxide (Fuller *et al*. 2011; Ellis *et al*. 2013; Ruddiman *et al*. 2016). This 'early anthropogenic hypothesis' (Ruddiman 2007) is intriguing but requires more systematic testing. Nonetheless, Lewis and Maslin (2015) argue that large-scale population collapse in the Americas after AD 1492 led to sudden reversal of long-term deforestation trends and an associated dip in atmospheric carbon dioxide between 1570 and 1620 that is documented in high-resolution Antarctic ice core records.

Land use and soil erosion in prehistory

Charly's work, of course, has centred on soils. Lying at the base of all human subsistence systems, soils are central to human societies around the world (McNeill

& Winiwarter 2004; Boivin & Crowther 2021). The global expansion of agriculture had broad-scale implications for soil, promoting soil erosion in a diverse array of times and places (van Andel *et al*. 1990; Bell & Boardman 1992; Bintliff 2002; McNeill & Winiwarter 2004; French 2010a; French *et al*. 2010). The research of Charly and his students has contributed deeply to our understanding of these ancient processes, and to establishing significant soil mobilization as one of the primary outcomes of the transition to farming.

Erosion was exacerbated by intensification of crop cultivation as well as pasturing of animals. In the Aguas Valley of southeastern Spain, for example, intensive wheat cultivation in the third millennium BC precipitated widespread soil erosion, filling the wide alluvial floodplain with eroded soil to a depth of several metres (French 2010a). Intensifying arable use of the River Avon valley of southern England in the first millennium BC exacerbated soil erosion, transforming regional downland and floodplain landscapes (French *et al*. 2012). Land clearance combined with intensive grazing facilitated extensive Roman-era erosion in north central Sicily (Ayala & French 2005). Maya deforestation is thought to have precipitated widespread and substantial erosion in Mesoamerica (Anselmetti *et al*. 2007).

While soil erosion can be traced back in numerous regions to the earliest phases of agriculture, geoarchaeological research also demonstrates how many societies responded to such trends by instituting land management strategies that enabled soil conservation and curtailed erosion (French 2010a). Charly's research shows that the adoption of such practices often enabled relatively sustainable farming practices until recent times. In Ethiopia, for example, geoarchaeological research suggests that the Aksumite Period (*c*. 400 BC to AD 900) witnessed considerable landscape stability and resilience, whereas the pace of alluvial aggradation has increased markedly in the last few centuries, reflecting a growing population and arable intensification (French *et al*. 2009; French 2010a). Similarly, despite soil erosion and desertification, agriculturally based societies persisted in the Aguas Valley (see above) through careful land management, only giving way with the introduction of monoculture farming, field amalgamation and water abstraction in the last few decades (French 2010a).

Ancient soil degradation and soil enrichment

Soils are not only displaced, they are also transformed. Today, some of the most challenging ecological and food security issues we face relate to soil degradation and attempts to address nutrient stripping by the addition of synthetic fertilizers. Soil quality suffers not only from erosion, but also salination, acidification, nutrient depletion, leaching, declines in organic matter and loss of soil biodiversity, amongst other factors (Jones *et al*. 2013; Lal 2015). Today these processes are especially severe in the tropics and sub-tropics, where they have been documented to reduce soil ecosystem services by as much as sixty per cent (Lal 2015). The synthetic fertilizers intended to address many of these problems create their own knock-on problems, impacting water quality and coastal and freshwater ecosystems (Foley *et al*. 2005).

Charly and his students closely examined human-wrought changes to soil quality in the past, feeding important studies into a growing network of research findings and discoveries. One key method they employed was soil micromorphology. This method was used to show rapid soil degradation and calcification in Neolithic Malta (French *et al*. 2018), and depletion of former woodland soil and incursion of windblown sand in the Neolithic Channel Islands (Scarre & French 2013), for example. To counteract these soil depletion processes, research shows that humans increasingly found it necessary to input nutrients and organic material through fertilization. Manuring has been documented as early as the sixth millennium BC in central Europe (Bogaard 2004). Charly and colleagues drew on soil micromorphology to demonstrate that manuring was practiced by Late Neolithic rice farmers in the Lower Yangtze River, in China (Zhuang *et al*. 2014). Charly's work also showed that manuring with midden-derived material continued on the island of Hern in the Channel Islands from the fourth to the late second millennium BC, but was ultimately insufficient to enable sustained cultivation of the island's agriculturally marginal land (Scarre & French 2013).

But geoarchaeological research has also revealed diverse ways in which past societies sustainably managed and even enriched soils. Research by Charly and colleagues in south-central highland Peru demonstrates that local agriculturalists initially depleted soils, but over the last 900 years were able to farm the landscape more sustainably through the construction of irrigated terraces and the use of crop cycles dependent on long fallowing (Nanavati *et al*. 2016). Severe erosion as a result of forest clearance in Mesoamerica was offset by indigenous soil conservation that evolved into successful land management (Beach *et al*. 2006).

Perhaps the most fascinating work in this regard, however, has emerged from the Amazon, where archaeological research demonstrates that pre-Columbian societies profoundly enriched the highly weathered, low fertility soils that dominate the region through the long-term addition of charcoal and other organic waste (Lehmann *et al*. 2003; Glaser & Birk 2012). The resulting

human-modified terra preta soils are characterized by high organic matter and nutrient contents that support agricultural fertility, enabling settled agriculture in the Amazon (Glaser *et al*. 2001; Glaser 2007; Arroyo-Kalin 2010). Other ancient societies similarly enriched soils, the Maya for example adding algae to their gardens (Fedick & Morrison 2004; Sedov *et al*. 2007), while farmers in early societies added seaweed to topsoils around the Baltic Sea (Acksel *et al*. 2017). Archaeological Dark Earths are found also in the Andes, Africa, New Zealand and Australia (McFadgen 1980; Sandor & Eash 1995; Fairhead & Leach 2009; Downie *et al*. 2011). Modern science has taken interest not only in their agricultural utility but also their carbon sequestration properties (Woolf *et al*. 2010; Downie *et al*. 2011).

