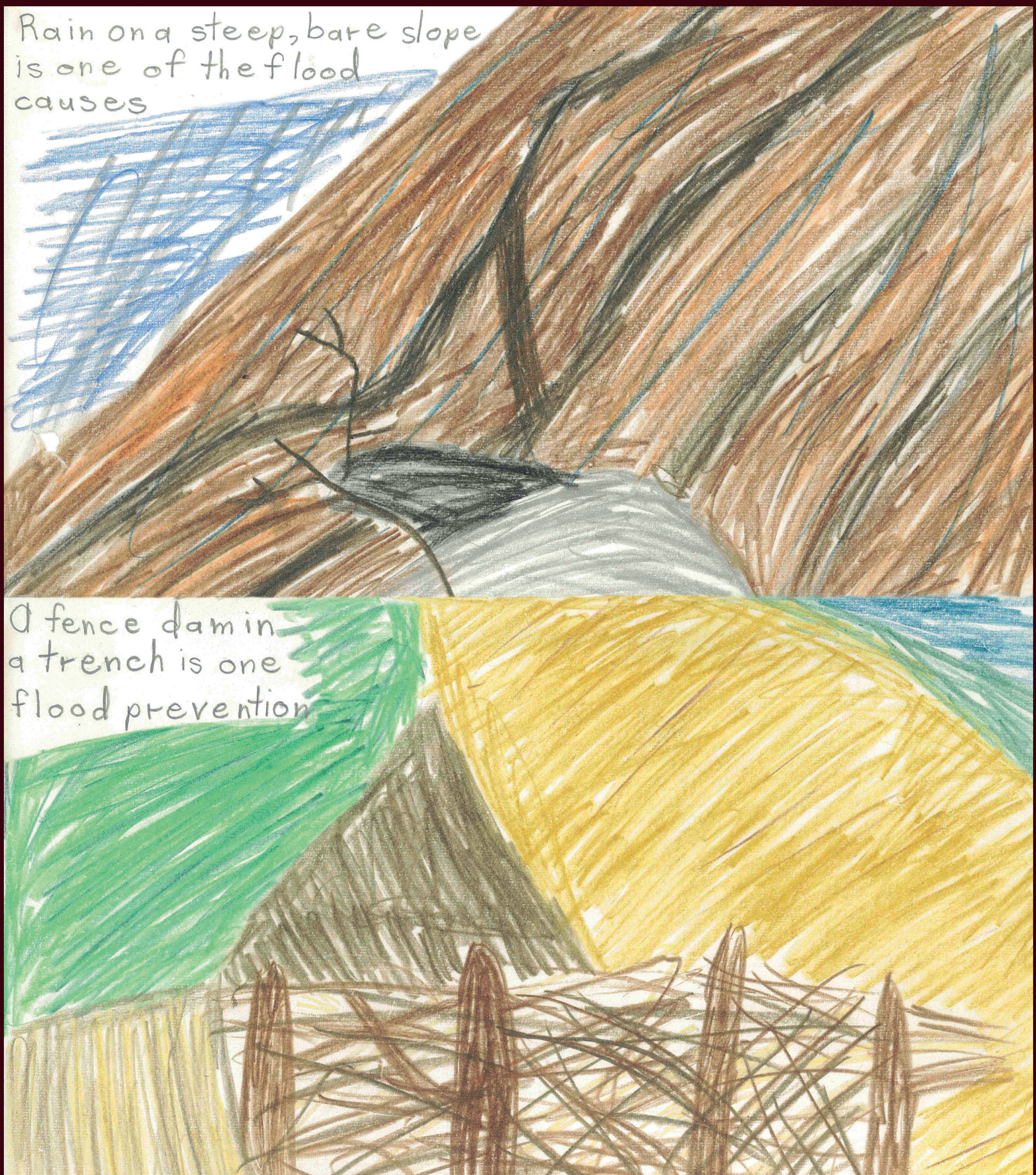
McDONALD INSTITUTE CONVERSATIONS

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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Contributors

Michael J. Allen
Allen Environmental Archaeology, Redroof, Green Road, Codford, Wiltshire, BA12 0NW, UK
Email: aea.escargots@gmail.com
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.

Manuel Arroyo-Kalin
Institute of Archaeology, University College London, 31–34 Gordon Sq., London WC1H 0PY, UK
Email: m.arroyo-kalin@ucl.ac.uk
Manuel is Associate Professor of Geoarchaeology at the Institute of Archaeology, UCL. He is interested in the Anthropocene, Human Niche Construction, and Historical Ecology and uses earth science methods, including soil micromophological analysis, to study past anthropic landscape modification and anthropogenic soil formation. His main research focus is the pre-Colonial human landscape history of tropical lowland South America, particularly the Amazon basin, where he is engaged in the long-term comparative study of Amazonian Dark Earths. He has also been involved in geoarchaeological studies in other world regions and published on the archaeology and palaeodemography of the Amazon basin. In recent years he has coordinated an intercultural and interdisciplinary research project focused on the northwest Amazon region.

Andrea L. Balbo.
Platform Anthropocene, 160 Riverside Blvd, 30E - 10069 New York, NY, USA
Email: andrea.balbo@planthro.org
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.

Martin Bell
Department of Archaeology, University of Reading, Whiteknights, PO Box 217, Reading, Berkshire, RG6 6AH, UK
Email: m.g.bell@reading.ac.uk
Martin is an emeritus professor of Archaeology at Reading University. His research interests are in geoarchaeology, environmental archaeology, coastal and maritime and experimental archaeology. He has been involved in several experimental archaeology projects, particularly the Experimental Earthwork Project. He has been excavating coastal sites in the Severn Estuary for forty years and has produced four monographs on the prehistory of the Severn Estuary. He believes that environmental archaeology has a key role in finding sustainable strategies for nature conservation. His most recent book *Making One's Way in the World: The Footprints and Trackways of Prehistoric People* (Oxbow 2020) explores the ways in which we can investigate prehistoric routeways and connectivity. He is a Fellow of the British Academy and the Society of Antiquaries of London.

Nicole Boivin
Max Planck Institute for the Science of Human History, Kahlaische Strasse 10, 07745 Jena, Germany
Email: boivin@shh.mpg.de
Nicole was a director at the Max Planck Institute for the Science of Human History in Jena, Germany. The author of *Material Cultures, Material Minds: The*

Role of Things in Human Thought, Society and Evolution (Cambridge University Press 2008), she has also been editor of several books, including *Globalisation and the 'People without History': Understanding Contact and Exchange in Prehistory* (Cambridge University Press 2018). She has been awarded research funding from many international bodies, including the European Research Council and the National Geographic Society, is a Fellow of the Society of Antiquaries of London, and holds an Honorary Professorship at the University of Queensland.

Christopher Evans
Department of Archaeology, University of Cambridge, Downing Street, Cambridge CB2 3DZ, UK
Email: cje30@cam.ac.uk
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).

David Friesem
Department of Maritime Civilizations, School of Archaeology and Maritime Cultures, University of Haifa, 199 Aba Khoushy Ave, Mount Carmel, Haifa 3498838, Israel
Email: dfriesem@univ.haifa.ac.il
David is a senior lecturer of environmental archaeology at the Department of Maritime Civilizations, University of Haifa, and a research member of the Haifa Center for Mediterranean History. He combines field archaeology, geoarchaeology, ethnography, and social theory in order to study human ecology, technology, and social interactions, and reconstruct the often-missing small-scale perspective of human-environment interactions. His research interests include human adaptation during the Late Pleistocene, the emergence of complex societies, and hunter-gatherer anthropology.

Kasia Gdaniec
Higher Shippon, Bridge Reeve, Chulmleigh, Devon EX18 7BB, UK
Email: kasia.gdaniec@btinternet.com
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.

Michael Gill
48 Saunders Avenue, Salisbury, SP1 3PQ, UK
Email: mjg.gbr@gmail.com
Michael has an MA in Landscape Studies (archaeology and history) and an MSc in Geographical Information Systems, both from Leicester University. He works as a GIS consultant with Ordnance Survey, and is an active member of Avon Valley Archaeological Society, where he leads the geophysics survey team. He has a personal research interest in the Neolithic monuments on Cranborne Chase and in the Avon Valley, and has surveyed a number of long barrows and related sites in this region.

Lars Erik Gjerpe
Cultural History Museum, University of Oslo, Frederiks gate 2, 0164 Oslo, Norway
Email: l.e.gjerpe@khm.uio.no
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).

Martin Green
Down Farm, Woodcutts, Salisbury SP5 5R, UK
Email: mgreendownfarm@gmail.com
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.

Ann-Maria Hart
Ann-Maria is currently working in contracts and commercial management within the Australian defence industry, but still maintains an interest in her former career as a geoarchaeologist.

Robyn Inglis
York Environmental Sustainability Institute (YESI), K/220, Department of Biology, Wentworth Way, University of York, Heslington, York YO10 5DD, UK
Email: robyn.inglis@york.ac.uk
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.

Martin Jones
Department of Archaeology, University of Cambridge, Downing Street, Cambridge CB2 3DZ, UK
Email: mkj12@cam.ac.uk
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.

Gabriella Kovács
Matrica Museum and Archaeological Park, 2440 Százhalombatta, Gesztenyés út 1–3, Hungary
Email: antropologus@yahoo.com
Gabriella (PhD) is a museologist and soil micromorphologist at the Hungarian National Museum National Institute of Archaeology. Her main interest is the Middle Bronze Age tell settlement of Százhalombatta-Földvár, under the framework of the international SAX (Százhalombatta Archaeological Expedition) project. Besides this site, other Bronze Age settlements of Hungary are also part of her research interests, regarding the comparison of single and multi-layered settlements of the period, mainly the so-called Vatya Culture. She focuses on the use of space and building techniques via soil micromorphology to add details to traditional archaeological methods.

Helen Lewis
School of Archaeology, University College Dublin, Dublin 4, Ireland
Email: helen.lewis@ucd.ie
Helen is an associate professor at University College Dublin School of Archaeology. Her background is in archaeology and anthropology (BA University of

Toronto), environmental archaeology (MSc University of Sheffield) and archaeological soil micromorphology (PhD University of Cambridge). She mostly works today on cave sites in Southeast Asia, but she still loves northwest European Neolithic and Bronze Age monuments and landscapes, and ancient agricultural soils.

Johan Linderholm
Environmental Archaeology Laboratory (MAL),
University of Umeå, S-90187 Umeå, Sweden
Email: johan.linderholm@umu.se
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.

