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Palaeolithic research at the Institute of Archaeology

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The Institute's tradition of research into the Palaeolithic period has been considerably strengthened by new staff. Here, four colleagues outline their research into the archaeology of human evolution, human dispersals into Europe, adaptations to past environments in the Iberian Peninsula, and subsistence changes since the most recent glacial epoch.

Since its foundation in 1937, the Institute of Archaeology has been an important centre of research on Pleistocene environments and Palaeolithic archaeology. Frederick Zeuner (IoA: 1937–1963) was greatly respected for his teaching and research on the subject, including his 1945 publication *The Pleistocene period*[1] and John Waechter (IoA: 1954–1978) for his Palaeolithic excavations at Gorham's Cave in Gibraltar and Swanscombe in the Thames Valley. Mark Newcomer (IoA: 1973–1989) inspired many of the students with his experimental research on prehistoric bone and flint technology and for his innovative work on the microwear analysis of flint tools. In 1982, Mark Roberts began his excavations at the Lower Palaeolithic site of Boxgrove in Sussex and more recently Matthew Pope has been involved in an extensive survey of the Middle Pleistocene raised beaches along the south Sussex coast.[2] Simon Parfitt has been undertaking groundbreaking research into the Lower Palaeolithic of East Anglia.[3] Andrew Garrard and Norah Moloney joined the staff of the Institute of Archaeology in 1990 and 1994 respectively, and Dietrich Stout and Ignacio de la Torre in 2005. Each are involved in research relating to human developments through the Pleistocene and this is outlined in the four sections that follow. Several other staff also undertake research in related fields, including Ole Grøn, Simon Hillson, Richard Macphail, Marcello Mannino, Tim Schadla-Hall, James Steele and Ken Thomas. The work of several of these has featured in recent issues of *Archaeology International*.[4]

Human technology and cognitive evolution (Dietrich Stout)

Human beings are technological animals. Although many species make and use tools, *Homo sapiens* is distinguished by obligatory reliance on complex technological modes of adaptation. How did we become this way, and what does it indicate about the nature of human intelligence? These are complex questions that require a similarly complex approach, crossing traditional disciplinary boundaries between archaeology, anthropology, neuroscience and psychology.

The earliest known technological artefacts in the world – simple stone flakes struck from river cobbles – come from the site of Gona in the Afar region of Ethiopia.[5] When such early Oldowan stone tools were first described from Olduvai Gorge in Tanzania, they were thought to indicate the emergence of distinctly human cultural and cognitive capacities involving "the imposition of arbitrary form on the environment".[6] Experimental replication subsequently revealed that these typological forms are more likely to have been imposed by the interpretations of modern archaeologists than by the intentions of ancient toolmakers,[7] leading some to argue that the Oldowan provides evidence of nothing more than ape-level cognition.[8] However, times are again changing as an increasing body of archaeological evidence reveals the technical skill and sophistication of the earliest toolmakers.[9] At Gona, this includes both mastery of flaking techniques and a pronounced degree of selectivity for high-quality raw materials.[10]

But what do these early indications of technological ability actually reveal about human cognitive and brain evolution? Modern imaging techniques of functional brains provide an exciting new opportunity to plumb the neural foundations of early technology. Positron emission tomography[11] applied to human subjects immediately after they have engaged in experimental manufacture of Oldowan-type stone tools have revealed the importance of complex perceptual-motor and spatial integration (Fig. 1), as opposed to abstract conceptualization and planning, suggesting that a broader view of the evolutionary foundations of modern human technological competence may be needed. This research highlights the fact that stone toolmaking is a concrete visual-motor skill rather than an abstract conceptual capacity, and that such skill may be developed only through deliberate effortful practice. What might this imply about the social contexts that encouraged and supported such investments in skill acquisition in prehistory?