Long-term anthropogenic alterations to biodiversity

Linked to patterns of deforestation, habitat destruction, erosion and climate change today is a major biodiversity crisis. As we witness the anthropogenic extirpation and extinction of countless species, some before they can even be described by researchers, some scientists have suggested that we are in the midst of the planet's sixth mass extinction event (Wake & Vredenburg 2008; Ceballos *et al*. 2015; 2017). But while rates of extinction today are unprecedented in human history, it is clear that the current crisis is the culmination of long-term patterns similarly linked to anthropogenic changes to ecosystems (Grayson 2001; Dupouey *et al*. 2002; Boivin *et al*. 2016; Ellis *et al*. 2016; Braje *et al*. 2017). As agriculture spread, opening up and reworking landscapes on a vast scale (Stephens *et al*. 2019), biodiversity was similarly reshaped. Today this has culminated in a world in which wild terrestrial mammalian biomass is vanishingly small in comparison to the biomass of humans and our suite of domesticated animals (Smil 2011).

While humans likely had a role to play in the Late Quaternary extinction of megafauna (Koch & Barnosky 2006; Braje & Erlandson 2013; Sandom *et al*. 2014; Bartlett *et al*. 2015; Boivin *et al*. 2016), the clearest evidence for anthropogenic impacts to biodiversity comes from the Holocene. And in the Holocene, some of the best evidence comes from islands. Following human arrival, many islands saw significant reductions in terrestrial and avian fauna (Fitzpatrick & Keegan 2007; Rick *et al*. 2013; Boivin *et al*. 2016; Ellis *et al*. 2016; Braje *et al*. 2017). In the Pacific, for example, thousands of species of passerine birds went extinct following Polynesian colonization (Duncan *et al*. 2013). Endemic reptiles, rodents and many other types of birds also disappeared (Steadman 1989; 1995; Holdaway & Jacomb 2000; Athens *et al*. 2002; Steadman *et al*. 2002). So too did numerous plant species (Prebble & Dowe 2008). While altered predation, fire regimes and deforestation certainly had a role to play, the commensal species transported both deliberately and inadvertently to islands were also key (Wilmshurst *et al*. 2008; Boivin *et al*. 2016; Braje *et al*. 2017; Swift *et al*. 2018). Polynesians carried with them 'transported landscapes' of cultivatable plants, domestic animals, weeds, and commensal species like rats that preyed on the eggs and seeds of endemic island species (Anderson 1952; Kirch 1982; Grayson 2001). The same types of patterns played out in many other regions of the world, including the Mediterranean, Caribbean, and Channel Islands (Fitzpatrick & Keegan 2007; Rick *et al*. 2012; Braje *et al*. 2017).

But biodiversity was also remade on continents. Vast numbers of species were moved around in continental-scale biological exchanges that long preceded the better-known Columbian exchange (Boivin *et al*. 2012; 2016; 2017; Prendergast *et al*. 2017; Hofman & Rick 2018). Long-distance mobility, travel and trade accelerated this trend, gradually driving numerous rodent and other commensal species to near global distributions well before the age of European colonialism. These translocations enriched diets, improved human health and led to a vast new array of useful products, but also homogenized ecosystems. Pressure on wild species squeezed into ever-contracting natural habitats, leading to extirpations and extinctions. Agricultural expansion and population growth in ancient Egypt, for example, contributed, together with climatic change, to the collapse of food webs and faunal communities, leading to the extinction of more than three quarters of large-bodied mammalian species still present at the start of the Holocene (Yeakel *et al*. 2014). The Roman appetite for wild fauna to stock sacred groves and hunting enclosures, to support religious ceremonies, and for entertainment and slaughter was similarly on a scale sufficient to reduce biodiversity in source areas (Hughes 2003; Morley 2007; Boivin 2017). Human activities globally reshaped biodiversity in fundamental ways over thousands of years, on a scale that is only gradually being recognized (Heckenberger *et al*. 2007; Boivin *et al*. 2016; Boivin 2017).

The implications of the past today

Charly's work has been part of a vast phase of data production in archaeology in relation to human impacts on the earth that was underway by the 1970s, but took off in particular in the 1990s. This work clearly demonstrated that the surface of the Earth we live on today is a palimpsest of human activities over thousands of years. Even seemingly pristine environments like the Amazon are now recognized to have been altered by millennia of human occupation and activity

(Heckenberger *et al*. 2007; 2008; Clement *et al*. 2015). In unearthing buried soils and lost landscapes, Charly and his many students have played an important role in cataloguing the extraordinary scale of anthropogenic environmental change by past societies.

This work, while far from complete, has begun to reshape the very discipline that engendered it. As datasets have accumulated, archaeologists have begun to ask – what does it all mean? Where do we go from here? How do we make our work meaningful on a planet that now faces levels of human impact unprecedented in the archaeological record – levels of impact large enough to suggest that we have entered a new geological era, the Anthropocene, in which humans themselves are now the dominant force shaping Earth systems (Crutzen 2002; Steffen *et al*. 2018)? And while the answers remain far from clear, one thing is certain – our findings demand that our discipline becomes one in which advocacy, policy shaping, and public engagement are key (Riede *et al*. 2016; Rick & Sandweiss 2020; Rockman & Hritz 2020; Boivin & Crowther 2021). As a stand-alone discipline, we learn about the past, but as a discipline that engages with other disciplines and beyond academia, we also contribute to shaping the future.

