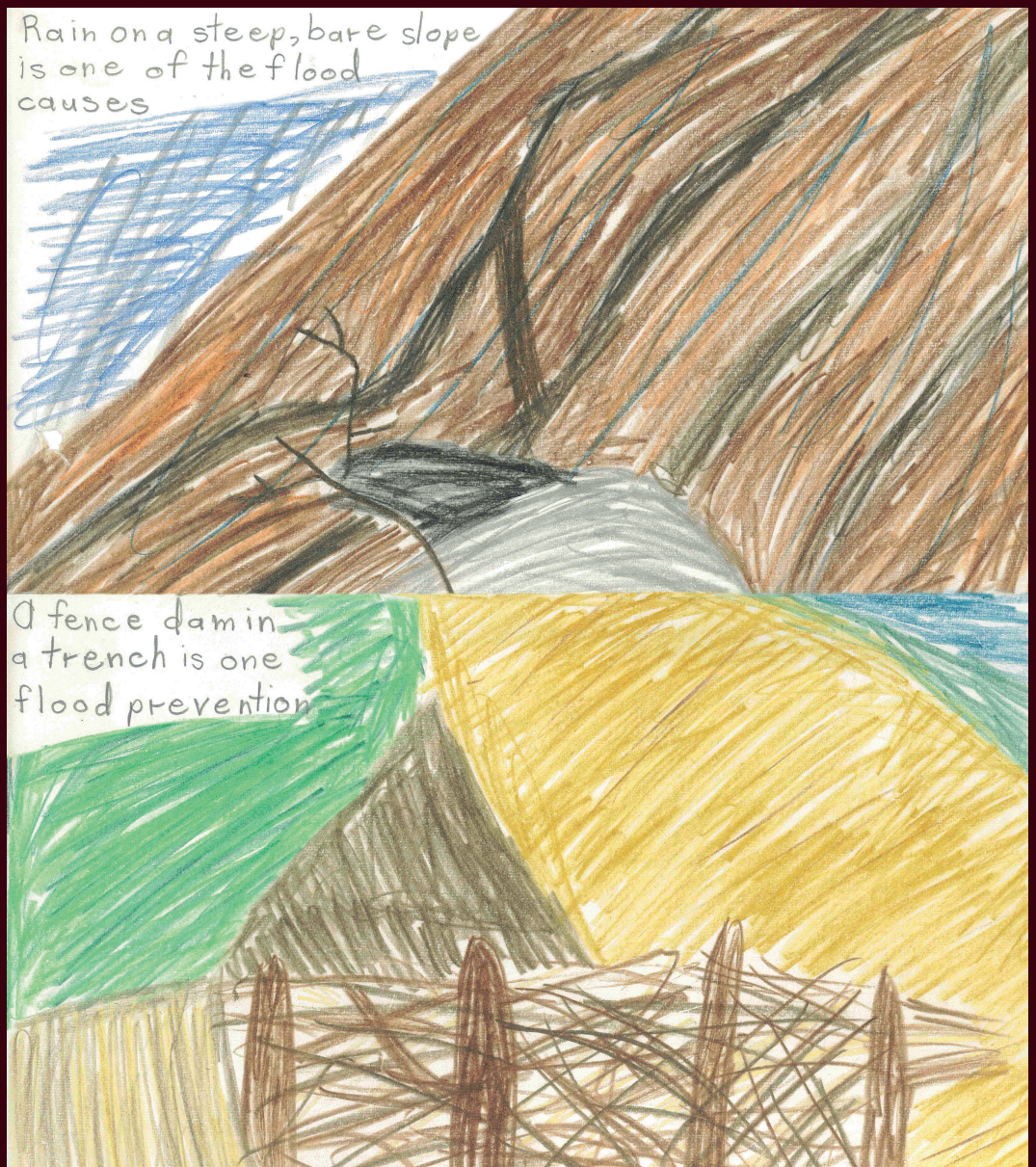
McDONALD INSTITUTE CONVERSATIONS

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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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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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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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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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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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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Figures