Ethnographic and experimental research with modern traditional stone toolmakers can provide a valuable reference point to address this question. Although Oldowan

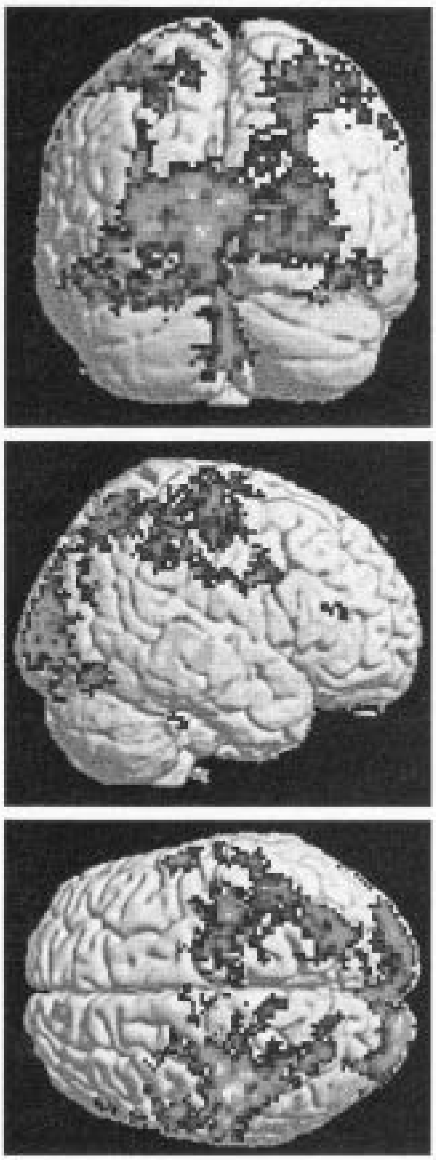

Figure 1 *Positron emission tomography (PET) scans of brain activation during experimental Oldowan toolmaking. Successful flaking requires the precise delivery of powerful blows, as well as the identification of appropriate targets based on visual assessment of the core. These demands are reflected in the activation of motor planning and execution regions in the posterior frontal lobe, seen in the middle of the brain in the central (right lateral) and lower (dorsal) images, and of higher-order visual cortex in the occipital and posterior parietal regions, as can be seen towards the back of the brain in the upper (posterior) image.*

knapping may have been mastered in a relatively short time, more refined tools from the later Acheulean (more than 500,000 years ago) and Middle Palaeolithic (more than 250,000 years ago) provide evidence that hundreds of hours or more were probably invested in practising their manufacture. A particularly extreme modern example of heavy investment in

