

der and household consumables, particularly flour, sugar and tea. Some of these structures indicate particular seasonal use such as special stone pens (Fig. 11) for very young goat kids, used in late winter and early spring, and stone platforms (Fig. 12) used for laying skin bags that contain milk in the process of being turned into yoghurt, which are spring and early summer indicators. Modern plastic and iron products are changing local material culture and, for example, temporary movable structures made from metal grills are increasingly preferred for storing household goods and penning animals, and the stone platforms traditionally used for milk-processing are no longer always constructed nowadays. Iron pegs are replacing the sticks and stones formerly used to secure tent ropes. Black plastic pipes from old irrigation projects are used as building materials and are even used to make shepherds' flutes and children's swings

In addition to examining the structure and use pattern of Bedouin camps, sedimentological samples were taken from three camps, one where animals were housed within the main tent and two others

where the animals were sheltered separately. Samples were taken from hearths (Fig. 9), floors, sleeping areas, drainage gullies, and animal pens, as well as control samples from the vicinity of the camps. These will be examined to determine whether the different activities observed during fieldwork, such as the penning of animals and food preparation, are reflected in the ecofactual and sedimentological character of the samples. In future, these samples will be compared with sediments from arable contexts (from farms around Qriqora and on the plateau edge east of the Wadi Faynan), to attempt to identify analogues for sediments recovered from archaeological structures mapped by the survey teams to aid in their interpretation.

The 1998 and 1999 fieldwork has demonstrated that the modern Bedouin camps of the Wadi Faynan region have particular forms and functions that relate in part to their seasonal use and in part to the nature of the family group occupying them. The main features of Bedouin camps that appear to have long-term durability, that are recognizable as archaeological features in the landscape, are stone



**Figure 11.** A small abandoned, sunken stone pen used to protect very young goats at night. A single roof support, resting on top of the pen wall, remains. Scale: 1 m. (Photograph: C. Palmer).



**Figure 12.** *A stone platform on which skin bags containing milk were once placed. The milk ferments into yoghurt that can then be processed into storable milk products. Scale: 1 m. (Photograph: C. Palmer).*

structures such as platforms for milk-processing and sleeping, kid pens, and stone-lined hearths (cf. Banning and Köhler-Rollefson 1992). The disposal of rubbish and the process of abandonment remain to be investigated (cf. Banning and Köhler-Rollefson 1992; Simms 1988).

#### **Archaeological field survey within the ancient field systems (PD, PN)**

The primary focus for this part of the project in the 1999 season was the detailed refinement and verification of the evidence gathered in the previous two seasons from the main field system WF4, in preparation for the development of a comprehensive analytical GIS. However, it was first necessary to record

and sample the remaining two unstudied segments of outlying field systems on the north bank of the Wadi Faynan, WF442 and WF443. The approach taken to complete this task was the same as that used successfully in the other areas of field systems recorded in the previous seasons: the field walls and structures were planned and catalogued, and surface artefacts sampled using systematic field-walking techniques. Once this initial phase had been completed, any feature considered of special significance, in terms of structure or of water-management potential, was given a WF site number and recorded using the standard site survey methodology. The completion of this recording process, at the end of the first week, marked a significant event for the field project as a whole, for it signified the total recording of all fields in all the cohesive field systems to be found along the floodplain of the Wadi Faynan.