Tables

Chapter 10

A geoarchaeological agenda for Tyrrhenian central Italy

Simon Stoddart & Caroline Malone

This paper critically reviews the current state of geoarchaeology for Tyrrhenian central Italy, defined as the region between the Arno and the Tiber, focused on later European prehistory (including the Etruscans) and the Roman period. The most incisive advances have been achieved for the Roman period. The work principally comprises studies of alluvial stratigraphy, inference from modern pedology and the heritage geology of urban centres. The main studies have been of important basins (e.g. Gubbio), deltaic regions (such as the Magra, Arno, Ombrone and Tiber), and some key historic centres (e.g. Perugia, Orvieto and Todi). From experience of working with Charly French in Sicily and Malta, we suggest ways forward for central Italy with the scope of enlarging the impact of geoarchaeology, addressed to the understanding of human impact on the landscape. We suggest that this can be achieved by implementing many of the techniques which form a central focus of Charly's work: systematic auger survey, the study of detected palaeosols, the use of micromorphology and geochemistry, and dating by optically stimulated luminescence. Our experience of working with Charly French has shown the importance of properly dated sequences of pedological and sedimentological change, strongly integrated with archaeological questions. The fate of geoarchaeology in central Italy (with some important exceptions) has generally been that its study has been subsidiary to other concerns, notably heritage and geology applied to modern risk management. Ahead of the full application of Charly French's methodologies, we propose a generalized model of the development of human impact on the landscape.

We have had the pleasure of working with Charly French on two major projects in the central Mediterranean, and he has contributed substantially to a third on Sardinia (Serreli *et al.* 2017), but until recently we have not had the opportunity to work with him in the region of the central Mediterranean where we have worked most: central Tyrrhenian Italy. Here we assess current geoarchaeological work (Table 10.1) and consider the lessons we have learned under his guidance that can be applied to one of the important regions of European civilization located between the Tiber and the Arno.

The mountain landscapes of the Mediterranean have been relatively neglected in a world dominated by the work of Classicists (Stoddart 2000). In the Classical World, the plains and coasts are the centres of intensification, whilst the mountainous peripheries belonging to other peoples were only vaguely understood by ancient written sources. In our collaboration with Charly French in Sicily (1996–2003), we addressed the culture and geoarchaeology of the Nebrodi mountains of north east Sicily. The Troina Project in Sicily showed convincingly that the uplands are part of a narrative entangled with the plains below: entangled not only in cultural terms, but also interconnected in the understanding of geoarchaeological processes. In times of demographic increase, erosional processes increased in the uplands, resulting in episodic colluviation and alluviation (Fig. 10.2) which added to the sediment loads of the major valley systems (Ayala & French 2003). As a field team, we integrated the evidence from exploratory windows excavated into colluvial sediments with a regional study of the Troina River that was accompanied by surface survey (Malone *et al*. 2001–3). This work revealed the dynamic effects of human activity on colluviation and alluviation. Those effects were dated by stratigraphic analysis of early settlement sequences, tied into the landscape by the then innovative application of OSL (optically stimulated luminescence). The outcome from this work, focused on a highly eroded upland landscape, was that we came to realize how careful survey can unravel signatures of both intact settlement and consequent geoarchaeological processes. Indeed, it has been possible to tie these two elements together with later historical sources to construct a longue durée,

Table 10.1. *Tabulation of geoarchaeological research in Tyrrhenian Central Italy: alluvial systems, estuaries, tectonic valleys, cities.*

Seminal work	Alluvial	Section analysis	Judson 1963; 1968
Seminal work	Volcanism	Stratigraphy and human effects	Alvarez 1972
Casentino	Tectonic basin	Morphology/archaeological survey	Stoddart 1981
Gubbio	Tectonic basin	Stratigraphy/modern soils; interdisciplinary site analysis	Coltorti 1994; Finke *et al.* 1994; Malone *et al.* 1992
Treia	Alluvial	Stratigraphy	Cherkauer 1976
Marta	Alluvial	Stratigraphy/archaeomagnetism	Brown & Ellis 1995
Tuscany	Alluvial	Stratigraphy	Coles *et al*. 1984; Gilbertson & Hunt 1987; Hunt & Gilbertson 1995; Hunt *et al*. 1992
Montelabate	Alluvial	Stratigraphy, pedology, micromorphology	French; Volhard-Dearman, McAdams & Thompson n.d. and in preparation; Taylor 2019; Ceccarelli *et al.* 2020
Magra	Delta	Stratigraphy, radiocarbon	Delano Smith *et al.* 1986; Bini *et al.* 2012
Ombrone	Delta	Stratigraphy	Innocent & Pranzini 1993
Tiber	Delta	Stratigraphy/pollen	Bellotti *et al.* 2011; Milli *et al.* 2013, 2016
Arno	Delta	Stratigraphy/pollen/archaeology	Benvenuti *et al.* 2006; Rossi *et al.* 2011; Amorosi *et al.* 2013; Sarti *et al.* 2015
Perugia	City	Stratigraphy	Bertacchini 2014
Orvieto	City	Stratigraphy	George *et al.* 2017
Todi	City	Stratigraphy	Cencetti *et al.* 2005a
Pisa	City	Interdisciplinary	Bini *et al.* 2015
Tarquinia	City	Micromorphology; geochemistry; AMS dating	French, Sheldrake, Schmidt