These next steps are being taken by researchers all around the world. Archaeological findings are increasingly playing a role in conservation projects, helping establish baselines and critical data needed to restore ecosystems (Wolverton & Lyman 2012; Braje & Rick 2013; Rick & Lockwood 2013; Amano *et al*. 2021; Boivin & Crowther 2021). Archaeological data and indigenous traditions are being drawn upon to shape fire management policies, for example in Australia (Yibarbuk *et al*. 2001; Whitehead *et al*. 2003; Russell-Smith *et al*. 2013) and North America (Black *et al*. 2006). Other archaeologists are trying to understand how ancient cities, including numerous global examples of low density, urban agriculture, can contribute to creating more resilient and sustainable cities in the future (Heckenberger *et al*. 2008; Isendahl & Smith 2013; Barthel *et al*. 2019), and how archaeology can play a role in increasing food security and agricultural sustainability (Guttmann-Bond 2010; Fisher 2019; Reed & Ryan 2019). Climate change scenarios increasingly invite policy-oriented application of archaeological data (Rick & Sandweiss 2020). The work of Charly and his former students is contributing to this emerging agenda, exploring how past can be linked with future (e.g. French 2010a; Sulas & Pikirayi 2018; Boivin & Crowther 2021), and how archaeological data can play a role in shaping policy (e.g. French 2004; French 2009; French *et al*. 2017; Boivin & Crowther 2021). There is much work still to do, but as we push our discipline in new directions in future, we will build on the foundations established by pioneers like Charly and the fascination they have instilled in us to foster a new archaeology for the Anthropocene.

Firmly on the ground: science and a three-dimensional past

Martin Jones

In January of 1989, *New Scientist* published an article on the newly expanding field of archaeological science, mentioning nine UK institutions leading the way. Cambridge was not among their number (Pollard 1989). Two and a half years later, Winifred McDonald was laying the foundation stone of the outcome of her late husband's endowment, the McDonald Institute for Archaeological Research at Cambridge, containing laboratories conducting leading research in zooarchaeology, archaeobotany, archaeogenetics and geoarchaeology. Just two months into his post, a person central to the instigation, maintenance and expansion of that endeavour had taken up the newly created position of lecturer in archaeological science. That person was my longstanding colleague, Charly French.

Just to backtrack a bit, a turning point for UK archaeological science had been a report prepared in 1985 by the renowned physicist Michael Hart for the Science and Engineering Research Council, challenging the UK community to get its act together in a field that clearly had great potential (Hart 1985). At Cambridge, the two subsequent developments of relevance to addressing Hart's challenge were a pair of very generous endowments that arrived as a consequence of the energetic endeavours of Colin Renfrew, one that established the George Pitt-Rivers Professorship, to which I had the good fortune to be elected, the other establishing the above-mentioned McDonald Institute of Archaeological Research. A third, very significant contribution came in a somewhat convoluted and less conspicuous manner, from the public purse.

By the early 1990s explicit algorithmic models had come into favour for determining public funding in the UK, often relying on some fairly straightforward metrics. One such algorithm brought together 'unit costs' devised by the University Funding Council with a revised subject classification formulated by the University Central Council on Admissions (Johnes *et al.* 1993). The resultant funding model enabled a small group of universities active in archaeological science, thankfully now with Cambridge on board, to lay claim to a recurrent and not insignificant additional resource. That enabled both an expansion of our technical and support staff (the department previously had just one

technician) and, significantly, the creation of a post that Charly French has occupied with great distinction.

Reflecting upon the absence of Cambridge from the lead institutions in Mark Pollard's 1989 *New Scientist* piece, we can debate whether or not that truly reflected what was happening. Geoff Bailey was, after all, following Eric Higgs in championing zooarchaeology. The article nonetheless reflected a wider perception of Cambridge archaeology at the time; it was seen as a place of theory, rather than either science or practice. It was an arena in which processual and post-processual archaeologies could lock horns, and our less sympathetic observers rather unfairly questioned whether there was much wear on a Cambridge archaeologist's trowel. With Charly's arrival, it wasn't just Cambridge's reputation for archaeological science that was changing, it was also its reputation for archaeological practice. Moreover, by today's standards, we were a very small department (when I came for my own interview, it was to a department with one professor and eight established lecturers). The Department's main challenge was not maintaining its reputation for archaeological theory (in which it was doing rather well) or archaeological science (for which there were few ground rules anyway), but instead in maintaining a global credibility with a team of such modest size.

Other strong archaeological departments in the UK, often with larger teams, had found it prudent to lead with a national or sometimes a European strength, but for a number of strategic reasons, it made very good sense for Cambridge archaeology to retain a global presence in some form. Fifty years ago, when Grahame Clark published *World Prehistory, a New Outline* (Clark 1969), that global presence could be maintained by dispatching young graduates, each to chart a new patch of the world map. By the time Charly joined the Department, that earlier approach was looking more than a little colonial in style. Not only was the home-grown archaeology in those regions on the world map rich and complex, a significant contribution of post-processual archaeology was according a much greater status to the many non-Western constructions of the many distinct human pasts.

Charly's style has always been to respond to the ideas of others by seeing a way his own expertise can contribute to progress towards their goals rather than his. Those who had perceived the processual/post-processual debate as a pro/anti-science issue, might have been surprised when a hands-on archaeological scientist like Charly gravitated, in one of his earlier Cambridge projects, to one of the more prominent post-processual projects. Ian Hodder's excavations at Çatalhöyük (Matthews *et al*. 1996; 1997a) (along with the Syrian site of Tell Brak, and Saar in Bahrain) provided the basis for Wendy Matthews to explore issues of domestic and ritual space within Charly's new geoarchaeology lab, which at that point was also housing a completely contrasting local project at Willingham Over.