The remaining three weeks were spent reassessing and supplementing the evidence previously gathered from the main field system WF4, to evaluate the information collected in the earlier seasons and to try to correct any inaccuracies. We recognised that there was a danger that observations of similarities and differences in wall layout and construction could have increased, with increasing experience of such variability, during the course of the 1997 and 1998 surveys, so we needed to check the comparability of the observations being made by the field teams at the different stages of the recording process. Also, the field units of WF4, numbered in the sequence WF4.1 to WF4.20, had been defined to facilitate the organization and recording of a mass of data into convenient and manageable form, largely by using wadi lines as unit boundaries, and the danger with these divisions was that they incorporated implicit assumptions about the nature of the field system and, in particular, of any sub-divisions within it. In the 1999 re-study, therefore, the formal unit boundaries used in the survey were ignored and all relationships between walls and related features were re-assessed. Criteria used in this re-assessment included the morphological and structural integrity of the walls, materials used in their construction, the cohesiveness of field layout, and relationships between the archaeology and the terrain with particular reference to water flow. The end result has been the recognition, with a reasonable degree of confidence, of a series of related fields and features that seem to have operated at some time in the past as individual systems. Finally, it was hoped to make a detailed assessment of the action of water across the field system, working back from the present situation to the periods in the past when the field system was in operation. To understand the present situa-

tion required the accurate mapping of all minor tributary wadis and where necessary, the areas where gullying has developed. For the past, the field walls were assessed for evidence of sluices, spillways and constructional aspects, which, along with local topography, reasonably suggested the general direction of water flow through the field system.

Two coverages were created, using the corrected photogrammetric map of the field system as the base map. The first detailed the true relationship of field walls and structures to each other as they appear on the ground today, thus rectifying mistakes and omissions in the photogrammetric map. Mapping the operating units in this manner also allowed for the inclusion of recent changes such as the removal of walls and features. Significant details of, for example, wall construction, water management features, and burial or field-clearance cairns were also included on this map, to build a comprehensive picture of what similarities in all these features might signify a discrete operating unit. The second coverage outlined the action of water. This primarily consisted of mapping wadis and gullies with a particular focus on the flow of any potential channelled or runoff water.

Using the above approach, the majority of the original field units was covered (WF4.1–1.14, 4.16–17). Initial analysis is revealing patterning suggestive of several discrete and related clusters of fields within what had previously been regarded as a homogeneous field system. In unit WF4.1, for example, the easternmost unit of the WF4 field system, the re-study revealed the presence of two systems of fields: the fields within each of these two systems shared similar characteristics, and we think operated separately using different sources of floodwater from the adjacent tributary wadis flowing into the main Wadi Faynan. On the flatter floodplain area further down WF4 towards the west, there are indications of other distinct clusters of fields linked to tributary wadis by parallel wall systems.

The previous reports of the project have discussed and illustrated examples of these parallel wall systems, and proposed the hypothesis that they were probably water conduit channels, with a Roman/Byzantine date proposed on constructional grounds. With increasing circumstantial evidence that these parallel wall systems supplied water to groups of fields within the field system, we set out to test the water control hypothesis. Two of the suspected water conduits, which would have provided the majority of the water for a large field system located in WF4.6 and WF 4.7, were sectioned and planned at three locations. All three trenches revealed traces of clay lining, two of which exhibited various phases of construction and re-lining. In two

of the trenches there were also subterranean structural elements indicating well-built channels, on the same alignments as, and integrally constructed with, the structural remains visible on the surface (Fig. 13), suggesting that the systems of parallel walls visible on the surface are indeed the traces of ancient conduits. Furthermore, Roman pottery was found associated with the various contexts of construction and sedimentation. In addition, the sediment character and layering in all three trenches strongly suggest that the sediments are waterlain. Column samples were taken from all three trenches for laboratory examination of sediment characteristics and palaeoecological indicators. Samples were also taken from sediments forming the base of one of the



**Figure 13.** The north face of Trench 2, cut into an assumed water channel in WF4.6.47, the latter visible on the surface as two parallel walls between the ranging pole in the foreground and the right-hand tree in the distance. The section shows that the parallel walls on the surface overlie buried walls of an ancient conduit filled with water-lain sediments, which contain Roman pottery. (Photograph: G. Barker).

channels for OSL dating. If the laboratory results are useful, more of these important water-related features will be investigated in the following field season using the same methodology, to provide further insights into the organisation and operation of the WF4 field system and its constituent parts.