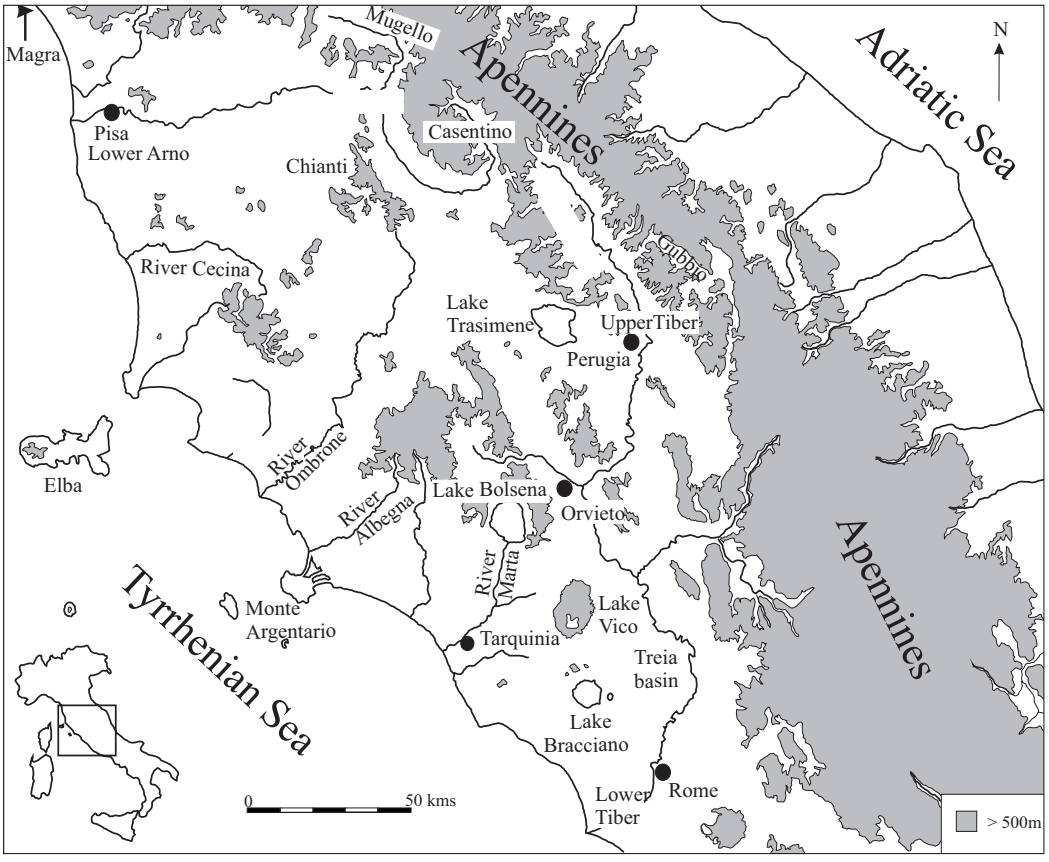

Figure 10.1. *Location of field sites mentioned in the text. Image: authors.*

Figure 10.2. *The alluvium of the Fiume Sotto Troina (Sicily) (with Andy Hall for scale). Image: authors.*

cyclical narrative complementary to the better-known intensifications of plains, in this case of Catania and its extensive plain.

In our more recent collaboration (FRAGSUS), some ten years later in Malta (2013–18), these lessons about the integration of data from excavation and survey were taken a step further (Fig. 10.3). In this work, coupled with the application of pollen and land snail analysis to provide an even more comprehensive programme of landscape understanding (French *et al.* 2020; Malone *et al*. 2020), the geoarchaeological analysis provided key evidence on the long-term viability of the small island landscape in the sustenance of the colonizing populations and their exploitation of island resources. The FRAGSUS Project was focused on prehistory and specifically the Late Neolithic (*c*. 3400–2200 BC) of the Maltese islands and their megalithic monuments. This work complemented the antiquarian focus on megalithic monuments (recorded by classicists such as Ashby and his successors in the early twentieth century, e.g. Ashby *et al*. 1913), which contributed to our understanding of the sustaining, yet over-exploited, landscape. One central achievement of this collaborative work was the identification of horticultural oases in a turbid landscape of erosion and desiccation during episodes of climate instability. A programme of augering by Charly French centred on the Ramla Valley below the Ġgantija monument on Gozo demonstrated the rarity of stable pedogenesis. Such stability is all but unknown except in the culturally enhanced enclaves around the 'temples' themselves, locations which favoured more secure access to water and greater horticultural intensity. This intensity was ultimately, we believe, maintained by ritual action and social bonds, a cohesive force that ensured both the longevity of the megalithic clubhouses at their centre and the horticultural enclosures around them (Barratt *et al.* 2020; Malone *et al.* 2020; Stoddart 2022).