By the end of that decade, Charly's group (it doesn't sound quite right to say the 'French Group') included South America in its range. As the following decade unfolded, South Asia, the Philippines, North America, Africa, East Asia, were added to extend that range further. By the time of his retirement, I don't think there remained a continent to which Charly's team hadn't contributed their skills and insights. Incrementally, Charly's unassuming but focused approach brought to his laboratory group a global reach of which an earlier generation of more colonially minded archaeologists could only dream; a model of how to give 'world prehistory' contemporary meaning. I think that has probably remained Cambridge Archaeology's contemporary take on its global presence. That is not a presence that assumes or imposes a single past, a single explanation, a single approach. It instead engages with many pasts within different discursive frames, theoretical, practical, and in Charly's case, scientific.

I had been aware of Charly's work since first meeting him in the 1970s on Francis Pryor's wet and windswept excavations at Fengate. In those days, British archaeologists could still operate abroad in a quasi-colonial style that now brings discomfort. It was quite a tonic to visit a Canadian project in England, not just any old dig, but the foremost landscape archaeology project of its time, us poor Brits getting shown how to do things properly by cheery youthful Canadians, among them Charly.

The project was also an object lesson in prompt publication, with four Fengate reports appearing between 1974 and 1984 (Pryor 1974; 1978; 1980; 1984). Those reports paid due deference to the Cambridge groups of Graham Clark and Harry Godwin, to which they were indeed the intellectual heirs. Beyond their status as heirs of what was to become 'environmental archaeology', they also brought radical changes in approach and methodology. A key site of that earlier episode of research was Peacock's Farm at Shippea Hill. Here, Clark's excavations were substantial for their time, exposing a trench of roughly 6 × 20 m (Clark *et al*. 1935). The engagement of his palaeoenvironmental colleagues, Harry and Margaret Godwin, was essentially vertical. They took advantage of the main section exposed by Clark's excavation to employ the novel approaches to peat stratigraphy developed from examining Quaternary (essentially one-dimensional) cores, and to extend this approach to the second

dimension of Clark's twenty-metre trench. In the 1930s that extension was certainly innovative. Half a century later, the Fengate Project had greatly expanded the scale of analysis, with trenches extending over an area around a kilometre in length, and almost half as wide. It moreover enhanced the analysis from two dimensions to three.

This latter enhancement underpins Charly's pioneering contribution as a palaeoenvironmental researcher in three dimensions. While his predecessors in both sedimentological and molluscan research had certainly been aware of the challenge of understanding spatial patterns, from his early work at Fengate Charly has been keen to place space, as well as time, at the core of his methodological approach. This is a feature we can see emerging in his work at Fengate, and then informing each of the subsequent projects in which he and his students and colleagues have made major contributions. A three-dimensional environmental methodology now seems a rather self-evident element of landscape archaeology, but it didn't come about without experimentation, insight and lateral thinking.

Throughout his varied career, alongside promoting geoarchaeology around the world, Charly has retained his productive commitment to the archaeology of the Fens of eastern England, the region from which so many methodological contributions to landscape evolution and environmental change have emerged. Charly left his post a full century after a pioneer of an earlier manifestation of three-dimensional archaeology, Cyril Fox, embarked upon his excavations of one of the Cambridge dykes (Fox & Palmer 1923), a series of earthworks spanning the chalk ridge between the boulder clay and the East Anglian Fens. Fox's Cambridge doctoral thesis, and book that followed (Fox 1923), prefigured many of the landscape and geoarchaeological interests that Charly's career has served. Fox was a pioneer of landscape archaeology, with a keen sense of how to bring together insights from both geography and stratigraphy. I have no doubt how much he would have enjoyed the opportunity of working with Charly; so many of the issues he addressed led directly to the possibilities of Charly's approach. As it was, it would take another decade before Harry and Margaret Godwin would bring pollen analysis to the study of landscapes through time, half a century before Eric Higgs' group would bring prominence to the study of seeds and bones, and three quarters of a century before Charly would return to the same fenland and fenland edge landscapes with the full potential of modern geoarchaeology. Between Fox and French, it has been a very productive century indeed.

The three-dimensional approach of Charly French has benefited archaeology on several different scales, locally, regionally and globally, from some of the largest archaeological landscapes down to the finest details of a micromorphology slide. The archaeology we do at Cambridge is much the richer as a consequence.

Geoarchaeology: reflections on progress and prospects
Martin Bell

Charly French's projects are informed by extensive experience as a field archaeologist. He worked initially with Francis Pryor in the Fens, including major contributions at Flag Fen (Pryor 2001), Etton (Pryor 1998a) and many aspects of the Fenland project (e.g. Pryor & French 1985). This has been combined with a detailed scientific knowledge of environmental archaeology, soils, sediments and micromorphology to develop a multi-scale approach extending from the detail of microstratigraphy and the micro-analysis of activity areas through to a wider landscape approach which is the hallmark of his projects. He has been an evangelist for geoarchaeology in his teaching and more widely through textbooks (French 2003; 2015). These explain the contribution of micromorphology and geoarchaeology in non-technical language, above all emphasizing the relevance of these scientific techniques to cultural archaeological research questions. He has combined successful collaborations with the effective leadership of his own projects. His students, as this volume demonstrates, have, in true Cambridge tradition, disseminated good geoarchaeological practice to diverse environment types in many corners of the world. French and the writer were both students at the Institute of Archaeology, London at about the same time and have followed parallel careers in geoarchaeology and wetlands. This contribution will reflect on three research areas in which we have common interests and then consider issues of wider relevance in terms of future prospects. The locations of the British sites noted are shown in Figure 0.10.