#### **Environmental investigations** (DDG, JPG, COH, SJM, FBP, AJT)

Previous field seasons in the Wadi Faynan have established the broad sequence of Quaternary deposits, started the process of detailed palaeo-environmental reconstruction, have monitored bioaccumulation of heavy metals through trophic levels, and initiated the dating of the event sequence through ten preliminary OSL dates funded by BIAAH (now CBRL) and five radiocarbon dates funded by the University of Huddersfield. A sequence of at least five major Quaternary fluvial aggradations has been recognized in the Wadi Dana and demonstrated to extend into the Wadi Faynan. Our mapping of the Quaternary stratigraphy started in the Wadi Ghuwayr in 1995 and has continued through the ensuing field seasons. Analysis of calcrete formation in the Quaternary deposits, based on more than 50 samples, has continued since 1995. Substantial palaeoenvironmental study of cored sediments has recognized, amongst other key findings, a wet early Holocene (*c.* 10,000–6000 BC) and thereafter a general drying to the present day (H.A. Mohamed, pers. comm.). Detailed investigations of the history of metalliferous pollution from natural processes as well as mining and smelting in the region started in 1996. These have revealed localized areas of profound and potentially dangerous metalliferous pollution. Interim results and maps are published in the project's earlier reports (Barker *et al.* 1997, 1998, 1999), and some further results from the geochemical programme are described below.

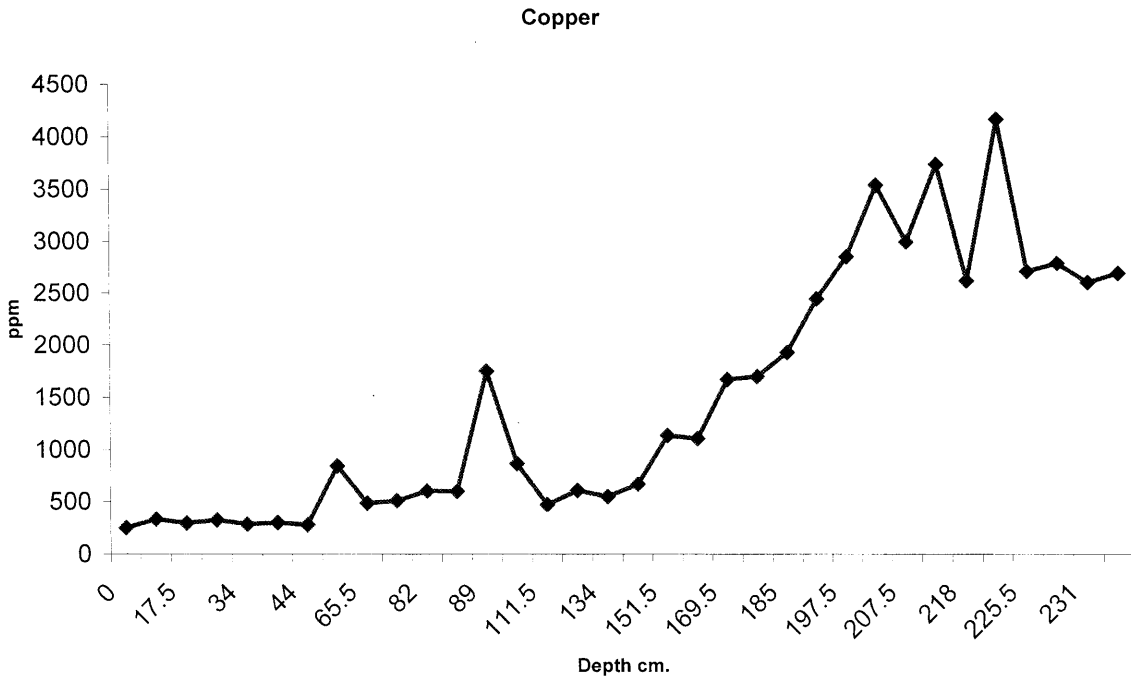
#### *Continued EDMA analysis of metal pollution*