Roy Loveday
School of Archaeology and Ancient History,
University of Leicester, University Road, Leicester
LE1 7RH, UK
Email: r.e.loveday@btinternet.com
Roy is an honorary research fellow in the School of Archaeology and Ancient History, University of Leicester. He completed a PhD surveying cursuses and related monuments of Great Britain in 1985. His particular interests are the societal mechanisms underlying monument plan transmission and construction.

Richard I. Macphail
Institute of Archaeology, University College
London, 31–34 Gordon Sq., London WC1H 0PY, UK
Email: r.macphail@ucl.ac.uk
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.

Wendy Matthews
Department of Archaeology, University of Reading,
Whiteknights, PO Box 217, Reading, Berkshire, RG6 6AH, UK
Email: w.matthews@reading.ac.uk
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.

Cristiano Nicosia
Dipartimento di Geoscienze, Università di Padova,
Via Gradenigo 6, 35131 Padova, Italy
Email: cristiano.nicosia@unipd.it
Cristiano is a geoarchaeologist working as full professor at the Department of Geosciences of the University of Padova, Italy. His research focuses on the study of anthropic deposits, on alluvial geoarchaeology, and on the human impact on soils and landscapes. He is currently the principal investigator of the ERC-funded GEODAP project (GEOarchaeology of DAily Practices: extracting Bronze Age lifeways from the

domestic stratigraphic record). He is involved as chief geoarchaeologist in several Italian archaeological projects and directs the excavations of the Bronze Age site of La Muraiola di Povegliano (Verona) and of the mid-Neolithic site of Molino Casarotto (Vicenza). He collaborates as field geoarchaeologist and micromorphologist in research projects at Olduvai Gorge (Tanzania), Petra (Jordan), Pompeii (Italy), Damyanitsa (Bulgaria), and the Jiroft plain (Iran). In 2017 he co-edited with G. Stoops the volume *Archaeological Soil and Sediment Micromorphology*, published by Wiley.

Bongumenzi Nxumalo
Department of Anthropology and Archaeology, Faculty of Humanities, Hatfield Campus, University of Pretoria, Private Bag X20, Hatfield 0028, South Africa
Email: u12378624@tuks.co.za
Bongumenzi (PhD 2020, Cantab.) is lecturer in archaeology at the Department of Anthropology and Archaeology, University of Pretoria. His research interests include hydrological modelling, geoarchaeology, the evolution of early state-societies, historical and modern climatic records.

Innocent Pikirayi
Department of Anthropology and Archaeology, Faculty of Humanities, Hatfield Campus, University of Pretoria, Private Bag X20, Hatfield 0028, South Africa
Email: innocent.pikirayi@up.ac.za
Innocent (PhD 1993, Uppsala) is professor in archaeology at the University of Pretoria. His research interests include geoarchaeology, development of ancient complex societies, water and social formation, and climate change.

Francis Pryor
Inley Drove Farm, Sutton St James, Spalding PE12 0LX, UK
Email: pryorfrancis@gmail.com
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).

Tonko Rajkovaca
Charles McBurney Laboratory for Geoarchaeology, Department of Archaeology, University of Cambridge, Downing Street, Cambridge CB2 3DZ, UK
Email: tr251@cam.ac.uk
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).

Rob Scaife
Palaeoecology, University of Southampton, University of Southampton University Road, Southampton SO17 1BJ, UK
Email: r.scaife@soton.ac.uk
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.

Simon Stoddart
Magdalene College, Cambridge, CB3 0EU, UK
Email: ss16@cam.ac.uk
Caroline Malone
8 Lansdowne Road, Cambridge, CB3 0EU, UK
Email: c.malone@qub.ac.uk
Simon and Caroline have been engaged in the research of ancient landscapes for nearly forty years, with a

focus on the central Mediterranean. They both attended lectures by Keith St. Joseph, Richard West, Nick Shackleton and John Coles on the outlines of environmental archaeology. Simon Stoddart went on to study with Bill Farrand and Donald Eschmann at the University of Michigan. Caroline Malone worked at Fengate under the inspired guidance of Francis Pryor, where Charly French also undertook his early geoarchaeological work. They both collaborated in their first major project in the 1980s with Edoardo Biondi, Graeme Barker, Mauro Coltorti, Rupert Housley, Chris Hunt, Jan Sevink (and his pupils Peter Finke and Rene Fewuster) in the regional study of Gubbio. It was, though, the later study of the uplands of Troina at the turn of the millennium in Sicily with Charly French and Gianna Ayala that opened their eyes to new ways of understanding geoarchaeology. This led to the in-depth collaboration with Charly on the island of Malta, entitled FRAGSUS (PI Caroline Malone), which substantially interrogated the rationale for the stability and fragility of the ecology of the Maltese temples. The collaboration lives on through the prospect of continuing work with Charly's pupils, notably Federica Sulas, Gianbattista Marras, Petros Chatzimpaloglou, and Sean Taylor. Caroline Malone is a professor emerita of prehistory at Queen's University Belfast and Simon Stoddart is professor of prehistory at the University of Cambridge.

Fraser Sturt
Southampton Marine and Maritime Institute,
University of Southampton, Avenue Campus,
Southampton SO17 1BF, UK
Email: F.Sturt@soton.ac.uk
Fraser is a prehistorian and marine geoarchaeologist who focuses on the Mesolithic/Neolithic transition in submerged, coastal and island contexts.

Federica Sulas
Charles McBurney Laboratory for Geoarchaeology,
Department of Archaeology, Downing Street,
Cambridge CB2 3DZ, UK
Email: fs286@cam.ac.uk
Federica (PhD 2010, Cantab.) is a senior research associate at the McDonald Institute for Archaeological Research, University of Cambridge. Her research interests include geoarchaeology and landscape historical ecology.

Magdolna Vicze
Matrica Museum and Archaeological Park, 2440
Százhalombatta, Gesztenyés út 1–3, Hungary
Email: vicze@matricamuzeum.hu
Magdolna (PhD) is an archaeologist with primary interests in household archaeology. She is working in the National Institute of Archaeology of the Hungarian National Museum as a Bronze Age researcher and is the leader of the SAX Project (Százhalombatta Archaeological Expedition). The archaeological expedition at Százhalombatta is a long-term international research program with the aim of studying the life and daily activities of prehistoric people at a Bronze Age tell settlement. Her other interest is in mortuary practices.

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Chapter 8

Modelling, mimicking and fighting waters: Lower River Great Ouse and Ouse Washlands investigations

Christopher Evans

The tracing and conceptualization of the palaeochannels of the River Great Ouse's floodplain are outlined, over the course of twenty-five years of investigation at its junction with the Fen basin at Earith/Over, north of Cambridge. There, in Hanson's Needingworth Quarry, strictly employing the same sampling methodologies across both of its banks, our initial research framework was simplistic: the changing role of a major river in prehistory – when was it a landscape corridor and when a territorial divide? Over the years, though, as the myriad of its palaeochannels and many midstream islands have become apparent (in whose documentation Charly French has been instrumental), this either/or perspective has changed radically, becoming far more multifaceted and nuanced. The chapter also attempts to model and 'capture' the river's dynamics – particularly, the Ouse Tidal Model (built in a Cambridge warehouse during the 1930s) – as well the use of the Bedford Level for various engineering and scientific trials.

From the Mississippi to the Nile and Danube, river valleys have long been a mainstay of archaeological study. They are widely envisaged as corridors of communication and trade/exchange – with some evincing distinct architectural/monumental and craft traditions – and even as 'cradles as civilization'. The dynamics of their lowland floodplains have received considerable attention in recent decades (e.g. Brown 2002; 2003) and, so too, have the more cognitive dynamics of rivers generally (Edgeworth 2011; Evans *et al*. 2016, 4–7, fig. 1.4).

Revolving around Fenland river investigations and drainage, this contribution first outlines insights accrued through long-term fieldwork concerning the River Great Ouse in England. It then relates the largely forgotten history of two local engineering initiatives: Cambridge's Ouse Tidal Model and the Bedford Level's Hovertrain trials of the early 1970s. On account of its length and transect-straightness, the Level has at times been employed as a testbed of 'science' and some such ventures are also related, particularly its use in Flat Earth trials. Common to all are issues relating to the path/management of waters and the impact of flooding. Themes of broad relevance, hopefully sufficient strands can be drawn out to give the piece's diverse parts a degree of structural coherence. Yet, we should be wary of over-intellectualizing these matters ('Archaeology as Memory Acts', etc.). The Ouse model and the Hovertrain were simply marvellous examples of early-day technological 'kit' and are worthy of appreciation on those grounds alone.

Tracing waters (and islands) – fathoming lands

Building upon the Haddenham and Fenland Projects' landscape investigations (Hall & Coles 1994; Waller 1994; Evans & Hodder 2006a,b), and the earlier research of Seale (1980) and others (e.g. Fowler 1934; Holmes 1970), since the mid-1990s the Cambridge Archaeological Unit (CAU) has undertaken huge-scale excavations within Hanson's Needingworth Quarry (Fig. 8.1). Straddling both banks of the River Great Ouse just above Earith, north of Cambridge, it is set to encompass almost 800 ha and, thus far, work has been conducted across some two-thirds of its eventual total (Fig. 8.2; Evans *et al*. 2016).