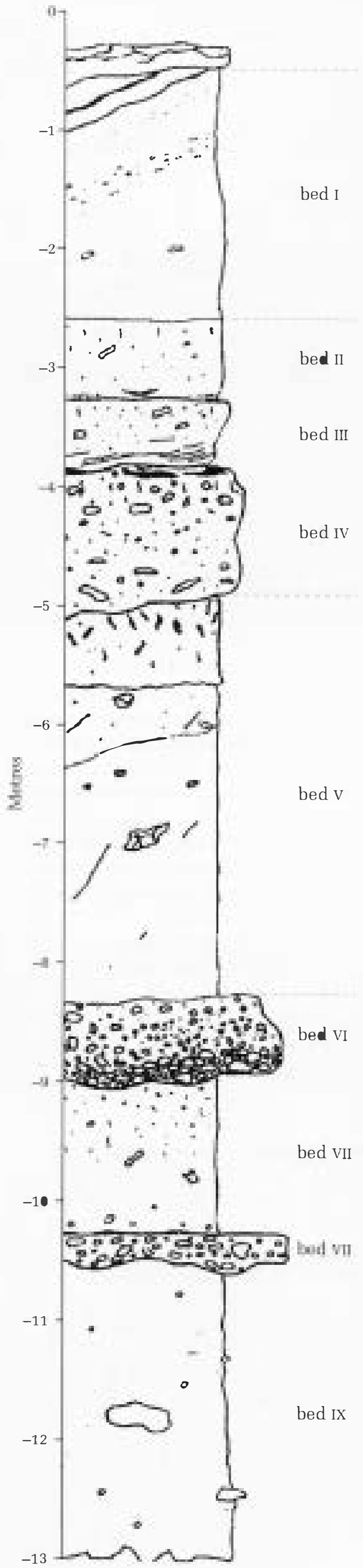

Figure 2 *A stratigraphical section of Azokh 1 deposits. Correspondence: bed* I *– Holocene; beds* II *and* III *– Middle Palaeolithic (Mousterian); bed* V *– late Lower Palaeolithic (Acheulian) to early Middle Palaeolithic. Absolute dating for the sequence is in progress. (Based on a composite section drawing by Peter Ditchfield.)*

the acquisition of toolmaking skills comes from the stone-adze makers of Langda village in the Highlands of New Guinea.[12] These remarkable artisans spend as long as ten years mastering their craft, supported as much by aspects of identity, prestige and social motivation as by the explicit demonstration, instruction and facilitation they receive as apprentices. How far back into human prehistory does such intensive social facilitation of expert-skill acquisition extend, and how far can it go in explaining our uniquely technological way of life? Continuing research at the Institute of Archaeology, including fieldwork at Gona and experimental studies of the acquisition of toolmaking skills (in collaboration with the Functional Imaging Laboratory at the UCL Institute of Neurology), aims to address these questions.

Exploring early hominin presence at Azokh Cave, Nagorno Karabagh (Norah Moloney)[13]

Archaeological and palaeontological evidence points to the Caucasus as a pivotal region for hominin dispersal out of Africa, and within Eurasia. The *c.* 1.8 million year old site of Dmanisi (Georgia) is rich in the remains of Europe's earliest hominins,[14] and Mezmaiskaya Cave in the northern Caucasus has some of the last Neanderthals in Europe dating to *c.* 29,000 years ago,[15] a time when they would have coexisted with early modern humans in the region. Investigations at Azokh Cave in Nagorno Karabagh are important for the information they may provide about hominin life in the intervening period.

Located 200 m above Azokh village, Azokh 1 is one of several southwest-facing fossiliferous chambers of a limestone karstic cave system.[16] Excavations in the 1960s exposed *c.* 13–14 m of deposits from the Postglacial to the Lower Palaeolithic, with clear evidence of human occupation throughout much of that period, including part of a hominin mandible described as pre-Neanderthal.[17] Unfortunately, these excavations were not well recorded and early publications provide limited information.

In 2002 systematic exploration of fossil and archaeological materials were undertaken by a multidisciplinary international team, with a focus on the undisturbed deposits of Azokh 1 (beds V–II).[16] A stratigraphical study enabled geologists to check and refine conclusions reached in earlier excavations (Fig. 2). Survey and mapping of the entire cave system revealed Azokh 2 and Azokh 5, both chambers with a long sequence of undisturbed deposits that may correlate with those of Azokh 1 (Fig. 3).

In the present investigations finds are recorded three-dimensionally, and all excavated sediments are passed through dry and wet sieving processes in order to retrieve micro-faunal, lithic debitage and botanical remains. Large animal remains include red and fallow deer, wild goat, wild boar, rhino, wolf, hyaena and, in particular, cave bear, the latter probably having died during hibernation. Bones, including bear bones, with cutmarks made by stone tools indicate dismembering and butchering processes by humans, although it is impossible to determine if humans killed the animals or scavenged dead carcasses.