The last report discussed preliminary studies of the geochemistry of sediments retrieved from behind the artificial barrage constructed immediately below and to the north of Khirbat Faynan, sediments spanning broadly the past 2500 years (Gilbertson *et al.* 1999). These data were generated by Energy Dispersive X-ray Microanalysis (EDMA), which is ideal for the rapid assessment of sedimentary material. The results reported suggested that significant concentrations of mining and smelting by-products remained in the environment, indicating significant

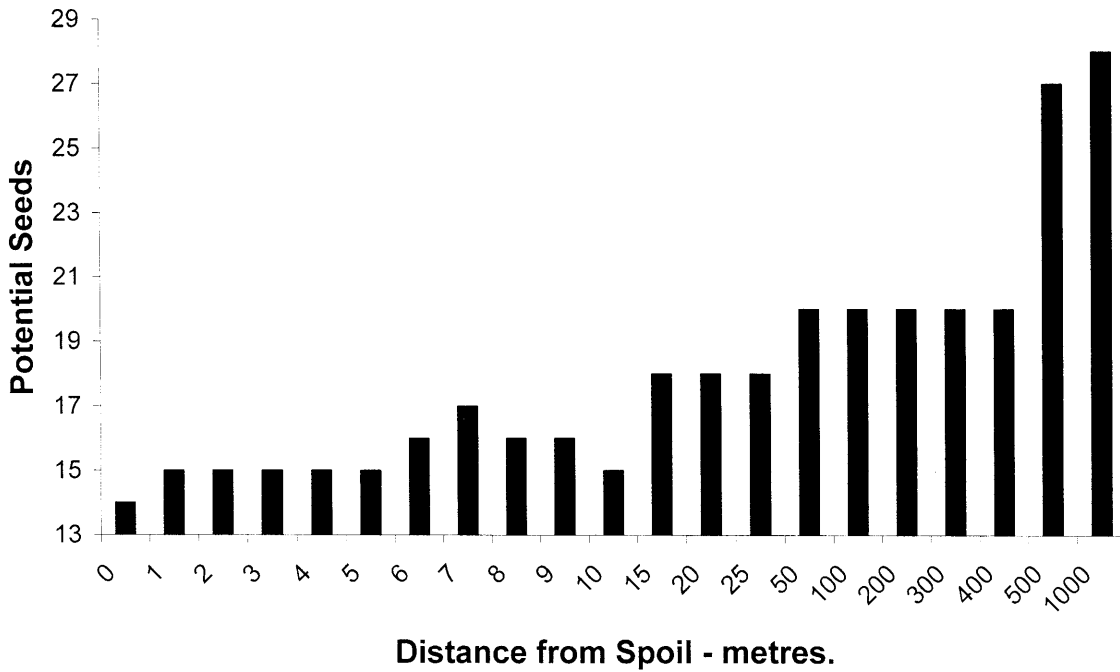
levels of industrial activity in the past as well as possibly posing an environmental problem today. As EDMA produces elemental data in the form of a ratio, the data are of limited value for the purposes of absolute comparison with other contaminated sediments and with figures reported in the literature. The sediments from the Khirbat barrage were therefore analysed using the Aberystwyth Inductively Coupled Plasma Mass Spectrometer facility (ICPMS). This analytical technique is highly accurate and the Aberystwyth instrument is capable of detecting absolute concentration down to parts per billion. (Full details of this procedure may be found in Perkins *et al.* 1993.)

The analysis has revealed a detailed record of copper production which may be tentatively interpreted as falling in two phases: the first phase, at a depth of 200–250 cm. below the present ground surface and dated upwards from *c.* 2500 BP, is characterized by the peak production of copper, and a second phase of smelting activity may be indicated between 50 and 120 cm. (Fig. 14). Figure 14 indicates abundant concentrations of copper far above typical crustal values: Krauskopf (1979), for example, suggested that concentrations above the crustal average of 22 parts per million could be considered enriched, and the sediments deposited in the Khirbat barrage can be seen to contain copper concentrated to several hundred times the average crustal value.