The archaeological fieldwork's trajectory has anticipated the quarry's zigzag progress, first across the western, Barleycroft Farm side below Needingworth, then northward across what were the river's midstream islands, and up to the so-named Over Narrows' ridges. Only since 2012 have the workings reached the river's eastern terraces, south of the Haddenham Project area, and the course of the Old West River and Willingham Mere. The latter, a large former lake established in the earlier first millennium BC, was only fully drained in the nineteenth century AD. From the mere-side, work

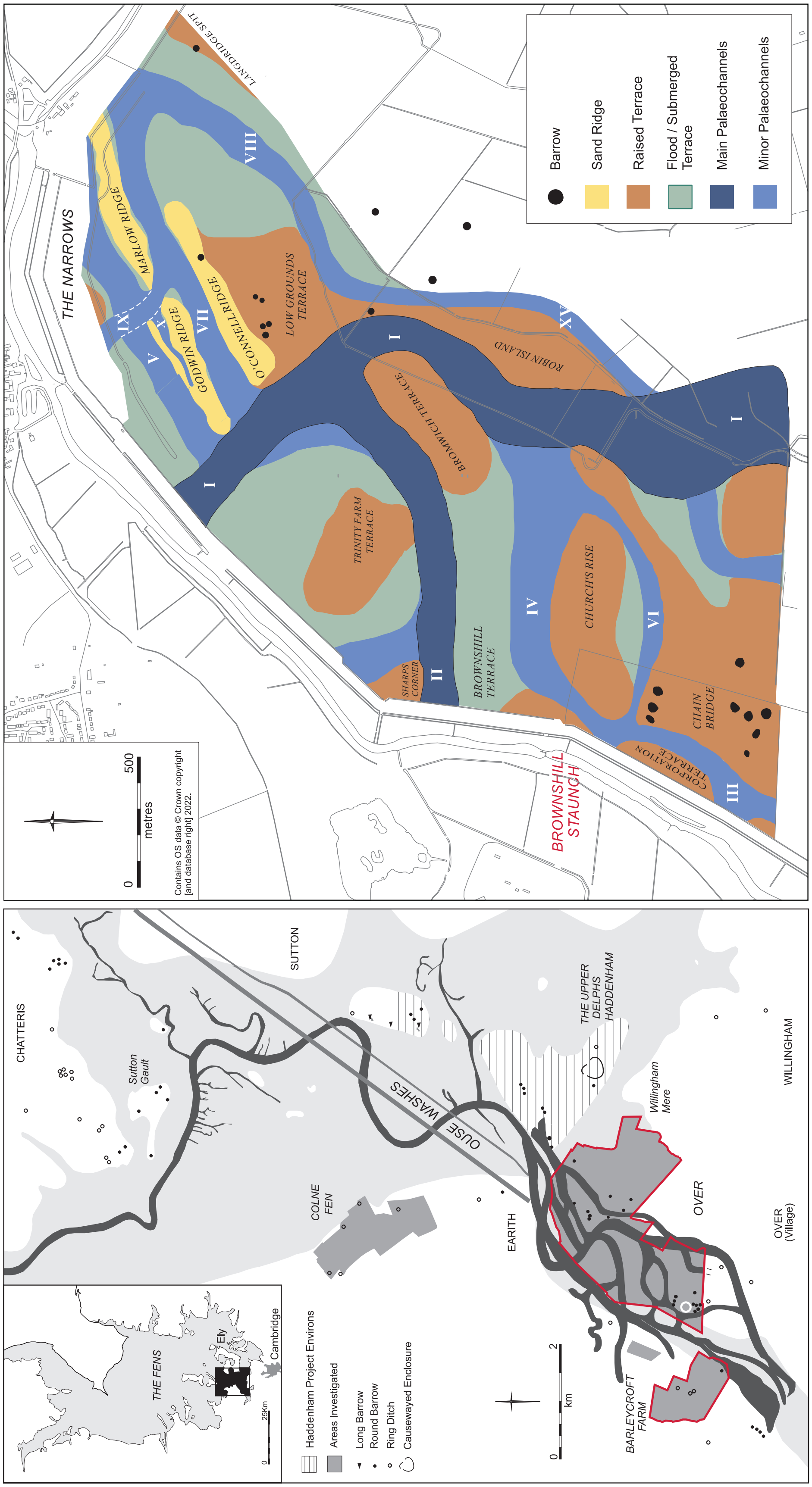


Figure 8.1. *Barleycroft/Over investigations, environs and location plans, with palaeochannels and midstream islands (note situation of Brownshill Staunch in relationship to Fig. 8.5). Image: Andrew Hall.*

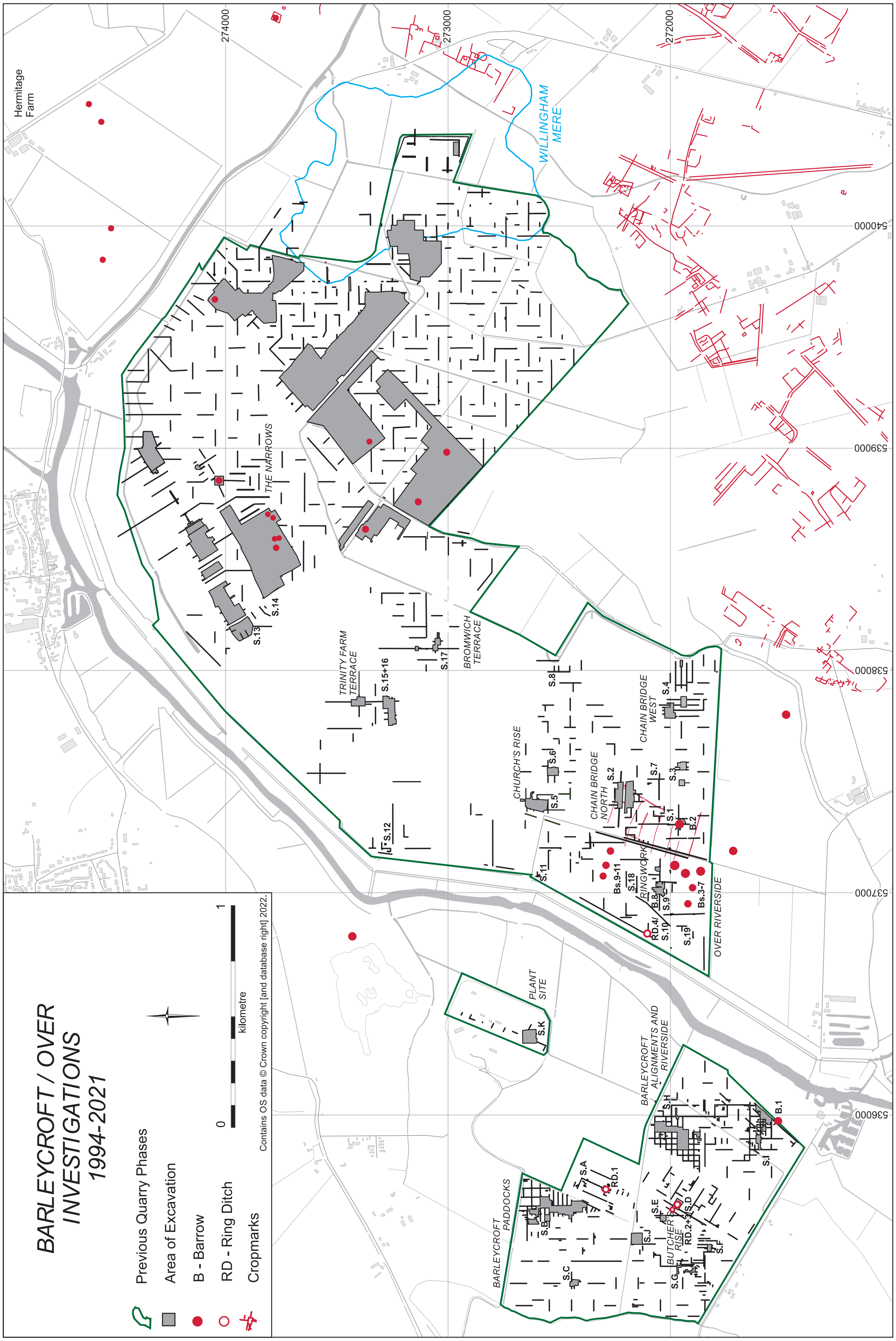


Figure 8.2. Areas of excavation, 1994–2020. Image: Andrew Hall.

will proceed southward, eventfully ending just north of Willingham.

The area amounts to a crucial regional 'hub'. It is where the Ouse formerly debouched into the Fen marshlands and, since the seventeenth century, its waters have been carried from Earith out to The Wash along the Bedford River's channels (defining the Ouse Washes; hereafter 'The Level'). Within and adjacent to the quarry, the Ouse's now 'regularized' single channel is embanked. The Ouse's 'regularization' and embankment apparently related to the construction of The Level itself, with the Bedford Level Corporation Bank there thought likely to date to *c*. 1650. Yet, as shown on early maps, the line of the Over Cote/Lode drains still reflected the southern and eastern sides of the area's main midstream islands (Channels I and VIII).

While not featureless, on the whole the area's alluviated floodplain landscape would have to be considered subtle. It does, though, include a number of significant (non-archaeological) locations. One is Brownshill Staunch, marking the river's tidal limits. The other is Sharp's Corner. True to its namesake, it denotes a distinct kink in the line of the Ouse, and is where a major breach occurred during the region's mid-last century floods. There is still another critical point: the high ground ridge upon which Over Village proper lies (at the southern limits of the map in Fig. 8.1). It is what deflects the river northward from its westerly upstream course and has clearly been a 'pinch-point' curtailing its channels, below which they fan.

With the same landscape artefact-sampling procedures strictly applied across the land's various parts (see Evans *et al*. 2014), from the outset the project's over-arching research directive has been understanding the changing role of a river in prehistory: when was it a communication corridor through land and when a territorial/community divide? The naivety of this premise was soon hammered home to us, particularly the idea of the river ever being *a* singular thing. It was only when its myriad palaeochannels started to register that we became fully aware of the number of its midstream islands. To whatever degree we have been able to come terms with its complexity, Charly French has played a fundamental role (French 2003; 2004; French & Heathcote 2003), as has Steve Boreham (2016) and, now, Charly's former student, Eduardo Machicado (e.g. 2019).

The area's floodplain topography is the product of a number of factors. Common to the middle/lower reaches of rivers generally is the successive bifurcation of the courses of the Ouse, and it is this which determined its islanding. Yet, as is clearly apparent in the alignment of The Narrows' ridges, underlying this is the earlier topography of the Pleistocene braidplain. Zebra stripe-like, this resulted in a series of parallel sandy gravel and/or silt ridges. While most marked in the Godwin/Marlow Ridge, these were not just confined to the immediate floodplain but continue – if more subtly – across the eastern riverside terrace. LiDAR imagery indicates that they also extend much further, northeast across the Fen basin towards the Isle of Ely (Evans *et al*. 2016, fig. 2.27).

The immediate area's interfacing with the main Fenland sequence was another contributing factor. The region's later Neolithic/earlier Bronze Age marine transgression – with the limits of its hallmark Fen Clay deposits falling just north of the Old West River (Waller 1994; French 2003) – evidently saw the backing up of the river system and the inundation of the low ground between the (mid-stream) braidplain ridges.