Human occupants of the cave exploited

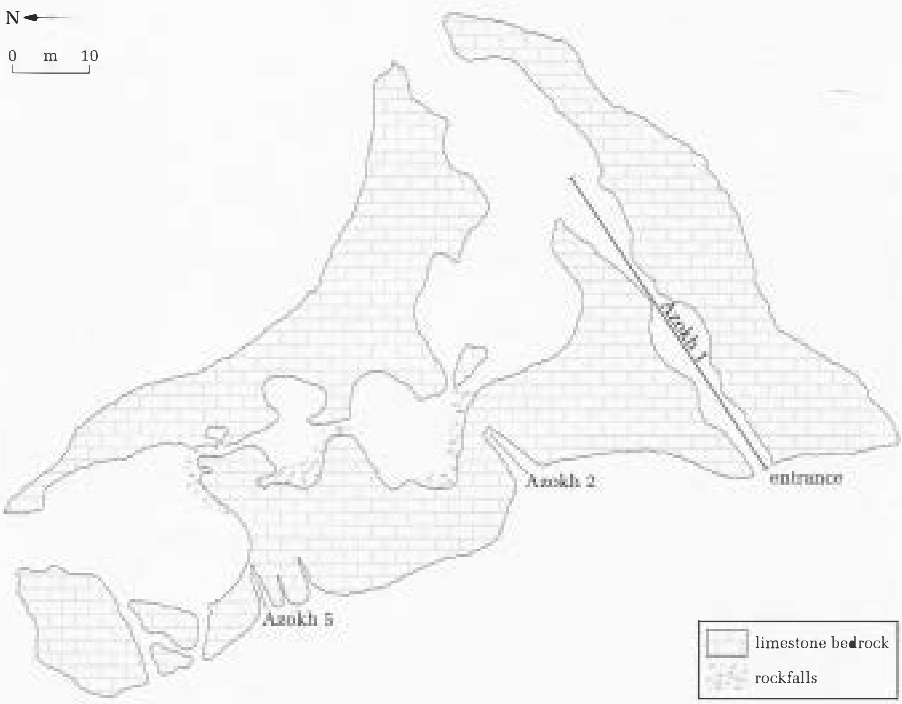

Figure 3 *The topography of the Azokh cave system (modified from an original by P. Andrews & P. Ditchfield, with permission).*

a range of stone types for tool manufacture, among them chert, limestone, quartzite, and obsidian. Most of the stone is of local origin; however, the nearest source of obsidian is about 60 km away which raises the question of how and why hominins obtained obsidian. Study of stone-tool technology indicates a change in production systems between stratigraphical bed V (see Fig. 2), where a simple technology is employed, and bed II, where the prepared-core, or Levallois, technique indicates a more complex approach to manufacture. These technological differences could be the handiwork of different hominin species. In Europe, Levallois production (as evidenced in bed II) is often associated with Neanderthals; however, the pre-Neanderthal mandible (indicating a different hominin species) that was found in the 1960 excavations came from bed V, where stone-tool evidence indicates less technological complexity.

A recent study of charcoal samples provides useful environmental information. Identified species include fruit-bearing trees, which could have supplied food as well as firewood. Analysis of sediments adhering to stone tools has revealed starch grains, although the particular species of plants from which these were derived have not yet been identified. Charcoal and starch analyses are at a preliminary stage, but future work, augmented by pollen and phytolith analyses, will increase the archaeobotanical database. Using a range of modern scientific techniques, the present excavations have begun to reveal tantalizing aspects of how Azokh's early occupants interacted with their environment. The prospect for future research is exciting.

The Palaeolithic occupation of inner Spain during the Upper Pleistocene (Ignacio de la Torre)

Cooling temperatures affecting Europe at the end of marine isotopic stage 5 (MIS5)[18] culminated in glacial conditions at the beginning of MIS4, around 74,000 BP. Ice sheets in northern Europe displaced populations of plants and animals (including humans) to refugia in warmer, more southerly latitudes, such as the Iberian Peninsula.