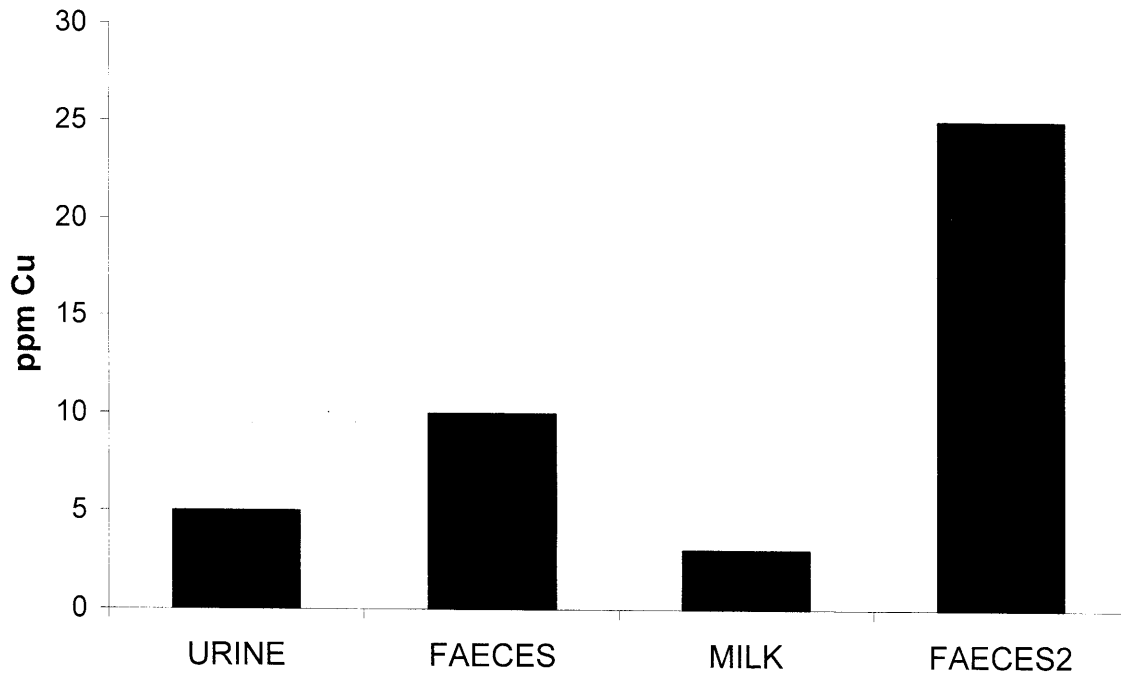
Such concentrations are typical of heavily-polluted industrial environments, and preliminary investigations suggest that this is indeed the case with respect to parts at least of the Wadi Faynan today, for the ancient metallurgical activity appears to have a clear pollution impact today. A clear ecological gradient in respect of barley seed potential is indicated on several transects from ancient spoil tips into apparently unpolluted areas (Fig. 15). Even in this arid region seed potential should be approximately 50–60 per plant, not the low levels indicated here. These data clearly beg the question as to the possible impact of the industrial activity on adjacent agricultural productivity when the mines and smelting sites were in peak production. Further research has concerned the potential accumulation of metals from the soil through the trophic levels. This was simply tested using copper sensitive papers. Goat milk, faeces and urine were analysed. The results of this preliminary investigation, shown in Figure 16, which are averages of 15 samples, indicate that grazing and browsing animals today are ingesting and excreting high concentrations of copper. Once again this begs the question as to the possible impact of metal accumulation on pastoralism in antiquity when industrial activity was at its height.