The lie of the terraces flanking Barleycroft/Over's floodplain proper varies. On the western, Barleycroft side they bed much higher, between *c*. 2.50 and 4.50 m OD (Ordnance Datum), with there being distinct 'hill-like' knolls. Although rising to the south by Willingham – and, in the north, dropping down along the flanks of the village's namesake mere – on the east side the ground is lower. Lying just between 0 and 1.20 m OD, those portions thus far investigated became drowned and were submerged by flood deposits during the later Bronze Age. Thereafter lost to marshland, it was only with post-Medieval drainage that, in part, they 're-merged' as farmland, whereas on the west side there was use through to Roman times (see James' 1994 summary of the area's drainage during the period 1575–1635; Evans *et al*. 2016, 62–71, figs 2.21, 2.22).

As detailed in the project's first, *Twice-crossed River* volume (Evans *et al*. 2016, 33–84, table 2.2; hereafter *TCR*), basal dates have been achieved from the river's various channels ranging from the Mesolithic to the Iron Age (see also that volume for period dates generally). Due, though, to channel-recutting and scouring, in some cases the later assays are not held to be representative of the actual date of their establishment.

Some of the smaller channels clearly relate to later breachings. Largely existing within the overlying peats, as they have scoured down into the terrace gravels they are only tens of metres across and less than a metre deep (e.g. Channel VI). Others are of altogether a different magnitude (e.g. Channels I and II). Hundreds of metres wide, with their courses often recut, these are upwards of more than four metres deep (Fig. 8.3). Their water levels evidently fluctuated; at times dropping and having little or no flow, their courses would nevertheless still have been apparent, marked by boggy ground and distinct vegetation.

Figure 8.3. *Ouse palaeochannels, Channel I photographs: top, showing full channel width as exposed at the south end of Godwin Ridge (notice attending figures at left for scale); bottom left, a creek incised into marine silts with its Middle Bronze Age 'wood mass' (including fish weirs and 'informal' bridge-crossing timbers); bottom right, 'flotsam' timbers cast up on the flanks of the main channel alongside the Low Grounds Terrace (see Fig. 8.1). Images: Dave Webb.*

The size of the midstream islands the channels describe varies considerably, as does the intensity of their occupation (pre-)histories. One small one identified in the north – Tebbutt's Island – only extending over a few hectares, saw no significant use/occupation. Three others – Chain Bridge, Trinity Farm Terrace and, in the north, the Over Narrows/Low Grounds Terrace – were much larger, covering *c.* 30–120 ha. Generally, their surface levels fell between 0.50 and 2 m OD. The Narrows' distinct sandy ridges lay as high as *c.* 3 m OD. Accordingly, the main, *c.* 6-hectare ridge-line there – the Godwin Ridge – had a remarkable occupation sequence. With thirty-five occupation 'site-episodes' defined, it saw usage throughout the Mesolithic to Early Roman times, and included a Late Bronze Age midden settlement and, at its southern end, an Iron Age riverside shrine (Evans *et al.* 2016, chs. 3, 6). Otherwise, apart from 'casual' Iron Age activity, occupation as such on the islands ceased by the Late Bronze Age.

There is not the scope here to detail the complexity of the area's sequences and there is now just too much to provide any kind of 'easy narrative' (Fig. 8.2; for summaries see Evans *et al.* 2016, 13–20). What is significant is how, only after twenty-five years of investigation – and finally getting to the eastern 'shore' – a convincing sense of distributional patterning has been achieved, at least for most periods. Middle Bronze Age field systems occur throughout, along both sides of the Ouse and on its larger islands. Noteworthy is that the main Early Bronze Age barrow cemeteries are only found on the islands. With just two barrows of that date occurring on both the western and eastern banksides, the Southern Over Barrow Cemetery involves eight such monuments (just two outliers being explored, with the group otherwise protected as a Scheduled Monument). Now excavated through the quarry's progress, the northern Low Grounds Cemetery encompasses three round barrows – as well as another outlier – and two pond barrows (*ibid.*, 301–484). It is not just the occurrence of the main barrow cemeteries on the islands that attests to their role as places of larger community-group gathering but that, in contrast to those excavated on the banksides, they each attracted far more interments. Otherwise, it was almost exclusively the midstream islands that saw the area's main Mesolithic scatters and the bulk of its Late Neolithic Grooved Ware occupation (the latter, though, also occurring on the immediate riversides along both banks).

What has been unexpected is that major Early/Middle Neolithic pit cluster settlements do not occur on the islands and, instead, are found some hundreds of metres back from the riversides proper on both banks. In any kind of 'rivers as corridors' and 'pioneering inroads' scenarios, greater proximity to the river would have been anticipated. Regarding their distribution, what also warrants mention is how extensive archaeological traces have been along the southern margins of Willingham Mere. Correlating with that, three Early Neolithic round barrows are now known on that eastern side. Their location must surely also relate to that of the Upper Delph's great causewayed enclosure (8.75 ha; Evans & Hodder 2006a, 239–345), which lies just north of the former mere's basin and the Old West River.

The river's midstream islands share attributes of 'island archaeologies' generally, as they can be considered 'closed' or at least circumscribed 'systems'/entities. This, for example, is apparent in the Middle Bronze Age field system upon the O'Connell Terrace in the north and its direct association with that island's one settlement of that date. This quite simply indicates that such boundary systems actually performed an essential agricultural function and did not just relate to ('liminal') land division between adjacent communities. Yet, with the midstream islands also serving as places of communal 'coming together' (see, e.g., Brown 2003), by no means should they be seen as isolated from their flanking riverside lands. In this capacity, what has been determined is that – as evinced in a droveway route – the northern Low Grounds Cemetery's linkages were with the eastern riverside terraces. In contrast, and albeit on somewhat more inferential grounds, the connections of the Southern Over Barrow Cemetery were with the western, Barleycroft-side 'shore'.

A few years ago, in connection with Leiden's Bronze Age West Frisia project, I spent some days sailing down through the Danube River delta (Evans 2018). The vessel was small. Accommodating Harry Fokkens, a few of his students and two eminent palaeoenvironmentalists (Corrie Bakels and Wilko van Zijverden), we also had the advantage of a local ecologist-guide and an experienced pilot. When faced with the myriad small channels and the dense 'green walls' of their flanking wooded banks, apart from the bounty of big birds – particularly herons and pelicans – what struck one was the skill needed to navigate and fathom these environs. As would have been the case of Barleycroft/Over's reaches of the Ouse, finding your way through so many courses would not have been straightforward. Such islanded reaches would have only been *a* corridor through land when viewed at a broader landscape-scale; traversing them would have certainly involved multiple choices, sound memory, and well-honed local knowledge.

Bringing the Fens to Cambridge – the Ouse Tidal Model

By the scale of the Ouse's catchment and resultant flood discharge (and high tidal levels), the problem is the wastage of Fenland peat-soils wrought by drainage and what it necessitates for artificial banks to 'train' its waters:

> 'When Vermuyden commenced his operations in the seventeenth century, comparatively low flood banks were all that were necessary to prevent the flooding of lands, and drainage was entirely by gravity. In 1678 we find the first mention of mills for pumping and, by 1748, there were two hundred and fifty windmills in the Middle Level alone. … Later the windmills gave place to the steam engine, then the centrifugal pump was substituted for the scoop wheel, and finally the steam engine was supplanted by the diesel engine. To-day practically all the drainage of the fen area is by pumps, and we have some ninety pumping stations in the catchment area.
>
> The increased necessity for pumping has been brought about by the wastage of the peat surface of the fens. It is on record that, before the fens were drained, the level of land was 5 feet above that of the adjacent silt-land, while, at the present time, much of it is 10 feet below the silt-land level. … *It is apparent that eventually the whole peat surface must disappear*' (Doran 1941, 219; emphasis added).

The degree of the area's peat wastage has been strikingly apparent in the course of the project's recent east bankside excavations, particularly in just how slight and shallow are any surviving Roman and post-Medieval features associated with Willingham Mere.

Now a little-known bygone in Cambridge's industrial heritage and Fenland drainage studies, in March