The methodology behind the geoarchaeological achievements of these two important projects was a

Figure 10.3. *Charly French in Malta. From left to right. Nicholas Vella and Charly French surveying the maritime landscape; Nicholas Vella, Chris Gemmell, Charly French, Anthony Bonanno, Katya Stroud and Reuben Grima in front of the Department of Classics and Archaeology; Charly French and Caroline Malone at Skorba. Images: authors.*

progressive enhancement of the same principles: an integration of the dated stratigraphy of alluviation and colluviation, which sought stable surfaces marked by pedogenesis, and given detail by micromorphological and geochemical study and breadth by an augering programme.

The state of geoarchaeology in central Tyrrhenian Italy

The seminal work in central Tyrrhenian Italy was undertaken by two U.S. scholars working closely with John Ward-Perkins in the British School at Rome, who brought into the picture an understanding of the importance of topography from his war experience. The first, Sheldon Judson, undertook a series of early studies of sections he identified in the river valleys close to Rome to understand rates of erosion. He attempted to tie the section data into settlement histories through dating the presence of distinctive material culture in the deposits (Judson 1963). He also researched the implications of these erosional studies by looking at the response by past urban civilizations to control sediment flow through the construction of rock-cut tunnels in the volcanic tuff. These he plotted and interpreted (Judson 1963). Judson went on to assist archaeologists in understanding the geological setting of excavated archaeological sites such as Acquarossa (Judson 1983). Cherkauer (1976) followed in a very similar tradition, collaborating with Tim Potter in the investigation of the riverine stratigraphy of the Treia River, just below Narce, in work that uncovered a complex pattern of changing fluvial regimes in close relationship with the long-lived settlement.

The second U.S. scholar, Walter Alvarez, concentrated more on the legacy of structural geology on landscape development in the immediate area of Veii (north of Rome) and the bend of the Tiber, a river which had in geological times been displaced by volcanic action. His work explored the implications of the rejuvenation of the River Treia catchment, which sought to restore its original base level, and thereby cut the deep, incised canyons characteristic of the region. Alvarez (1972) pointed out the implications of these features for settlement location and access to resources. Easily defended pre-Roman settlement locations of sizes ranging from a few hectares to large plateaux up to 200 ha were located on tuff outcrops, and these sites were selectively occupied according to the political needs of individual periods. The same deeply incised canyons provided a series of resources for emerging nucleated communities, including access to different raw materials ranging from volcanic tuffs to Plio-Pleistocene clays, and secured spring-lines and fertile soils. More recently, similar points have been made by Force (2015) without reference to his illustrious compatriot.

Another important interaction of archaeology and geology in the Tyrrhenian region has been in the study of sea level change, where the archaeological date of sites has been used to define the active shoreline, resolving problems of tectonics and local alluvial regimes in interaction with global patterns. The seminal research was first undertaken by Schmiedt and Caputo (1972). This integrative work has been taken even further by ENEA, looking for sites that are submerged or left high and dry along the coastline of Lazio (Leoni & Dai Pra 1997). The findings demonstrate both the limits of this analysis and the regional variation, work that has been generalized more broadly across the Mediterranean (Auriemma & Solinas 2009).

The recognition of geoarchaeology in the Mediterranean is usually heralded by Vita-Finzi's 1969 model of the Mediterranean valleys. This global model was attractive because of its relative simplicity, proposing two substantial climatic impacts on Mediterranean landscapes, which Vita Finzi entitled the Older (Mousterian) and Younger (Late Roman) Fills. Ongoing debate over this model appears to have provoked more research in Turkey, Greece, North Africa and Spain (Bintliff 2002) than in central Italy, with some exceptions (Potter 1976; Stoddart 1981; Coltorti *et al.* 1991; Coltorti 1994; Brown 1997, 239–47). As elsewhere in the Mediterranean (e.g. Jameson *et al*. 1995), the advance of research has shown that Vita Finzi's simple model required modification, since, as new studies are made, considerable variability has been found in the cycles of alluviation within individual fluvial sequences. This variability suggests considerable input from localized human activity in the landscape. Nevertheless, within central Tyrrhenian Italy, the number of studies is relatively limited, because the main preoccupation of scientists from applied geology is on the erosion rates and neotectonics of near-modern scenarios, even if sometimes retrojected back onto earlier formation processes (Della Seta *et al.* 2009). Still today interdisciplinary teams of archaeologists and soil scientists are relatively rare in the Tyrrhenian region between the Arno and the Tiber.