The portrait of the Iberian Peninsula as a refuge for human populations during the Upper Pleistocene is demonstrably valid for the Cantabrian and Mediterranean coasts, where relevant archaeological sites are plentiful. In such regions, intense archaeological research undertaken during the nineteenth and twentieth centuries continues today. However, the density of Upper Pleistocene sites is significantly lower in the interior of the Peninsula and this has traditionally been attributed to the dry and cold climatic conditions that prevailed during the marine isotope stages MIS4, MIS3 and MIS2.

Nonetheless, the fragmentary record of Palaeolithic colonization of continental Spain could equally reflect a lack of research rather than extreme climatic conditions. Our research project is focused on an evaluation of Palaeolithic settlement in the interior during MIS4, MIS3 and MIS2 (the so-called Pleniglacial period, which was the coldest known period of the Iberian Peninsula). Current fieldwork is in two regions (Fig. 4): the Pre-Pyrenees of Catalonia and the Spanish Southern Plateau at Cuenca (Castilla–La Mancha).

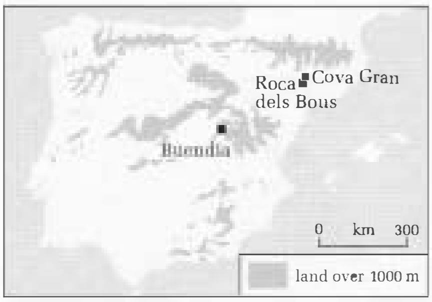

Figure 4 *The location of the sites studied in the Iberian Peninsula.*

The project at Lleida in the Pre-Pyrenees aims to reconstruct the behavioural adaptations of the Neanderthals and early modern humans who occupied the caves and rockshelters of this mountainous region.[19] Several field seasons at La Roca dels Bous (Fig. 5), have revealed many Middle Palaeolithic levels. Studies of hearths, lithics and lithic refits, as well as analysis of fossil bones, the spatial configuration of the