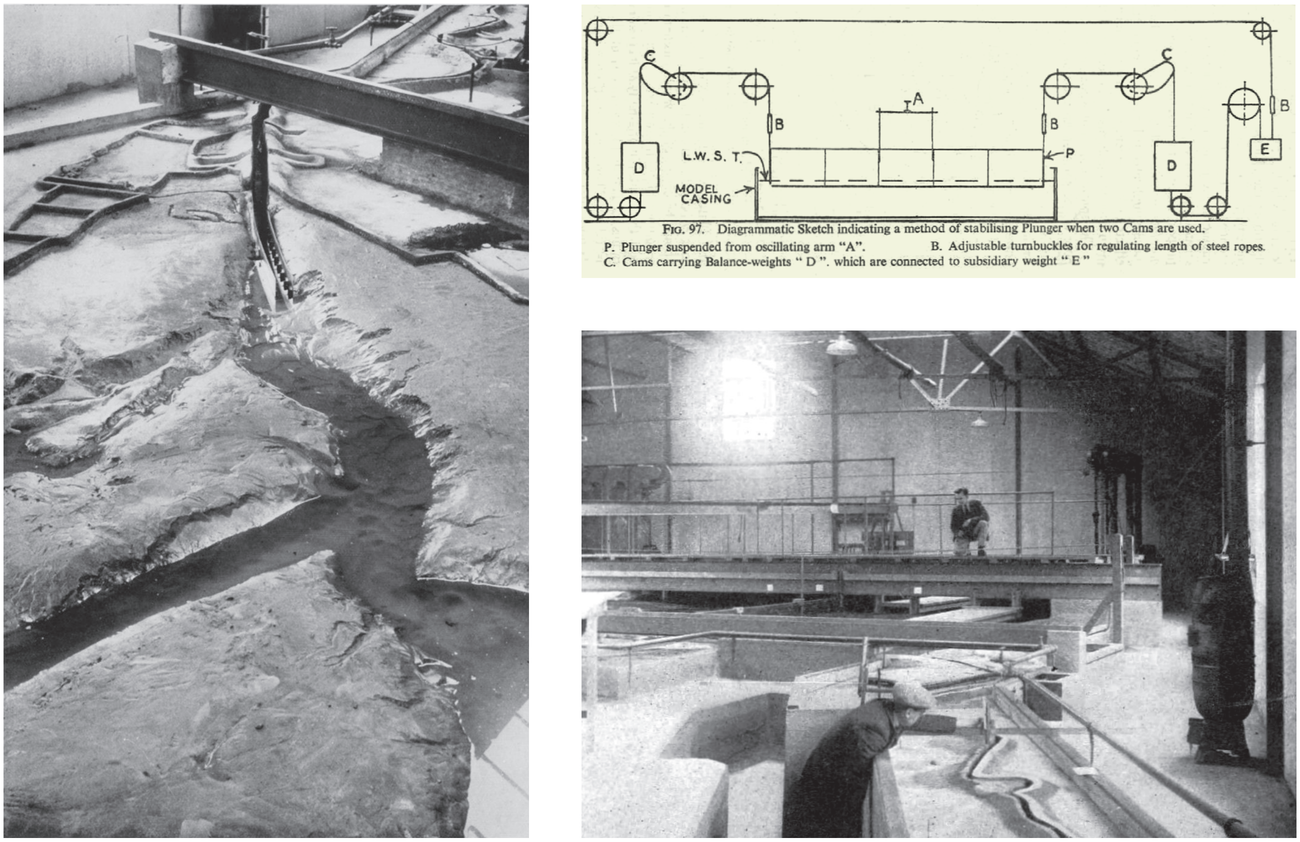


Figure 8.4. *Ouse Tidal Model: left, in demonstration 'flow' and, lower right, under construction (from Doran 1941); upper right, sketch rendering of the model's plunger system (Allen 1947, fig. 97). Operating the model may well have taken its toll. Apart from the fact that the shed's roof and walls were apparently of asbestos, a Pathe film of 1950 (*Fens Model*) recording its operation actually has men pouring mercury down its channels. This must have been to enhance the model's demonstration purposes, as the operation of a 'mercury-flow Ouse' would surely not equate with that of the river's waters. Images: Andrew Hall.*

of 1935, under the headline 'River Ouse in Cement', the *Cambridge Daily News* proudly announced:

> 'Great Ouse Catchment Board officials will shortly be able to study the effect of plans to improve the outfall of the Ouse and drainage of the Fens without going nearer to the spot than Cambridge.
>
> They will be enabled to do this by means of *the largest model in the world of a tidal river,* which is to be opened in a shed off Coldham's-road on March 28th' (emphasis added).

Built at a scale of two-foot-to-the-mile (1/2500), with a vertical exaggeration of 1 to 41.7, the model was housed in a large purpose-built shed (35 × 75'; *c.* 245 sq. m; Figs 8.4 and 8.5). Its reduced-scale concrete-moulded river apparently wound its way over 75' (*c.* 23 m) and connected to a reservoir whose floor modelled the bed of The Wash.

Such hydraulic models have their own esoteric specialist literature. Aside from specific model-account papers, there is Gibson's book (1933) devoted to the Severn Estuary Model. More useful as an overview is Allen's (1947) *Scale Models in Hydraulic Engineering*. These are essentially technical manuals. While including relevant photographs and insights into their construction techniques, they are given to the calculation of scale-river velocity or the estimation of the necessary size of introduced grains to reproduce the effects of silting.

Stressing its size and exactitude, the Ouse model's construction and operation were detailed in *The Journal of the Institution of Municipal and County Engineers* (O'Shea 1936). The paper also outlines the pedigree tidal models. Noting that it had then been fifty years since Osborne Reynolds first made such

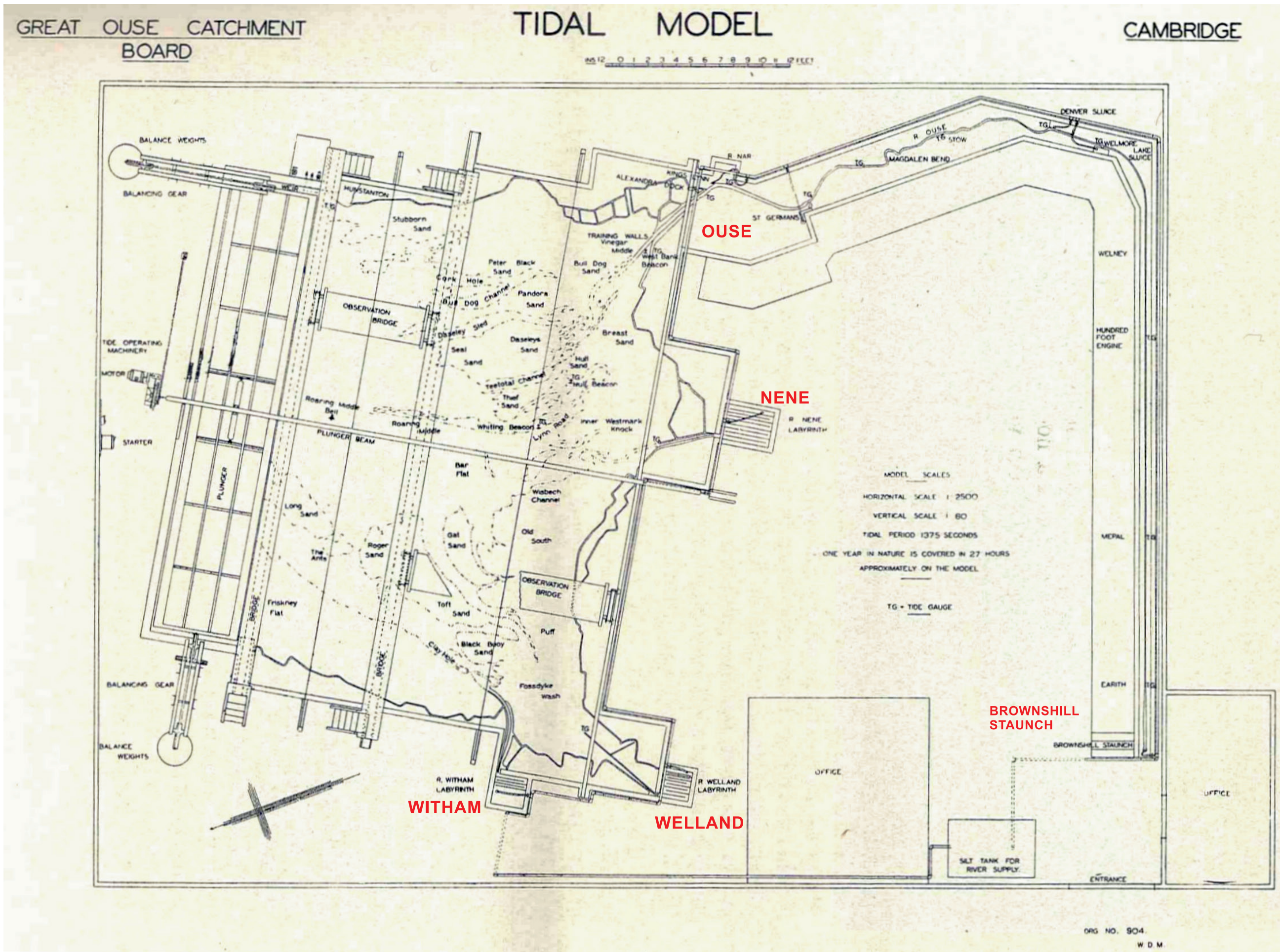


Figure 8.5. *Ouse Tidal Model, with Fenland river systems and Brownshill Staunch highlighted (O'Shea 1936, 1505). Image: Andrew Hall.*

experimental apparatus (e.g. Jackson 1995), with comparable research conducted on the Continent, in Russia and America, the Ouse's was actually the third large tidal model to have then been built in Britain, following one of the Severn and another for Rangoon's navigation (see also Allen 1963). The Ouse model and others of its ilk were essentially *mimetic*, as – in small – they attempted to physically render the operation of rivers (see MacKinnon 2016, ch. 5 for overview). More sophisticated, or at least abstract, were later nineteenth- and twentieth-century Tide Predictor 'models'. Intended to forecast tides, these were rather *calculating machines*, with Thompson/Lord Kelvin's of 1872 the leading example.

Other early-day river models paled by comparison to the size of the Ouse's and were rather akin to large model railways. While the Ouse model was far more ambitious, some later river models were much larger still (Borer 1938, 206–7 mentions proposals to build a much larger Ouse/Wash model outdoors). That of the Chesapeake Bay system was housed in a vast eight-acre (3.2 ha) warehouse on Kent Island, Maryland (CLUI 1998). It is of particular interest on the grounds of its transitional status. Constructed in the 1970s and only operational between 1978 and 1982, it had been built with the specific aim of providing computational data. Still extant, though now decrepit, housed with it are apparently heaps of mainframe computer printouts amassed from the time of the model's employment.

The 'titanic', as it were, of river system models is that of the Mississippi River Basin (e.g. Cheramie 2011). While earlier individual lengths of the system's channels had been model-rendered, this was enormous and amounted to a massive 'Lilliputian' landscape in its own right. Built outdoors at a scale of 1/2000 (vertical 1/100), it eventually covered 200 acres (81 ha). Some forty per cent of the USA was thereby represented, including *c*. 15,000 miles of river (24,000 km). Starting in 1943, its construction was undertaken by the US Army Corps of Engineers and involved thousands of prisoners of war. Although portions were in service by the end of that decade, it was only completed in 1966. Over the next three years a succession of historical floods were replicated there. Thereafter only used occasionally, it ceased operating in 1973. Albeit in dereliction, it remains open as a public attraction in Clinton, Mississippi's Buddy Butts Park.

Physical reduced-scale models were both an integral basis of later eighteenth to earlier twentieth century scientific study and a prime means of public demonstration (see, e.g., de Chadarevian and Hopwood 2004; Lightman 2017). Indeed, such 'miniature worlds' were still commonplace attractions during my youth in Canada. Museums would feature models of the Parthenon and the like, and our annual exhibition fairs – alongside real-life beaver lodges – would have working models of nickel mines and hydro-electric dams. By these means, their operations were readily intelligible. Once grasping that they were the same – just in small – as the real thing, their principles were readily grasped. Unlike plan renderings, they did not require 'decoding' of technical graphic conventions (e.g. Evans 2012; see, e.g., Seabald 2002, 242–8 and Mendelsohn 2019, 90–1 on the allure and 'translations' of model-rendering).

Arguably, it was the 1970s and 1980s that marked the decline, if not the demise, of such public demonstration and scientific models. While a few have survived on account of their early-era charm, computer-based rendering then came into prominence. Not only was this due to greater reduction accuracy – and that 'alternatives' could more easily be applied – but, particularly in the case of river systems, they have much greater capacity for incorporating bankside environmental factors. What, for example, happens to a river's velocity if such-and-such a percentage of its flanking terraces undergo deforestation?