Work in the Gubbio Valley of Umbria, undertaken in collaboration with Mauro Coltorti, one of the few earth scientists to work closely, and at an early stage, with archaeologists, largely followed the principles of refining the Vita Finzi model (Fig. 10.4). This work detected a series of fills within the intermontane basin and showed the need to modify the simple bipartite model (Coltorti 1994). A well-defined older fill of red Plio-Pleistocene terraces was confirmed by the

Figure 10.4. *The Mousterian red terraces (*alla *Vita-Finzi) of Ponte d'Assi with the limestone escarpment of Gubbio in the background. Image: authors.*

discovery of Mousterian material particularly in the eastern Branca region of the valley, but also at Ponte d'Assi (Fig. 10.4) (Malone & Stoddart 1994, 17–25). However, later deposits demonstrated a much greater range of complexity, including alluvial fans covered with both Upper Palaeolithic and Neolithic material, following principles of slope process and angle defined by Sevink (1985), who had suggested that the change in slope mid-fan provided the optimum opportunity for discovery of archaeological material. This particular location resulted from the balance between deposit erosion and protection that led to the exposure of early to mid-Holocene archaeological material. By contrast, generic Roman material was very widely distributed across the valley and suggested that many of the alluvial features of the lower part of the landscape had not been so badly affected either by erosion or deposition in post prehistoric times.

An outcome of the Gubbio analysis was to make the working assumption that the modern soils could be deployed to give an idea of the distribution of Bronze Age agricultural production. Students of Sevink undertook a very wide auger survey of the central part of the Gubbio basin encircling the main Bronze Age sites to calculate Land Utilization Types (LUTs) from the FAO classification of soils and the level of technology available in early times (Finke *et al.* 1994). In many ways this approach shares much with the methodologies employed by Charly French. His more recent methodology adds control of the date of the soils by the detection of palaeosols, and the use of micromorphology and geochemistry from such securely dated contexts. A fresh analysis of the Gubbio landscape today, inspired by his work, would seek to control the dating of the ancient soils by OSL to establish the relationship between past and present, and by application of a broad range of geoarchaeological techniques. Similar use of dated micromorphology on palaeo-surfaces (Marra *et al.* 2019) has generally only been undertaken in Tyrrhenian central Italy on much earlier deposits, where both potassium-argon dating and lithic scatters were deployed to provide chronological brackets for precision dating.

One of the most successful integrated analyses of the Gubbio valley was the study of the Neolithic site of San Marco (Malone *et al.* 1992; Malone 1994). In the

study of this site (found by Coltorti's geoarchaeological team, and located at a prime 'Sevink' location), a multi-proxy, interdisciplinary study controlled by many AMS dates successfully combined faunal, floral, pollen and land snail study with some elements of geoarchaeological analysis. This research, pooled with a similar study of La Marmotta on Lake Bracciano (Fugazzola Delpino *et al.* 1993), showed the niche location of many early Neolithic sites in a well-watered, quasi-lacustrine environment where the broad spectrum of resources could be maximized. This strongly horticultural focus has a conceptual similarity to that identified in Malta by Charly French, even if strikingly different in many ways.

The most successful analyses integrated with archaeological dating in Tyrrhenian central Italy have been undertaken on the deltaic regions of both the Arno and Tiber, and primarily focused on the Roman period. The lower reaches of the Arno were studied in the context of the discovery of the remains of Roman ships (Benvenuti *et al.* 2006). This research has uncovered the considerable instability of flood conditions from Etruscan to Roman times. More recent research has suggested that the earlier Holocene morphology of the area in the form of soft sedimentary units (*panconi*) may have had a strong influence on the development of the landscape (Rossi *et al.* 2011). Most recently, research using interdisciplinary study of borehole data and including substantial use of archaeological information by earth scientists, has shown the gradual consolidation of the lower reaches of the Arno, which permitted increasingly dense human population during the first millennium BC (Amorosi *et al.* 2013; Sarti *et al.* 2015). This consolidation accompanied the transformation of swamp conditions to landscapes closer to the modern alluvial plain.