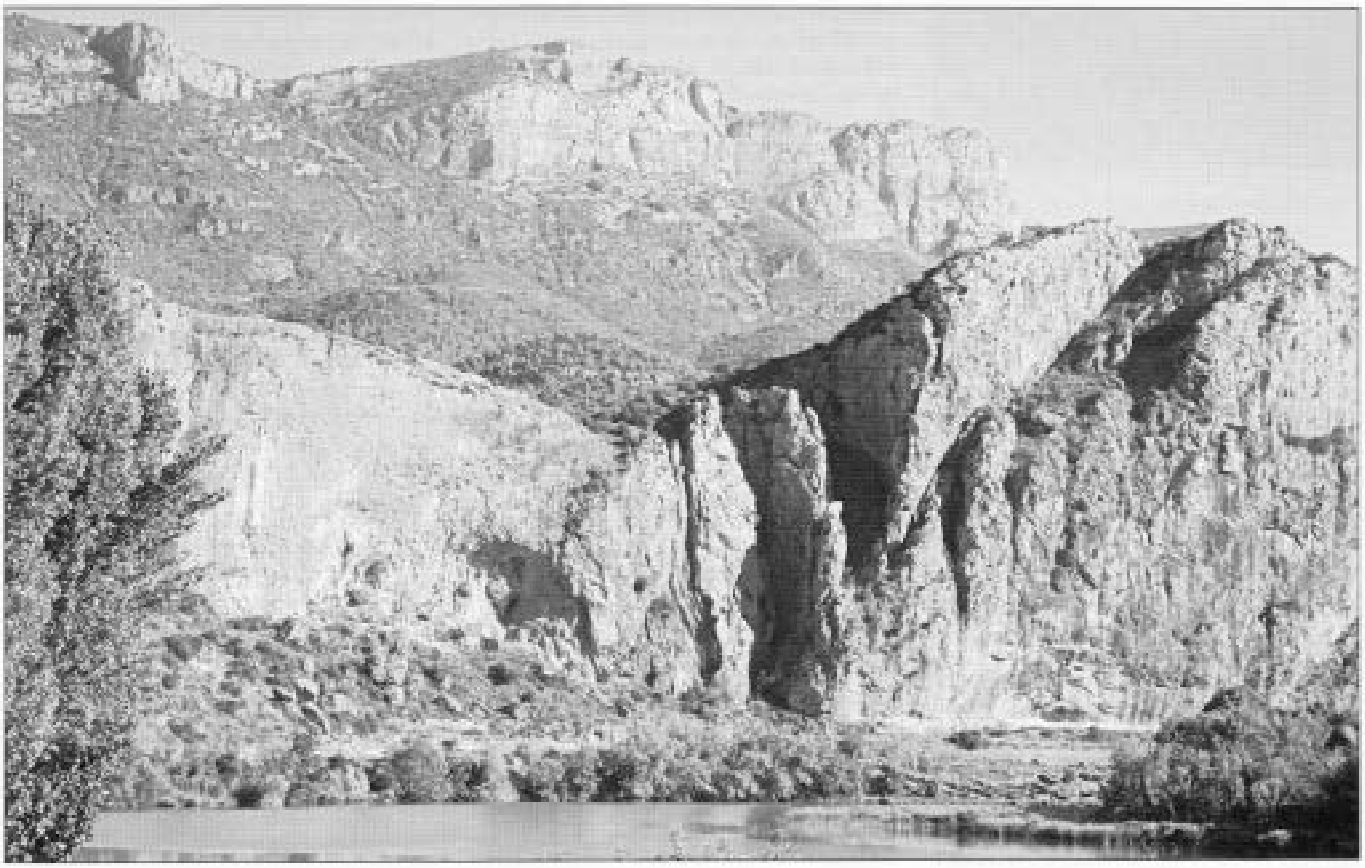

Figure 5 *Topographical setting of the Roca dels Bous Middle Palaeolithic site.*

Figure 6 *The Cova Gran rockshelter in Lleida region, a few kilometres away from La Roca dels Bous.*

archaeological remains, etc., are providing exciting information about the adaptations of late Neanderthals south of the Pyrenees.[20]

Cova Gran (Fig. 6) is a second rockshelter currently under investigation as part of the Upper Pleistocene human settlement project of the Catalonian Pre-Pyrenees. Discovered in 2002, Cova Gran has a thick stratigraphical sequence the excavation of which has not yet reached bedrock. We have identified Mesolithic and late Upper Palaeolithic levels in one area of the site and Middle to Upper Palaeolithic transition levels in another. Therefore, this site constitutes a compelling case for evaluating the adaptations of both Neanderthals and early modern humans and, along with La Roca dels Bous, will contribute to understanding the Upper Pleistocene settlement of the Pre-Pyrenees.

How did modern humans colonize areas farther south in the Iberian Peninsula? We are seeking to answer this question through a new project in the Southern Plateau at Cuenca. Excavations in 2005 at Buendia rockshelter (Figs 4, 7) and will continue over the next few years. So far, more than 20 archaeological levels have been found, each containing a high density of cultural remains. Magdalenian (a later Upper Palaeolithic culture, *c.* 14,000 BP) materials have been found in the upper levels, but there are also many earlier Upper Palaeolithic levels below these. Although the information is still preliminary, Buendia rockshelter has become crucial for reconstructing the way in which Late Palaeolithic hunter–gatherers lived in the harsh conditions of the Spanish Plateau during the most recent glacial maximum.

The goal of our research in Spain is to reconstruct cultural adaptations of Palaeolithic hunter–gatherers to the changing climatic conditions of the Upper Pleistocene in extreme environments such as those of the mountainous Pre-Pyrenees and the Southern Plateau. At the same time we are seeking to understand those adaptive responses in evolutionary terms through the comparison of behavioural strategies developed by Neanderthals and modern humans during the most recent ice age.