Having written on the application of modelling formats in British archaeology (e.g. Evans 2004; 2008), some of us have long toyed with the idea of rendering the quarry's length of the Ouse system in working miniature. For the *Twice-crossed River* volume, a day was pleasantly spent with Steve Boreham and our artist-colleague, Issam Kourbaj, admittedly playing with the Department of Geography's wonderful Armfield Flume apparatus, making riverine patterns in small (*TCR*, fig. 7.25).

In the context of Barleycroft/Over's investigations, of relevance is that our portion of the river was actually the Ouse model's starting point. As shown in Figure 8.5, this was the bottom right-hand corner and at the end of its long straight length: essentially The Level and, literally, 'the river as a corridor.' Seeing this as its 'start' is, of course, only from the point-of-view of the river's outflow: from a tidal perspective, that point – Brownshill Staunch – marks its tidal limits (see Fig. 8.1).

With the region experiencing terrible floods in both 1947 and 1952 (Darby 1956), as far as can be ascertained the Ouse model was maintained until the early 1960s, its 'job' having been done with the completion of the Great Ouse Relief Channel in 1964. Coldham's industrial properties have been scouted in the hope of finding some dumped remnants of its moulded parts, but to no avail. Attempting to mimic a river system in all its many complexities – effectively bringing the Fens to Cambridge – the model was clearly considered a controlled 'arena of science' and it can only be regretted that no one thought it worth preserving.

The 'Big Straight' and the Hovertrain

An allied offshoot to the main quarry project, as part of a broader Ouse Washes HLF programme, the CAU undertook a series of public fieldwork initiatives alongside the Bedford Level channels. Starting construction in 1634, the Level effectively runs as a 32 km-long transect – the 'Big Straight' – across the Fen's peatlands, from Earith out to Denver (Figs 8.1 and 8.9; see James 1994 on its bank construction from engineering borehole and test pit data). The fieldwork saw investigations relating to the Civil War fort – The Bulwark – at the Level's southern end, and also Manea's short-lived utopian colony (Brittain 2016; 2017). Of much more recent date, there was also our pursuit of Earith's Hovertrain. Its investigations were released as a YouTube film ('The Train that Floats in the Sky'), and it here serves as a coda concerning the control and regularization of rivers.

It was during the course of Haddenham Project research in the 1980s that, when scanning aerial photographs of local barrows, we became intrigued by the Hovertrain's 'lost history' (Fig. 8.6). Featuring in that project's second volume (Evans & Hodder 2006b, fig. 9.5), we wondered what the trackway was running alongside the Bedford Level's bank and connecting with an enormous hanger at Earith. Searches quickly revealed this to be the route of the experimental Tracked Hovercraft (also known as the Hovertrain). Over the intervening years, interest in this venture was kept alive as, every time taking the train through Peterborough, when passing beside its Railworld, there perched proud on a raised trackway was the prototype. It looks for all the world like something out of 'Star Trek': a sleek streamlined 1960s modernist vision of the once-future.

Building upon the success of Cockrell's (untracked) Hovercraft – and reflective of the nation's unassailable

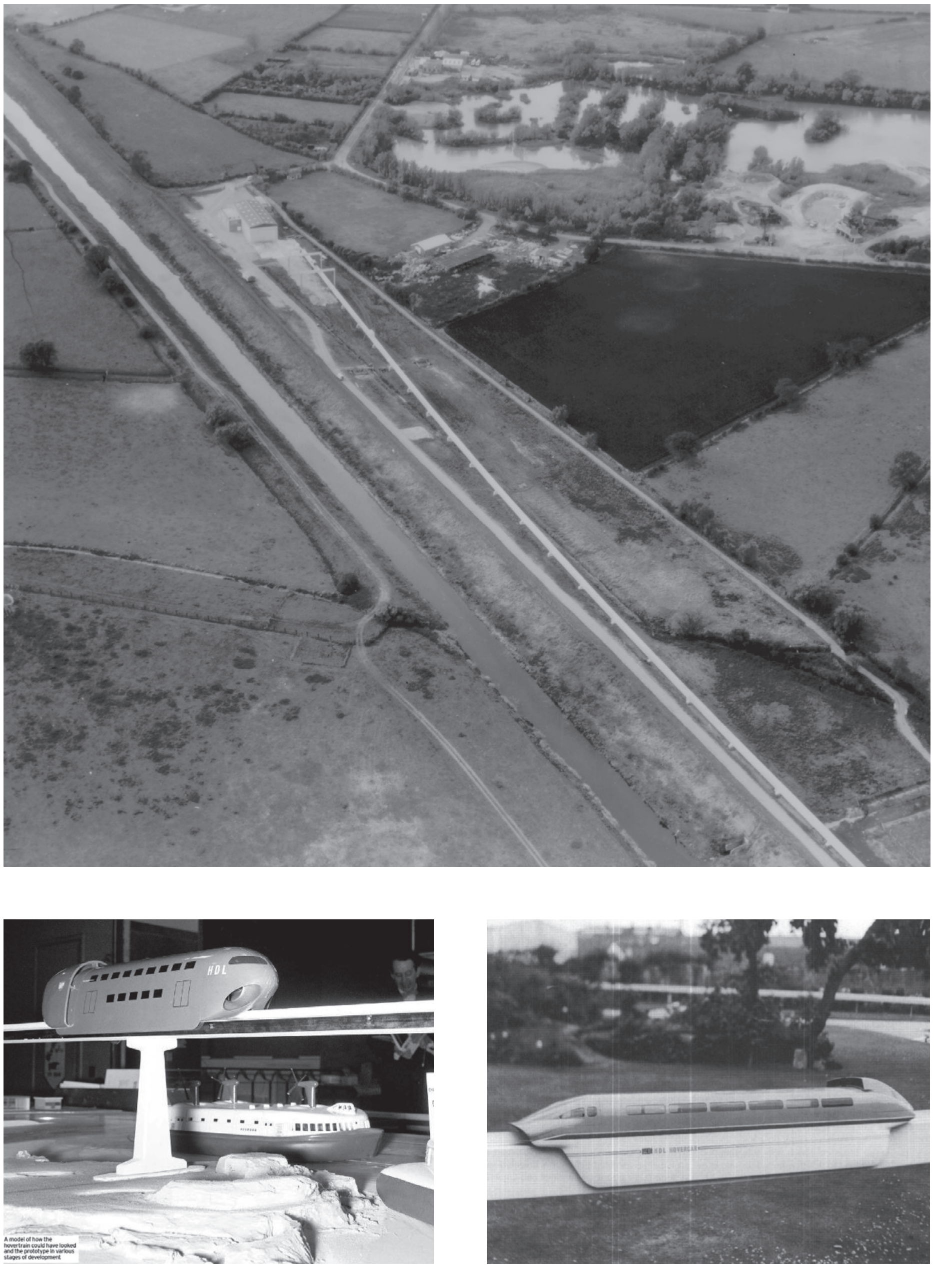


Figure 8.6. *The Hovertrain: top, aerial photograph looking southwest along the trackway (beside The Level) to the works' hanger at Earith (Simmons Aerofilms; Evans & Hodder 2006b, fig. 9.5); below, model renderings: left, as envisaged with a water-borne hovercraft (*Cambridge News *02/03/2009) and, right, demonstration model at the 1966 Brownsdown 'Hovershow' (Bailey 1993, fig. 1). Images: Andrew Hall.*

belief that it could continue to lead in world-class technological innovation – the tracked train-version was intended to deliver smooth travel at tremendous speeds. With the Tracked Hovercraft Ltd. established in 1968, whose head office and laboratories were in Cambridge, the Bedford Level was chosen for its test-track by virtue of its flat straightness (Bailey 1993 thoroughly details the technology and brief history of this enterprise). As one J.I. Bertrand wrote in a county magazine: 'Imagine it, a full-scale train hurtling across the Fens at speeds never dreamed of for land-based transport!'

Work on the facility commenced in 1970, but within three years only three miles of what was hoped to be twenty miles of test-track had been built. The top speed achieved was just 107 miles per hour, far short of the 250–300 that had been promised. With the budget exhausted, the government announced that there would be no further funding; the work was duly cancelled, and the trackway dismantled in 1974.

The focus of our recording was at The Gulls/Gullet (Fig. 8.7). Located some 4.5 km northeast of Earith and defining an amphitheatre-like space, this deflection in the line of the Bedford Level's northern bank must relate to where there had been a major flood breach. Evidently an old breach, it is indicated on Moore's 1658 map (Willmoth 1993). It is recorded

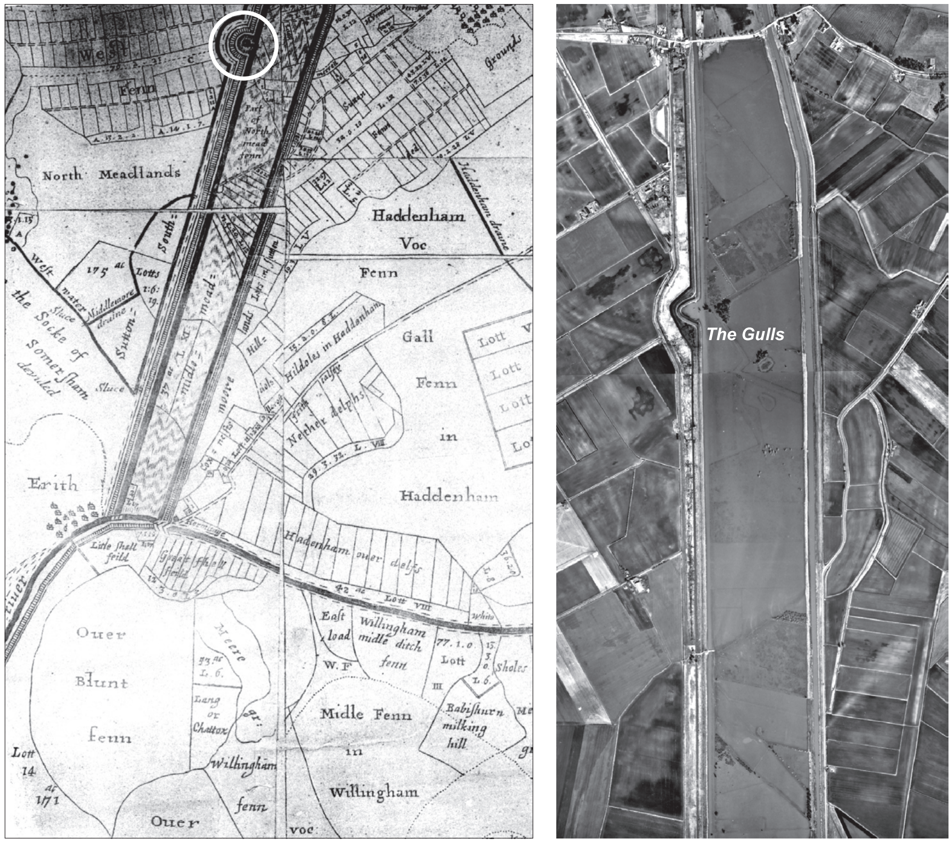


Figure 8.7. *Moore's 1658 map showing the southern length of The Level (with The Gulls highlighted) and, right, aerial photograph of the same, with the imprint of the main Ouse palaeochannel snaking 'behind' it (CUCAP RC8-EC 121–3; TCR, fig. 1.3). Images: Andrew Hall.*

that the Old Bedford River actually burst its defences within hours of being opened in 1637 and this may, in fact, have been the point of the bank's initial collapse. The ground there is wet and there is a small pond. Three of the great concrete stanchions that carried the Hovertrain's track still survive at that point (Fig. 8.8). More importantly, a cluster of pile-tops project above the water of the pond's edge and attest to failed attempts to foot the stanchions.