The study of the other major delta of Tyrrhenian central Italy, the Tiber (Bellotti *et al.* 2011 Milli *et al.* 2013; 2016), has defined the environmental conditions which enabled the establishment of the harbour installations of the Roman age. In later prehistory (1900–600 BC), the deltaic area was covered by oak-dominated mixed woodland bordering marshland. Following 450 BC, the cusp of the delta extended sufficiently far to enable permanent early Roman settlement on the adjoining land. This transformation from 'a wave dominated estuary to a wave dominated delta' (Milli *et al*. 2013, 160) had, according to these studies, much to do with increased fluvial power. It is worth considering how far these transformations impacted on humans located upstream. We have been able to undertake some work in the upper Tiber Valley near Perugia to assess such impact (see below). The third largest river system of Tyrrhenian central Italy, that of the Ombrone, has largely been studied by earth scientists (Innocent & Pranzini 1993) without the full integration of archaeological evidence. Importantly, however, this river system is in the heartland of Etruscan civilization, a people whose activities may have affected the sedimentary regimes of Tyrrhenian Italy, even before the Romans.

One exceptional and early interdisciplinary project was set around the Roman city of Luni at the mouth of the much smaller, more northerly, Magra River (Delano Smith *et al.* 1986), where the current authors were junior members of the field team. By contrast with the larger river regimes briefly discussed above, this comprised a much smaller catchment and short traverse from the surrounding mountains leading to what Delano Smith defined as a high-risk regime, enhanced by steep relief, high precipitation and impermeable parent rock. The interdisciplinary work identified major changes in alluviation from the late first millennium BC onwards. Very little prehistoric material was found through survey, since it was rendered invisible by the combined effects of later erosion and deposition. More recently, work was undertaken in a collaboration between the Superintendency and a number of Italian and German universities, to date six new sediment cores (Bini *et al.* 2012) and attempt to define lagoonal areas where ancient port facilities for shipping Carrara marble might have been located.

Another important series of projects was undertaken in the smaller river systems of Tuscany, which sought to combine the study of alluvial processes with information derived from land snails. These studies have demonstrated the localized effects of settlement and clearance in the last three millennia BC (Coles *et al.* 1984; Gilbertson & Hunt 1987; Hunt *et al*. 1992; 1995). Such work is the way forward in our collective efforts to link settlement survey and excavation with an understanding of the human impact on the surrounding landscape. The Roman Peasant Project, located broadly in this same region, has continued the Dutch tradition of LUTs implemented earlier in the Gubbio Valley rather than analysing the dated impact of human activity on run-off (Bowes 2021).

Brown and Ellis (1995) looked more comprehensively at the river systems of southern Etruria. Their work established the considerable depth of the Younger Fill defined by Vita Finzi, and made some important strides towards exploring its variation over space and time across the trajectory of river systems. However, as they admitted, the very dynamic contexts posed a serious problem in the dating of the processes because of the substantial charcoal residuality within cultural material sequences. They applied archaeomagnetism, but were defeated by the lack, at the time, of a local

curve, and wisely proposed the systematic application of OSL dating, which they later implemented (Brown *et al*. in press), as applied at much the same time in the Troina Sicilian project by the current authors working with Charly French.

Studies of urban centres

The collaborative working of geologists and heritage managers has developed in a different direction to the field science practised by Charly French. Many geological studies have been undertaken of the *centri storici* of living Italian cities, which are frequently located on unstable hills and ancient basins. These sites often have a deep history of place, and so the chance encounter with the ancient past is a constant theme. Such cities have rarely been studied through geoarchaeological methods, and instead research on geological deposits has dominated. Recent studies of the urban stratigraphy of Perugia have shown the implications of building a city on the palaeo-delta of a much earlier version of the River Tiber (Bertacchini 2014, 49–50). This substratum required the development of considerable engineering skills in ancient times to mitigate and take advantage of the pooling of water, preventing collapse whilst providing a ready supply of potable water. The neighbouring hill town of Todi, located about 40 km to the south of Perugia, was also built on basal clays underlying sands and gravels derived from a Plio-Pleistocene lake basin. In ancient times, many wells were constructed in the underlying stratigraphy, and in modern times considerable consolidation has been required to preserve the town (Cencetti *et al.* 2005a). In Orvieto, the upstanding ancient volcanic tuff outcrop from the *Apparato Vulsino* dating to about 315,000 BP overlies a Middle Pliocene basal clay, separated by a much thinner (*c.* 15 m) Lower Pleistocene fluvio-lacustrine layer, and this combination has become fragile at its edges over the course of time, requiring substantial programmes of consolidation (Cencetti *et al.* 2005b). An archaeological by-product of this consolidation has been the discovery of a substantial range of ancient cavities and tunnels, often providing sediment traps that can be explored to ask geoarchaeological questions (George *et al.* 2017).