**Figure 14.** The distribution of copper (in parts per million – ppm) through the sediments that accumulated behind the Khirbat Faynan barrage. The sequence extends from c. 2500 years ago (far right) to the present day (far left).



**Figure 15.** The productivity of wild barley seeds, based on the mean of four transects from ancient spoil tips in Wadi Faynan.



**Figure 16.** Outline copper concentrations detected in modern livestock in the Wadi Faynan.

#### *The 1999 field season*

In the 1999 field season the following issues were addressed:

- testing previously established models of valley development, slope evolution and wadi alluviation throughout the research area;

- mapping and establishing type sites for the major wadi aggradation complexes in the wadis Dana, Ghuwayr, Shayqar and Faynan;

- geochronometric dating of the event sequence previously recognized, using OSL techniques for all these wadis;

- developing models for calcrete formation and their distributed variability;

- refining the Holocene palaeoenvironmental sequences, especially addressing gaps in the existing record;

- refining understanding of the long-term human/environment relationship through geoarchaeological techniques;

- producing predictive models for the location of Palaeolithic sites;

- integrating models of modern and recent Bedouin behaviour with outcrop pattern;

- continuing the programme of field sampling to determine the possible past biological and human impacts of the metalliferous pollution burden by examining the present contamination load of grazed

plants (including cereals) and domesticated animals, with some attention to the partitioning of metals within organisms. Sites employed for this investigation include both metalliferous (mining) spoil tips and smelting (slag tips) areas;

- ascertaining population parameters of ground-running invertebrates and the pollution load incurred in this trophic level through a series of pit-fall traps;

- further investigating the utility of barley as an ecological indicator of environmental quality.

These issues were addressed through a series of mapping and sampling programmes. A total of 40 OSL, 15 calcrete, 30 pollen, 39 polluted sediment, 40 bioaccumulation and 30 barley samples was taken. Regrettably, due to the drought conditions, it was not possible to progress the work on the metal localization of caterpillars, but it is hoped to advance this line of research in the next field season.

#### **The finds (RA, TEGR, RT with HP)**

##### *The lithics (TEGR)*

A total of 3771 worked pieces was examined during the 1999 season. The sample derives from a total of 692 collection units, including both 'pick' and 'grab'

collections from the field system (see Barker *et al.* 1998 for the description of this component of the project's methodology), the transect line-walking, and the units mapped in the grid-square survey. Most of the samples are small, with only 36 collection units yielding more than twenty pieces. Consequently, the caveats about interpretation stated in earlier reports need to be re-emphasized: material has been subjected to high energy transport, dramatic thermal changes and field sampling, all of which limit the level of analysis and confidence of interpretation. Despite these limitations, however, it is possible to discern a few broad trends in the material.

Material has been recorded in the same way as in previous seasons: blank type (flake, blade, flake-blade, and bladelet); blank form – primary, secondary, and tertiary; platform type – plain, dihedral, cortical, lipped, crushed, and prepared; raw material type; retouch presence, location and form; and edge damage characteristics – snaps, micro- and macro-flaking, nibbling, edge crushing, impact fractures, and rolling. Certain other technological characters have also been studied, including the frequency of plunged, hinged, multiple-bulbed, sired and janus pieces. Cores were recorded in terms of not only the main types (Levallois, disc, opposed platform, and so on), but also the number of platforms and the directions of flaking, in addition to the type of blanks removed and the number of blanks removed. Retouched tools were also classified according to typological class. Counts were also made of the amount of utilized pieces, shatter, and burnt fragments. All retouched tools were drawn.