The Gulls directly corresponds to a great loop of the main palaeochannel of the Ouse. Proving to be some 5 m deep, this had a pollen column taken from it during the Haddenham investigations (Peglar 2006). Its lower deposits registered very early Neolithic forest clearance – with possible cultivation – and were dated to 4470–4000 cal. BC (Q-2814).

The channel's existence must account for the problems of anchoring the track there. Those responsible for the route's construction were aware of its grounds' 'complications'. In 1967–9, both borehole and (geo) 'electrical resistivity' surveys were undertaken along the southern portion of the route's intended length (McDowell 1971). These indicated significant variation in the peat/silt clay and sand/gravel layers overlying the area's basal clay strata, with the gravel terrace deposits there absent over some two-fifths of the route. Yet they failed to recognize its ancient river channels and for this – and the lack of earlier literature review – they were duly taken to task by Holmes (1971), who had contributed to *The Fenland in Roman Times* surveys (Holmes 1970). This omission is all the more surprising as the palaeochannel's roddon (dry raised streambed) can easily be made out on the ground and, indeed, is clearly shown as determining field boundaries on Moore's 1658 map (Fig. 8.7).

While the underlying channel at The Gulls may not have been the direct cause of the Hovertrain's demise, it evidently gave them serious difficulties. Generating delays and additional expenditure, this amounts to palaeoenvironmental factors conspiring against 'brave new world' ambitions. But so too does it serve as a reminder that, however level The Level and the Fens generally might seem, they certainly do not amount to a uniform land-surface.

Figure 8.8. *The Hovertrain: top, 1971 trials photograph (*Cambridge Evening News *archive); middle, The Gulls 2015 (notice pond and extant stanchions); bottom, Dave Webb's reconstruction of the Hovertrain in operation at The Gulls' crossing. Images: Andrew Hall.*

Flat earths – engineerings and follies

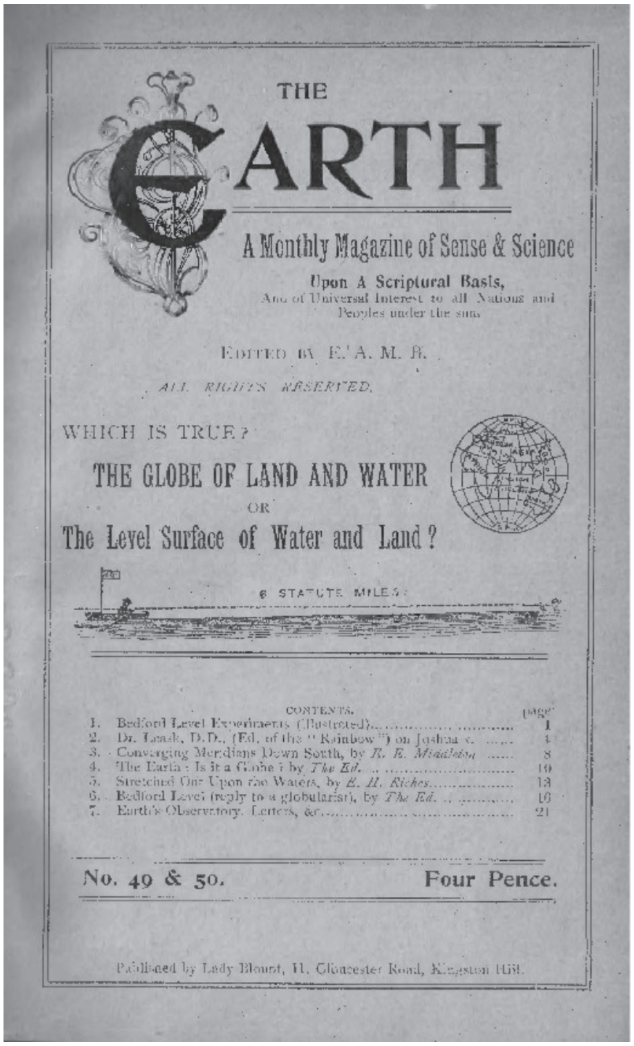
It is too easy to caricature the straight path of The Level – in juxtaposition to the underlying organic meanderings of the Ouse palaeochannels – as just an imposed 'newness' on the land. Built using Scottish and Dutch prisoners of war (Darby 1956, 54–5, 70–7; James 1994), it arguably attests to the 'internal colonialism' that can be ascribed to the region's drainage (Evans 1997). Yet, having now stood for almost four centuries, The Level itself is effectively a major historical monument in its own right and has, for example, operated longer than the span of the Roman Empire in Britain.

The Hovertrain's trails were not the first time that The Level had been selected as a testbed. In 1670 King Charles II issued a challenge to the English scientific community that, in response to a recent French initiative, they should accurately measure a degree of the Earth. The Royal Society duly decided that this should be performed by Robert Hooke on 'the Bedford-river about twenty miles in length, formerly surveyed with exactness by Mr Moor' (*sic* 'Moore'; see Willmoth 1993, 119–20; Jardine 2000, 207–8). While never actually enacted, this challenge foretold of The Level as a 'space of science'.

Some 170 years later, The Level was deployed for 'alternative science'. In 1838, one Samuel Rowbotham – associated with Manea's Utopia and the first president of the Flat Earth Society (and author of *Zetetic Astronomy* 1848) – conducted experiments along it in demonstration that the world was flat. Using flag-topped boats deployed along a six-mile length northeast of Welney (see Fig. 8.10; Evans *et al*. 2013a, 265–6, fig. 6.9), not taking into account refraction, telescopic viewing of the markers showed no difference in their heights over that distance and was, thereby, held to 'prove' that the Earth was without curvature (see Michell 1984 and Garwood 2007 on the 'flat earth story').

Further ventures (and controversy) followed. In 1870, an ardent follower of Rowbotham, John Hampden, staked a £500 wager that, by repeating his mentor's experiments, he could conclusively demonstrate the Earth's flatness (e.g. Hunter 2015). Extraordinarily, and in the face of critique from the professional scientific community, this was taken up by Alfred Russell Wallace. The renowned naturalist whose rival theories on evolution finally propelled Darwin to proceed with the publication of *On the Origin of Species* in 1859, Wallace avoided Rowbotham's procedural errors and duly won the bet. (Not without, though, Hampden claiming that he cheated and suing him; Hampden was eventually imprisoned for libel.)

At the turn of the century, Henry Oldham, a Cambridge University Reader in Geography, conducted further trials along The Level. Providing incontestable


THE EARTH

A Monthly Magazine of Sense & Science

Upon A Scriptural Basis,

And of Universal Interest to all Nations and Peoples under the sun.

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WHICH IS TRUE?

THE GLOBE OF LAND AND WATER

OR

The Level Surface of Water and Land?

6 STATUTE MILES

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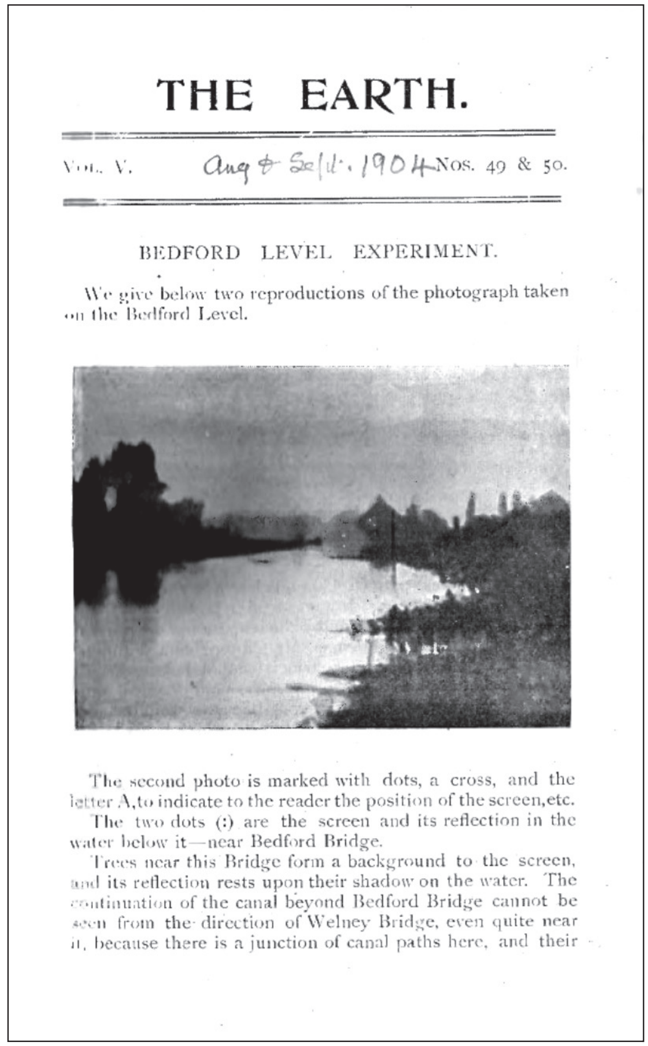
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BEDFORD LEVEL EXPERIMENT.

We give below two reproductions of the photograph taken on the Bedford Level.