An intriguingly different approach, more similar to the geoarchaeological approach, has been applied to the development of the city of Pisa in the alluvial plain of the Arno River. There a systematic project has integrated all the archaeological and geological interventions over the last few years (including aerial and satellite images, electrical resistivity tomography, LiDAR, and core analysis) (Bini *et al.* 2015). In the Etruscan period, two topographic relief formations became the nuclei of the ancient city. In the Roman period, these reliefs were enhanced by what appears to have been a combination of both alluvial and cultural action that increased the quantity and quality of firm ground available for settlement. The original settlement nucleation was centred on the palaeo-Auser, a tributary of the Arno, and only later did population gravitate more towards the Arno itself, in a period accompanied by more intensive agriculture, deforestation, drainage and centuriation.

A model for Tyrrhenian central Italy

A model for landscape impact in Tyrrhenian central Italy has recently been developed, drawing on summed settlement numbers from survey, radiocarbon and pollen data (Stoddart *et al.* 2019). These data suggest a greater than expected environmental impact in the Neolithic, a rather subdued Etruscan effect and a much more generalized Roman environmental impact across the whole peninsula. Some regional studies already confirm this generalized model (di Pasquale *et al.* 2014). Others confirm our suspicion that Etruscan impact was localized to areas immediately around their settlements and associated cultivated areas (Drescher-Schneider *et al.* 2007; Buonincontri *et al.* 2020). A *Quellenkritik* of the data behind this generalized sequence shows a number of key issues regarding the level of systematization of the collected data. Firstly, the distribution of survey data was not systematically collected across the landscape, or, in the case of cityscapes, across the territories themselves. Secondly, only one pollen sequence (that of Lago di Accesa) was closely associated with a settlement. Most pollen sequences were from rich pollen catchments such as volcanic lakes and uplands, locations which were generally far removed from the main zones of landscape intensification until the onset of the Roman period. Thirdly, because rich material culture accompanied by cross-dating was considered a better substitute for absolute dates, the practice of radiocarbon collection from the Iron Age onwards has been unsystematic (other than when associated with dendrochronological calculations, which are extremely rare in central Italy). Finally, as already outlined, the application of integrated geoarchaeological work in central Italy is relatively sparse in the region between the Tiber and Arno (in comparison with Dutch work further south).

Testing the model

In common with our projects in Sicilian Troina and Maltese Ggantija, Tyrrhenian central Italy offers considerable opportunity for an integrated geological and

archaeological analysis. This is because of the long 'Grand Tradition' of cultural research spanning from the Neolithic (Malone 2003), Bronze Age (Barker & Stoddart 1994), Etruscan (Stoddart 2020a), to Roman (Carandini 1979) and Medieval (Francovich 1992) periods. This, coupled with an extensive surface survey tradition, has recently been brought together in various forms (Palmisano *et al.* 2017; 2018; Stoddart 2020b; Stoddart *et al.* 2020).

What lessons from Charly French do we apply to future work in Tyrrhenian central Italy? We can add to the traditions already outlined above, by contributing Charly's clear integration between site excavation and regional coverage, underscored by detailed auger survey. This, together with detailed implementation of micromorphology, geochemistry and optically stimulated luminescence (OLS) could be applied to promising profiles both in excavated sites and those detected in the field. We can also add a suite of archaeological questions, rather than simply providing some incidental dating to geomorphological and pedological processes.

Recently, we have begun collaboration with Charly French by bringing his work to bear on the important Etruscan monumental sequence of Tarquinia (French & Sheldrake 2020), excavated by Maria Bonghi Jovino, Giovanna Bagnasco and their team from Milan for some forty years (Bagnasco *et al.* 2018). This work has contributed substantially to our understanding of the site formation processes of one ritual focus within one of the greatest Etruscan cities, and nestled in a deep cavity of the Civita plateau of Tarquinia. In this case, what is needed now is that same balance achieved in Troina and Ggantija, the regional coverage that provides the landscape context for the evolution of a focal place in the landscape. The reapplied and contextually adapted 'French' methodology has every prospect of success, similar to that previously achieved by deploying it (augering, micromorphology, geochemistry and OSL dating) to link settlement to landscape so as to understand better their relationship and mutually reinforcing impact (French *et al.* 2020).