The Late Palaeolithic and Neolithic in the Levant (Andrew Garrard)

Southwest Asia is regarded as one of the earliest centres of village-based farming in the world; as a consequence, extensive research has been undertaken on the adaptations of the Late Pleistocene hunter–gatherers in the region, and the factors that may have led to the development of sedentism and plant and animal domestication. The most detailed field studies have been undertaken in the natural habitat areas of the main plant cultivars, and particularly in the moist steppe and open woodland environments of the Levantine Corridor – stretching from southern Israel and western Jordan to the Euphrates Valley of northern Syria and southeastern Turkey (Fig. 8). For many years, far less was known of the Late Palaeolithic and Early Neolithic communities that inhabited both the more arid and the mesic areas to either side of the Corridor – in particular, the dry steppe and sub-desert environments of the Syrian–Jordanian plateau, and the mesic forested mountain environments of Lebanon, western Syria and southern Turkey. Much of the author's field research over the past 20 years has been attempting to redress this imbalance, by reconstructing the environmental history of selected areas in these arid and mesic habitats and examining their role in regional developments through

Figure 7 *The Buendia rockshelter in Castejon (Cuenca, central Spain).*

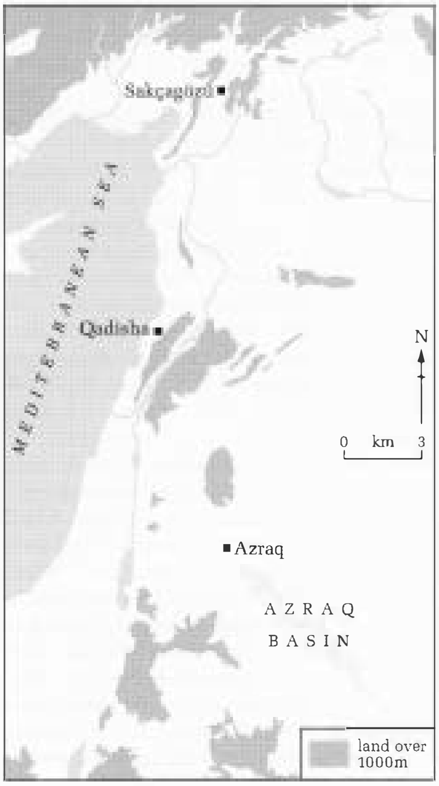

Figure 8 *The Levant region: the locations of Azraq (Jordan), Sakçagözü (Turkey) and the Qadisha Valley (Lebanon).*

the Late Pleistocene and Early Holocene.

In the 1980s, the author undertook an extensive field project in the steppe and oasis environments of the Azraq Basin in eastern Jordan (Fig. 8). Following an initial survey programme, small-scale excavations were undertaken at ten Late Upper Palaeolithic and Epi-Palaeolithic sites dating to 28,000–12,000 BP and larger-scale excavations at five Neolithic sites dating to 12,000–8,400 BP. The majority of these sites contained dense midden deposits with very substantial lithic and animal bone assemblages as well as carbonized plant remains. Their analysis has provided valuable insights into many aspects of human settlement, technology and subsistence at the southeastern margins of the Levantine Corridor.[21] In the mid-1990s, the author began similar research in the formerly forested environments of the Sakçagözü region of southern Turkey (Fig. 8), where a detailed survey project was undertaken.[22]

Since 2002, the author has been undertaking field research with Dr Corine Yazbeck from St Joseph's University in Beirut, looking closely at Palaeolithic and Neolithic adaptations to the thickly forested environments of the northern Lebanese Mountains, which rise to over 3,000 m to the southeast of Tripoli. Following an initial survey, excavations were begun at two adjacent caves at Moghr el-Ahwal in the Qadisha Valley (Fig. 9). In 2004, excavations were undertaken in the smaller cave, where well preserved Late Neolithic, Natufian and Geometric Kebaran material (17,500–7,500 BP) was found; and, in 2005, excavations were begun in the adjacent larger cave, where there is evidence for similar periods of occupation, plus earlier material possibly dating to the late Lower or Middle Palaeolithic. Preliminary analysis of faunal remains from the Epipalaeolithic levels has clearly demonstrated a high dependence on forest resources, but, by the Late Neolithic, domestic livestock were also being kept in this region. It is hoped that the detailed investigations on the artefacts, bio-remains and sediments from the survey and excavations will provide a strong foundation for reconstructing Late Pleistocene and Early Holocene environments, settlement and subsistence in this otherwise poorly known region.[23]