Chalkland soil and vegetation history
At different stages in our careers, French and I have investigated soil and vegetation histories of areas of the English chalk which have produced informatively contrasting conclusions. My PhD research on the South Downs indicated extensive erosion leading to the replacement of loess-based soils on thin superficial sediments by more chalky soils as a result of erosion which was mainly Bronze Age to medieval (Bell 1983). The area is subject to frequent soil erosion events today and these provide analogues for the past processes involved (Bell & Boardman 1992). On the South Downs

there is also evidence for former woodland, both in dry valley fills and on Neolithic sites (Thomas 1982). Allen (1992) and K. Wilkinson (2003) carried out further investigations of dry valley sediments in Sussex and Wessex, finding significant evidence of colluviation and also spatial and temporal contrasts leading to a more nuanced understanding. Mike Allen and I contributed to the Stonehenge Environs Project (Richards 1990) where we found only thin colluvial sediments, though thicker sediments have been found in places more recently during assessments for the A303 tunnel near Stonehenge (Wessex Archaeology, 2020, pers. comm.). With the increasing coverage of palaeoenvironmental studies in the Stonehenge landscape, Allen (1997a) has reconstructed the landscape at stages between the Mesolithic and Bronze Age. The Mesolithic landscape in the eighth millennium BC, when large postholes were dug close to where Stonehenge was later erected, was open woodland with patches of grassland, the latter expanding significantly in the Neolithic. More recently, an extensive programme of boreholes and environmental analysis in the Avon valley around Durrington Walls has shown that the landscape became more open in the later Mesolithic and Neolithic (French *et al*. 2012). Allen and I worked on the Hambledon Hill project where Mollusca from the Neolithic causewayed enclosure ditches pointed to construction in woodland (Bell *et al*. 2008). This contrasted with the results of the French *et al*. (2007) project in the Upper Allen Valley, Cranborne Chase, where an extensive borehole programme produced a far more spatially detailed picture than my earlier section and site-specific studies elsewhere. This was coupled with environmental evidence from the valley and old land surfaces below barrows, leading to the conclusion that dense woodland may not have existed, soils were thin even before construction of Bronze Age barrows, and evidence of colluviation was limited.

It can be concluded from these various projects that there was significant spatial variation in the extent of Mesolithic, Neolithic and later woodland on the chalk and also in the extent of colluvial sediments derived from soil erosion. Vera (2000) has hypothesized that the early and mid-Holocene woodland was less dense than once supposed, more park-like due to the activity of animal grazers. Vera's hypothesis has proved influential in the nature conservation field, though it is by no means fully in accord with the palaeoenvironmental evidence (Whitehouse & Smith 2010; Alexander *et al*. 2018). Limitations of this hypothesis include insufficient consideration of the role of disturbance factors other than grazing. Furthermore, the effects of grazing, in common with other disturbance factors, would not have applied evenly across landscapes but have been concentrated in certain areas. That being so, did more open areas created by antecedent conditions contribute to the special significance of locations selected for prehistoric monuments? A particularly fruitful case concerns the role of paths made by both animals (wild and domestic) and people, the more open corridors with which they are likely to have been associated and the social significance which we can suppose accrued to such places. This is likely to have applied especially to path intersection points where different communities met and exchanged goods, knowledge and genes (Bell 2020). Maybe this contributed to some of the patchiness of mid-Holocene woodland and accounts for some long continuities in focal points, conceivably the eighth millennium postholes and much later Neolithic activity round Stonehenge, or Mesolithic activity below later Neolithic long barrows. The opposed entrances of later Neolithic enclosures such as Avebury and Durrington Walls could be interpreted as earlier points of path intersections, since in both cases the monuments were preceded by grassy clearings. The presence of an avenue and cursus monuments at Stonehenge and the long cursus at Cranborne Chase can also be argued to hint at a relationship to routeways, linear openings and mobility.

Coastal wetlands

French and the writer have shared a long preoccupation with the archaeology of coastal wetlands (Fig. 0.10), though our spheres of interest have been largely separated by seawalls, much more than can, on reflection, be academically justified. His work has been mainly on the inner, principally freshwater, part of the East Anglian Fenland, which provided about half of the case studies in French (2003). The Fenland research of Pryor, French and others are built on the interdisciplinary approaches pioneered by the Fenland Research Committee and later the Fenland Project (Hall & Coles 1994). My coastal wetland focus has been intertidal and in western Britain, mainly the Severn Estuary.

Separation at the seawall is of course artificial since these wetlands existed as a result of maritime influence, the extent of which, prior to seawall construction, varied constantly, even down to the extent of ingress by individual tides. Before seawalls and coastal erosion there existed vastly greater areas subject to varying degrees of tidal influence, which must have represented a huge resource in terms of biodiversity. This is perhaps sometimes under-emphasized in our inevitable archaeological focus on those parts of the landscape the utilization of which is most tangibly demonstrated by settlement and enclosure. In the