The second photo is marked with dots, a cross, and the letter A, to indicate to the reader the position of the screen, etc.

The two dots (:) are the screen and its reflection in the water below it—near Bedford Bridge.

Trees near this Bridge form a background to the screen, and its reflection rests upon their shadow on the water. The continuation of the canal beyond Bedford Bridge cannot be seen from the direction of Welney Bridge, even quite near it, because there is a junction of canal paths here, and their

Figure 8.9. *Account of a late-era Bedford Level Flat Earth 'experiment', as published in* The Earth *('A Monthly Magazine of Sense & Science upon a Scriptural Basis'), 1904. Images: Andrew Hall.*

evidence of the curvature of the Earth, he presented his findings to the 1901 meeting of the British Association for the Advancement of Science in Glasgow. It only seems remarkable that, still as late as last century, this should have been something in need of proof. (Apparently on their arrival in Tibet in 1903, the Younghusband Expedition was astonished to learn that the world there was held to be flat; Allen 2004.) Yet, in point of fact, despite the test results latter-day Flat Earth adherents continued to employ The Level in demonstration of their 'non-global' convictions (Fig. 8.9). Even today, various Flat Earth societies still attract large numbers of believers, both within Britain and the United States.

There is something wonderfully absurd about all this and it amounts to a legacy that readily accommodates the (failed) Hovertrain and even the 'lost' Ouse Tidal Model. Indeed, half tongue-in-cheek, in our second Colne Fen volume it was proposed that a statue to local engineering ambitions could be erected at the point where the area's various ventures bisected: the Roman Car Dyke canal, The Level itself and the Hovertrain's route (Fig. 8.9; Evans *et al*. 2013b, fig. 6.5).

Multiple strands and reclamations

If there was scope here, the theme of The Level's 'thick history' could now be further developed, detailing Earith's Bulwark or Manea's Utopia, and perhaps even adding Mepal's RAF airbase (housing Cold War Thor nuclear missiles). Certainly, The Level's legacy – not unlike the river – is multi-stranded and dense.

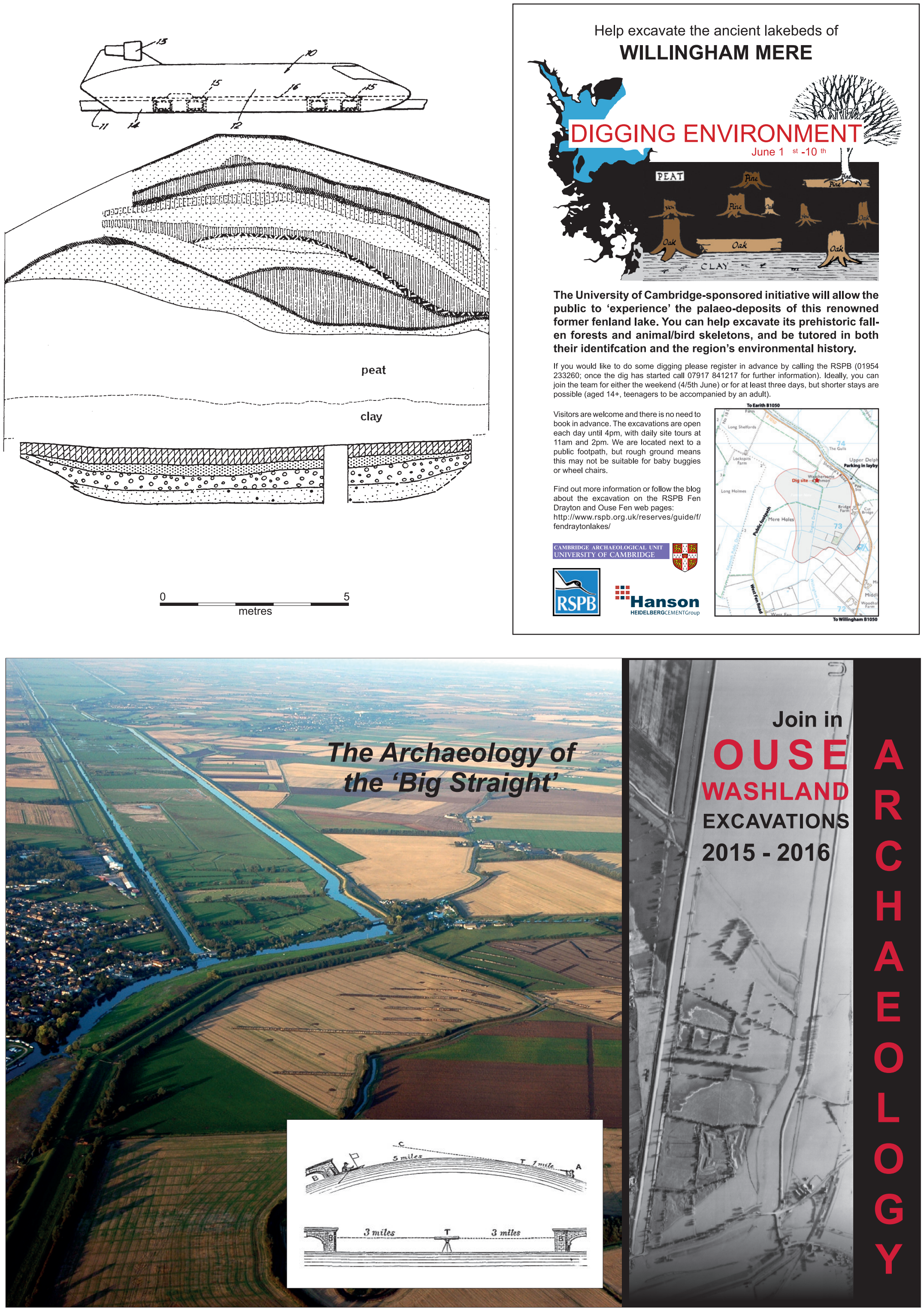

Figure 8.10. *Proposed 'Fenland Engineering Ambitions' monument (upper left; Evans* et al. *2013b, fig. 6.5); upper right, poster announcing the CAU's Willingham Mere 'Digging Environment' programme (Evans* et al. *2016, fig. 7.23); below, CAU unit-issued Ouse Washland Archaeology pamphlet: left-centre aerial photograph looking northeast along The Level (with an inset illustration of Rowbotham's Flat Earth trials); right, aerial photograph with the floodwater-marked outline of The Bulwark's star-shaped fort visible. Images: Andrew Hall.*

The Ouse still refuses to be tamed. In the winter of 2020–1, its middle/lower reaches were once more in severe flood. It is inevitable that *the* river – in all its complexity and many parts – will continue to evade us. After all, it is only a very limited portion of its lower reaches that we have traced. Look again at our mapping and the land north of the project-area (Fig. 8.1). Based on earlier research and subsequent aerial photography, the Ouse palaeochannel's near-single strand, serpentine loops are effectively little more than a caricature. Surely a web-work of channels and small islands, comparable to that revealed through the quarry's fieldwork, must there still lie largely undetected.

Over what is now the decades of the project's duration, its environmental studies have come to ever-increasing prominence and, with it, a 'problematization' of palaeoenvironmental resources. Had Willingham Mere been entirely quarried away, as was originally intended, what would this imply in terms of knowledge loss? Ancient lake beds are today arguably something far rarer than, for example, Middle Bronze Age field systems and settlement sites. It was in this context that, in 2011, the CAU conducted a 'Digging Environment' initiative, providing members of the public an opportunity to excavate the mere's deposits and, in effect, have a hands-on experience of environmental change (Evans *et al.* 2016, 600, fig. 7.23). This was undertaken in conjunction with the Royal Society of the Protection of Birds. Under their custodianship, the quarry lands are being restored as a vast bird reserve, in part compensation for the loss of their coastal reserves through sea-level rise. Like the area's marsh inundation – and the eventual re-emergence of its topography through soil/peat deflation – this marks a massive transformation of the landscape. The appreciation of such changes is not something unique to our times, with nineteenth century commentators aware of the loss of wetland species and habitat then wrought by steam pump drainage (see, e.g., Evans 1997). Accordingly, the tracing of (buried) lands, and the documentation of landscape and environmental change – their reclamation as it were – is considered an entirely worthwhile pursuit. Not only is it fundamental to the situation of archaeology and long-term land-use, but is now also a matter of much broader contemporary relevance.

Acknowledgements

The input of many colleagues at the Cambridge Archaeological Unit (CAU) is here fully acknowledged, and all of us are aware of the extent of Charly's contribution and congratulate him on his retirement. Over the years we have only benefited from working with, and the astute insights of, many, including Steve Boreham, Kasia Gdaniec, Nick James, Mike Petty, Martin Redding and Rob Scaife. It has only benefited this contribution that it has been read and commented upon by Marcus Brittain, Tony Brown and Simon Schaffer. Increasingly reflected in the CAU's documentation, also to be thanked for his filmmaking is Nick Edwards. This paper's graphics attest to the skills of Andrew Hall, with Dave Webb supplying some of its photographs. Finally, the Needingworth Quarry programme could never have been attempted without the exemplary cooperation throughout of Hanson's managers, particularly Hilton Law and, previously, Brian Chapman. Similarly, Mark Nokkert must be acknowledged for facilitating the HLF-funded Ouse Washland investigations.

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.

Editors:
Federica Sulas is a senior research associate at the McDonald Institute for Archaeological Research, University of Cambridge. Her background is in oriental studies and African archaeology (BA Hons, Naples) and geoarchaeology (MPhil & PhD, University of Cambridge). Her main research interests are in landscape historical ecologies and water–food security.
Helen Lewis is an associate professor at University College Dublin School of Archaeology. Her background is in archaeology and anthropology (BA, University of Toronto), environmental archaeology (MSc, University of Sheffield) and archaeological soil micromorphology (PhD, University of Cambridge). She mostly works today on cave sites in Southeast Asia, but she still loves northwest European Neolithic and Bronze Age monuments and landscapes, and ancient agricultural soils.
Manuel Arroyo-Kalin is Associate Professor of Geoarchaeology at the Institute of Archaeology, UCL. He is interested in the Anthropocene, human niche construction and historical ecology, and uses earth science methods, including soil micromorphological analysis, to study past anthropic landscape modification and anthropogenic soil formation. His main research focus is the pre-Colonial human landscape history of tropical lowland South America, particularly the Amazon basin, where he is engaged in the long-term comparative study of Amazonian dark earths.

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