Figure 9 *The caves at Moghr el-Ahwal in Qadisha Valley (Lebanon).*

Notes

1. See G. Simpson, "RememberingFrederick Zeuner and others at the Institute of Archaeology, 1945–48", *Archaeology International 2000/2001*, 9–10; and J. Sheldon, "Environmental archaeology at the Institute: the early years", *Archaeology International 2001/2002*, 9–11.
2. See M. B. Roberts & S. A. Parfitt, *Boxgrove: a Middle Pleistocene hominid site at Eartham Quarry, Boxgrove, West Sussex* (London: English Heritage, 1999); and M. Pope, "Placing Boxgrove in its prehistoric landscape", *Archaeology International 2003/2004*, 13–16.
3. See S. Parfitt, "A butchered bone from Norfolk: evidence for very early human presence in Britain", *Archaeology International 2004/2005*, 14–17.
4. See O. Grøn, "Underwater landscapes: unrecognized cultural heritage and research resource", *Archaeology International 2004/2005*, 18–21; M. Mannino & K. Thomas, "A site for all seasons? Prehistoric coastal subsistence in northwest Sicily", *Archaeology International 2003/2004*, 31–34; T. Schadla-Hall, "The Vale of Pickering in the Mesolithic: uncovering the early post-glacial landscape", *Archaeology International 2000/2001*, 11–13; and K. Thomas & M. Mannino, "Mesolithic middens and molluscan ecology", *Archaeology International 1998/1999*, 17–19.
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13. The Azokh project is under the direction of Drs Tania King of Institute of Man, Yerevan, and Yolanda Fernandez-Jalvo of the Museo Nacional de Ciencias Naturales (CSIC), Madrid. The members of the team include Drs P. Andrews, P. Ditchfield, J. Murphy, P. Dominguez, L. Yepiskoposyan, V. Safarian, E. Allue, K. Hardy, and students from Nagorno Karabagh, Armenia, Spain and England.
14. The term "hominin" includes not only early modern humans but other related species on the human evolutionary lineage. For information on the Dmanisi hominin material see L. Gabunia, A. Vekua, D. Lordkipanidze, C. C. Swisher III, R. Ferring, A. Justus, M. Nioradze, M. Tvalchrelidze, S. Antón, G. Bosinski, O. Jöris, M. A. de Lumley, G. Majsuradze, A. Mouskhelishvili, "Earliest pleistocene hominid cranial remains from Dmanisi, Republic of Georgia: taxonomy, geological setting, and age", *Science* **288**, 1019–1025, 2000; and A. Vekua, D. Lordkipanidze, G. P. Rightmire, J. Agusti, R. Ferring, G. Maisuradze, A. Mouskhelishvili, M. Nioradze, M. Ponce de León, M. Tappen, M. Tvalchrelidze, A. Zollikofer, "A new skull of early *Homo* from Dmanisi, Georgia", *Science* **297**, 85–89, 2002.
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18. Marine isotopic stages refer to alternating cold and warm periods in the palaeoclimate. They are based on cyclical curves of oxygen isotope ratios (the proportions of the heavier and lighter isotopes vary according to colder or warmer climatic conditions), obtained from the analysis of the calcareous skeletons of microfossils from deep-sea core samples.
19. The project is in collaboration with Rafael Mora and Jorge Martinez-Moreno of the Universidad Autónoma de Barcelona, Spain.
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