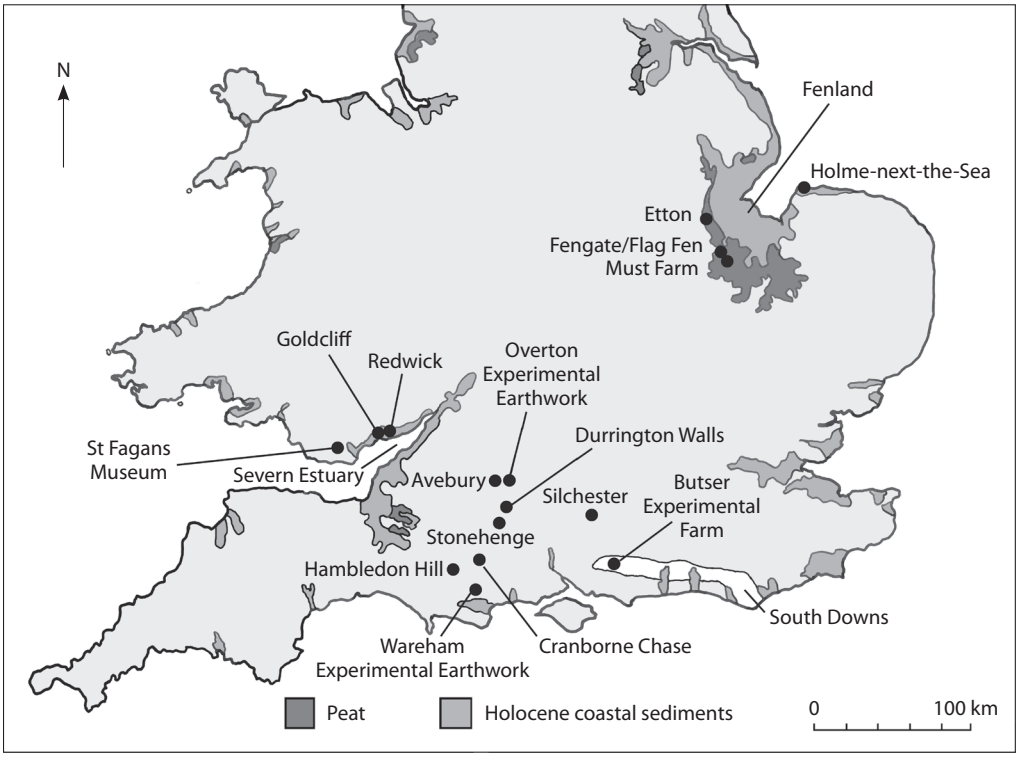

Figure 0.10. *Location of British sites noted in the text against a background of Holocene coastal sediments (graphic Jennifer Foster). Image: Martin Bell.*

Fenland, marine transgression and saltmarsh formation has sometimes been seen as a factor which limited prehistoric activity, in the late Bronze Age for instance (French 2003, 149). The Severn Estuary illustrates a contrasting situation in which saltmarsh was an especially significant resource, with evidence of settlements of rectangular buildings of middle Bronze Age to Iron Age date, established on peat at the tidal limits of the saltmarsh edge at Goldcliff and Redwick, and roundhouses at other sites (Bell *et al*. 2000; Bell 2013). The interface between peat and saltmarsh silts around the buildings, and extensively along the foreshore, is marked by footprints, mainly of cattle and some sheep (Fig. 0.11). Bones and footprints of neonatal animals indicate activity was concentrated in spring and early summer, and the insubstantial structures with small and restricted artefact assemblages are thought to represent seasonal settlements. This seasonal element, at least in some areas, must lead us to question the assumption that in the middle Bronze Age all people settled down into permanent agricultural settlements year-round.

At the Fenland edge the evidence for extensive field systems in the Fengate area and elsewhere is of a mainly pastoral character (French 2003, 97–112), and drove roads leading down to the wetland edge at Fengate indicate grazing on riverine and coastal wetlands (Pryor 2001). The same practices would seem to be indicated by the river terrace and coastal edge distribution of many middle Bronze Age to Iron Age coaxial field systems, some with drove ways leading to wetlands. Intensive cattle husbandry based on the river valleys and coastal edge has been seen as a main engine of wealth creation and metalwork acquisition in the Bronze Age (Yates 2007). In the Fenland, where archaeological investigation is inevitably mainly concentrated in the inner freshwater dominated areas, there is less evidence for ephemeral seasonal settlement than in the Severn Estuary, and the application of seasonality models, which in that area had been derived mainly from medieval practice, has been critiqued (Evans 1987). A point at which the perspectives of the maritime and the intertidal Fenland come together is on the foreshore at Holme-next-the-Sea, Norfolk. Here two sea henges were constructed in 2049 BC in a saltmarsh, on which there was some beetle evidence of animal grazing and then later evidence of a trackway and other wood structures at a time of subsequent freshwater peat (Brennand & Taylor 2003; Robertson 2016).

Just as it is important to establish the relationships between wetland edge settlements and fields, and activity on the freshwater and maritime wetlands, we must also recognize the contrasting nature of the formation processes, archaeological record and the opportunities they afford, particularly as regards intertidal sites. Often these cannot be excavated in the conventional sense. Episodically extensive transects of

Figure 0.11. *Cattle and sheep footprints at the interface of peat and estuarine silt around a Bronze Age rectangular building at Redwick, Severn estuary. Image: Edward Sacre.*

former landscape may be exposed on the foreshore by storms and much can be achieved by rapid recording and sampling of what is revealed. In addition to the discovery of wood structures, buildings and trackways, among the most striking discoveries are footprints of people, birds and animals (Figs. 0.11–0.13; Bell 2020). In the Severn Estuary, they are especially preserved in two contexts: in laminated estuarine silts of mainly later Mesolithic date, and at the transitions between peat and estuarine silt of middle Bronze Age to Iron Age date. Such sedimentary conditions are especially favourable for the registration of footprints. Exposure

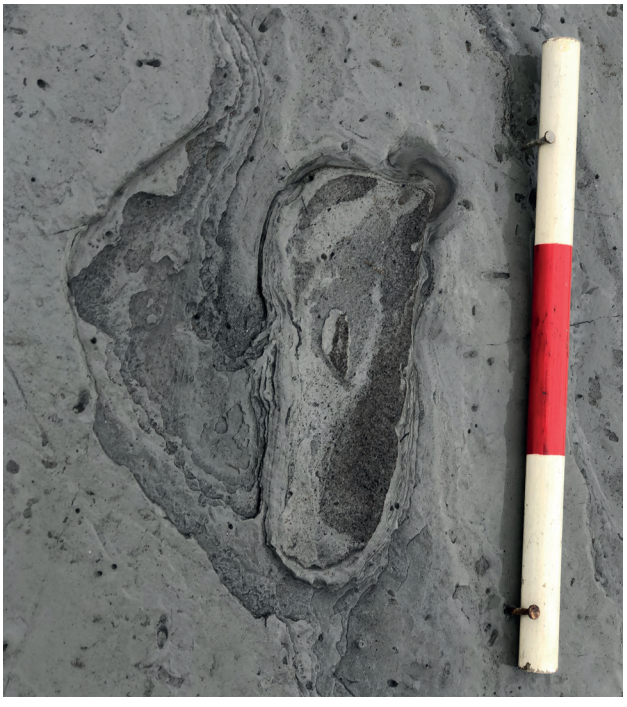

Figure 0.12. *Human footprint in laminated silts of later Mesolithic date at Goldcliff, Severn estuary. Image: Martin Bell.*