With the assistance of one of Charly French's colleagues, Sean Taylor (2019), we have begun to apply broader landscape analysis to the Upper Tiber Valley, some distance upstream from the catchment covered by the seminal studies of Judson. Here we had already completed some of the site-based studies undertaken in Sicily and Malta, once again working with a number of Charly's undergraduate and MPhil students (Saskia Volhard-Dearman, Conor McAdams and Phoebe Thompson), as well as a surface survey of the left bank of the Tiber in the Gaslini Montelabate estate (Stoddart *et al.* 2012; Malone *et al.* 2014). Taylor's (2019) pilot work established through auger survey that a great deal of geomorphological change had taken place in the study area. Abundant evidence suggests that there has been severe soil erosion in the catchment. Several geological sections show that much of this erosion is now in the form of colluvium. Such information is important because it is relevant to the interpretation of survey data. Many of the finds will have been moved from their primary contexts and potential *in situ* archaeological sites are likely to be buried, some possibly quite deeply. Locating these will be worthwhile because they are likely to be well-preserved, and organic materials could be present in the right geomorphological contexts. There are also areas of the floodplain where definite relict palaeosols of considerable antiquity have been identified, repeating the patterns we found in Sicily and Malta, since geomorphological 'windows' into the distant past can be found intact. Once these locations are sampled and investigated, micromorphological studies may provide an understanding of the changing nature of the environment in the study area over a long time scale (Fedoroff & Courty 2010). A further step will be to link future research in this upstream study area with work that has been carried out downstream in Portus, Ostia, and the Tiber delta (Bellotti *et al.* 2011), as already suggested.

The broad outcomes of our current understanding of environmental and human impact on the landscape are that the Roman period resulted in the widespread impact which can be consistently picked up by generalized and summed proxies: namely erosion/alluviation and clearance. In the preceding Etruscan period, the effects were localized and beyond the grain of the current detail of analysis. Only a few innovative studies that, by design (Buonincontri *et al.* 2020), or from the presence of a convenient lake for a pollen core next to a relevant settlement (Drescher-Schneider *et al*. 2007), have detected Etruscan impact on the landscape by examining a range of proxies (charcoal, sediment and pollen). The Roman impact was decisive, and this impact was renewed in the course of the Early and High Middle Ages (Buonincontri *et al.* 2020). What is required now is a series of settlement-based geoarchaeological studies to tie in local histories of the landscape, applying the widespread principles practised by Charly French on a global scale.

Conclusions

Charly French's contribution to the landscape is distinct from the current regional tradition of Tyrrhenian central Italy. Firstly, it is an approach that asks archaeological questions, and does not simply supply material culture as a potential dating of sequence. Secondly, it

is an approach that moves beyond the construction of riverine stratigraphy and contributing erosion and mass wastage, the understandable preoccupation of many earth scientists of the *geologia applicata* tradition who work in this neotectonic region. Charly's approach sets out to detect datable palaeosurfaces and the gradations of deterioration that have frequently led to the ecological disaster that faces us today on the wider stage that he has investigated. In Malta, he uncovered a microcosm of our current global disaster. In Tyrrhenian central Italy, we have the opportunity to uncover the *longue durée* processes that led to the over-urbanized landscapes of the demographically dense modern world. We suspect, for instance, that a study of the immediate environs of emerging urban centres from the first millennium BC onwards will uncover localized effects on the landscape that have yet to be appreciated, but were hinted at in the studies of Judson some sixty years ago. The career of Charles French has lessons for modern policy makers, if only they would listen and not simply attend to the self-serving dynamics of short-term populism. In a memorable moment of a recent 'research away day', Charly reminded us that when he first studied Wessex, he (and his teacher 'Snail' Evans) could rely on a sequence of fossil land snails to date the environment. Today the anthropic processes of the last fifty years, the life cycle of some ten prime ministers, have disintegrated those fossil land snails to destruction. A similar process is taking place in the Mediterranean, and geoarchaeologists need to take a measure of these changes and give advice for their prevention before it is too late. The lesson of Wessex is strongly related to the lesson of Malta, where the land snails still survive but where the landscape is literally consumed by modern settlement. It is also the lesson of Tyrrhenian central Italy. We must learn from these lessons of the past that interdisciplinary geoarchaeology provides.

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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