Figure 0.13. *Crane footprints in laminated silts of later Mesolithic date at Goldcliff, Severn estuary. Image: Martin Bell.*

by the sea also plays a key part in gently etching out contrasting sediment types to reveal footprints. It must be the case that footprints are more widely represented than is generally recognized and one wonders if archaeologists always recognize both their existence and significance. Cattle footprints were identified at the end of a Fengate Main Drove (Pryor 1998b, fig. 46) and both cattle and human footprints have more recently been identified at Must Farm (M. Knight, 2016, pers. comm.; Knight *et al*. 2019).

Footprints are an under-utilized source of evidence for the age structure of human populations, including the role of children and patterns of movement within and between sites and activity areas. They tell us about the animals and birds physically present in an area, including the ecology of species which later became extinct, either globally in the case of aurochs or nationally in the case of cranes (Fig. 0.13; Bell 2020). The later Bronze Age to Iron Age footprints which include those of neonatal and young animals also provide evidence of animal husbandry and its seasonality (Barr & Bell 2016). New multi-proxy sources such as footprints provide fresh perspectives from which we can test hypotheses and triangulate our understanding of the past.

Experimental geoarchaeology

The approach advocated in French's (2003; 2015) instructive textbooks is landscape based, founded on a detailed familiarity with the research area. Field investigation employs boreholes and test pits, with samples taken to address specific questions using a multi-proxy approach. Interpretation, he argues, should be informed by analogy drawn from ethnographic and experimental examples. His work, and that of his students and colleagues, includes several examples where ethnographic structures or activity areas provide a sort of natural experiment, which contributes to the interpretation of archaeological examples, such as the microtraces of activities in buildings and other areas (Matthews *et al.* 1997a). He and his students have employed experimental approaches to identify the micromorphological traces of past cultivation in buried soils (Lewis 2012). Experiments have a special role in helping us to understand how the archaeological record forms and this could be argued to be as essential for the archaeologist as effective source criticism is for the historian. One of the most important lessons from the long-term Experimental Earthwork Project initiated at Overton, Wiltshire and Wareham, Dorset in the early 1960s is that the processes affecting buried soils, earthworks and buried materials are rapid at first, achieving something like an unstable equilibrium over time (Jewell 1963; Bell *et al*. 1996). Thus, even relatively short-term experiments on timescales of 1–32 years have helped us understand the processes affecting soils which have been buried for millennia. It is striking that a thirty-three-year-old buried soil is so similar to those buried since the Neolithic or Bronze Age (Fig. 0.14). The same point has been demonstrated with great elegance in experimental round barrows at Lejre, Denmark, which have been important in understanding the exceptional burial conditions found within some middle Bronze Age barrows such as Egtved (Breuning-Madsen *et al.* 2001). The Experimental Earthworks project has also highlighted the role of faunal agency in the formation of the archaeological record. This was perhaps unsurprising in that the main inspiration for the project was Darwin's (1881) long-term experiment on the role of earthworms in soil formation. What has been more surprising has been the role of other faunal agents, for instance deer and sand lizards at Wareham (Bell 2015). In these contexts, people have created affordances for faunal agents which in turn influence the traces we recover of past human activity. My students and I have carried out investigations of experimental Iron Age round houses at Butser and St Fagans (Bell 2009; 2015). At the latter, wood ants proved to be a significant factor in structuring the archaeological record. Artefact plotting, micromorphology and geochemistry as part of these investigations have contributed to the interpretation of both formation processes and activity areas, evidence which Banerjea *et al*. (2015) have been able to apply to the interpretation of Romano-British structures at Silchester.

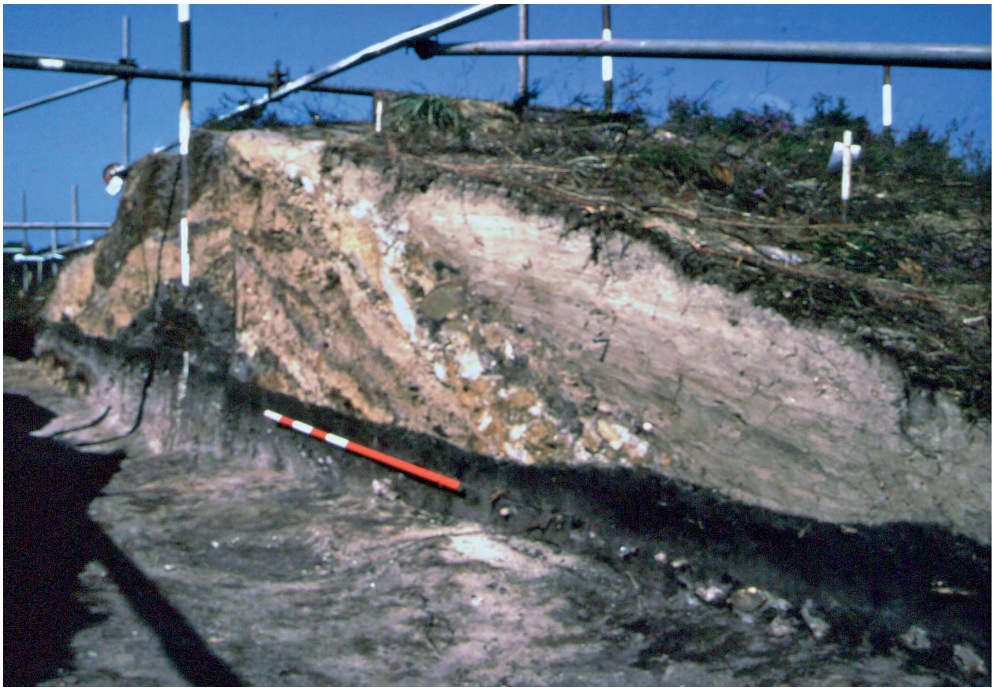

Figure 0.14.
Wareham, Dorset. Experimental earthwork burying a 33-year-old buried soil overlain by bank and, to the right, sand from earthwork erosion. Image: Edward Sacre.

Conclusions and future agendas

These topics bring together some of the ways in which geoarchaeology is contributing to wider agendas today. As the density of palaeoenvironmental studies increases, we can move beyond generalizations concerning environments in particular periods to identify spatial variations of potential social significance. Contrasting environmental histories have been identified in Fenland river valleys and embayments (French 2003) and spatial contrasts in the soil and vegetation history of areas of chalkland have been noted above. In considering this environmental patchiness, no longer are we thinking simply in terms of how people changed landscapes, but how a diversity of agents, human, animal, plant, geomorphic agents, etc., interact in the construction of niches which create affordances for various organisms and processes. This has relevance across the multi-scale spectrum, from thin section to landscape, which is so much a feature of the approach developed by French and his students. There is a wide range of factors from the role of earthworms and ants in the formation of the archaeological record, to the contribution of grazing herbivores in the creation of woodland patchiness, and the ways in which the paths made by animals contribute to patterns of human connectivity (Bell 2020). There is also that quintessential example of 'other than human agency', such as the role of the beaver as a keystone species in promoting environmental change, increasing biodiversity and flood resilience (Coles 2006). The reintroduction of nationally extinct species such as cranes (Fig. 0.13) is increasingly recognized as enhancing biodiversity, and the palaeoenvironmental record provides evidence of their former presence and ecology. The contribution of grazing herbivores including birds also turns out to be highly significant in the case of saltmarshes, where, as we have seen, grazing resources were important in the later prehistory of some areas. Chatters (2017) has demonstrated that grazing contributes very significantly to the biodiversity of saltmarshes today. Saltmarsh is a habitat being reduced by coastal erosion, but now being re-established through managed realignment schemes which contribute both to more sustainable coastal protection and nature conservation.

Environmental archaeology and geoarchaeology provide time depth to inform current debates concerning environmental sustainability, whether that is French and colleagues' (2020) important recent work on soil and environmental history in Malta, or the contribution of terrace cultivation to sustainability in the Andes (French 2015). Sustainability is not something that can be conceptualized or measured at a point in time; a long-term perspective and modelling of past and future trends is required. Faced by growing awareness of the effects of global warming, sea-level rise, pollution, and loss of biodiversity, there is increasing emphasis on the need for sustainable solutions (Attenborough 2020).

This recognition is to varying extents global, but in Britain it has a particular urgency. As Britain leaves the European Union there is the need to develop policies of environmental protection and agricultural

subsidy to which, for the last forty-seven years, international agreement through the EU has played a key role. The UK Government's twenty-five-year environment strategy (HM Government 2018) proposes a greater emphasis on soil sustainability, which has been conspicuously deficient for a generation, and for that a time-depth perspective is imperative. The government also proposes a new subsidy system based on the concept of 'public money for public goods'. The promise is that substantially more land will be designated for nature conservation, increasing from a current twenty-six to thirty per cent by 2030; this means an additional 4000 sq. km (Gov.UK 2020a). The target is hugely ambitious, particularly given that the majority of Sites of Special Scientific Interest have not been managed in a way which means their biological significance is sustainable (Gov.UK 2020b). Substantial increases in provision for biodiversity had been identified as essential by the Lawton *et al.* (2010) report, which demonstrated that nature conservation sites were far too small, fragmented and in need of much greater connectivity. New approaches to nature conservation based not on intensive management but concepts of rewilding (letting nature take its course, whatever that may be) are increasingly proposed with varying degrees of radicalism (Monbiot 2013; Tree 2018). The development of new approaches to nature conservation, including rewilding, needs to draw on a deep time-depth perspective essential for any consideration of sustainability. Relevant topics include many of those noted here: the circumstances under which sustainable, or unsustainable, soils existed in the past; the park-like or closed nature of early Holocene woodland; the role of grazing herbivores and other faunal agents to the character of woodland, saltmarsh, etc., and the relationships between the agency of people, animals and other environmental factors which in combination can create sustainable communities. This is but a (mainly British) sample of the many issues internationally to which the research of Charly French and his students has made illuminating contributions.

Inspired geoarchaeologies

Geoarchaeological research captures dimensions of the past at an unprecedented level of detail and multiple spatial and temporal scales. The record of the past held by soils and sediments is an archive for past environments, climate change, resource use, settlement lifeways, and societal development and resilience over time. When the McDonald Institute was established at Cambridge, geoarchaeology was one of the priority fields for a new research and teaching environment. An opportunity to develop the legacy of Charles McBurney was bestowed upon Charles French, whose 'geoarchaeology in action' approach has had an enormous impact in advancing knowledge, principles and practices across academic, teaching and professional sectors. Many journeys that began at Cambridge have since proliferated into dozens of inspired geoarchaeologies worldwide. This volume presents research and reflection from across the globe by colleagues in tribute to Charly, under whose leadership the Charles McBurney Laboratory became a beacon of geoarchaeology.

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