The numbers and percentages of the tool types recorded in 1999 are shown in Table 1. It can be seen that various types of scraper dominate the collection, together with truncations, end-scrapers, knives and sickles, denticulates, followed by borers, piercers and backed blades. In terms of chronology there is a number of pieces which could fit into a Mousterian context: a Mousterian point WF739, double raclours from WF775, WF660, WF737, and WF4.18.13, and raclours from WF737, WF542, and WF1249. There is also an elongate Mousterian point from WF4.18.13, a scraper on a Levallois flake from WF484, and a Levallois point from WF705. A Levallois core was obtained from the line walking (3391750–3392000) and there was a biface fragment from WF690 which could pre-date the Mousterian. This shows a low intensity of Pleistocene activity in the Wadi Faynan area. The frequency of pieces is too low to identify any Mousterian 'sites', but the survival of such open air sites in this area is likely to be extremely limited except in pockets where relevant sediments are protected.

**Table 1.** Numbers and percentages of tool types recorded in 1999.

	number	%
Sickles	23	7.9
Knives	23	7.9
Scrapers	107	36.8
Denticulates	12	4.1
End-scrapers	28	9.6
Burins	5	1.7
Arch-backed blades	2	0.7
Backed blades	10	3.4
Piercers	10	3.4
Truncations	30	10.3
Borers	11	3.7
Retouched blade	8	2.7
Retouched flake	8	2.7
Bilaterally-retouched blade	6	2.1
Elongate Mousterian point	1	0.3
Fabricator	1	0.3
Notch	1	0.3
Levallois point	1	0.3
Mousterian point	1	0.3
Biface fragment	1	0.3
Multiple tool	2	0.7
<b>Total</b>	<b>291</b>	

The remaining material cannot reasonably be assigned a specific date beyond ascribing it to a general mid-Holocene phase. Borers, fan-shaped scrapers, sickles, arch-backed blades and occasional microliths could all date anywhere from the Pre-Pottery Neolithic A to the Early Bronze Age. Unfortunately, chronological definitions are dependent upon the relative frequencies of tools rather than the presence and absence of tools, so field surface collections are not well suited to dating by lithics. More blade-based assemblages characterized by a lack of the raw material that was apparently favoured during the Early Bronze Age and which could, therefore, be earlier, were found at the following units: WF424.15, WF4.29.7, WF4.17.1, WF442.24, WF780, WF 643, WF615, WF1331, and WF1252. Early Bronze Age raw material was found at WF4.18.19, WF371, WF421, WF686, WF800, WF824, WF501, WF566, WF4.13, WF116, WF640.2, WF750, WF1289, WF585 and WF615. This distinction is based on the prevalence of fan-shaped scrapers on a dark brown tabular flint with an orange cortex assumed to be of an Early Bronze Age date, but we need to remember that such reasoning can be dangerously circular. The hypothesis will need to be tested by correlating the lithic lists with the ceramics when the analysis of pre-historic pottery has been completed.

Axes, chisels, and adzes were absent and no fragments of such pieces were observed despite being specifically sought. No projectile points were found during the 1999 season.

Examination of the recovered cores shows a clear dominance of single platform and direction flaking (70%) aimed at producing flakes (60.7%), blades (1.2%), blade-flakes (3.7%) and bladelets (3.7%). There was a single Levallois flake core showing a single major flake removal and truncated scars resulting from platform preparation. The management of platform edges and the flaking surface does not, however, appear to have been important, for only two core tablets have been recovered and only 26 (0.96%) platforms were prepared out of a total of 2720 blanks with platforms. Plain platforms were the most common type (2182: 80%), with cortical and crushed platforms present in about the same frequency (240: 8.8%; and 237: 8.7% respectively). The lack of specialized knapping is reflected in the blank frequencies: flakes (2396: 67%) predominate over blades (559: 15.7%) and blade-flakes (524: 14.7%). Bladelets were rare, although selection of blades and bladelets for tools is apparent (115: 39.5%). The frequency of crushed platforms, multiple bulbs, and silet flakes suggests controlled direct hard-hammer percussion. No lipped platforms were seen. There were no crested pieces and blade cores were rare (only two out of 79). Bladelets were rare, but three finely-worked bladelet cores were recorded. No microburins were found: deliberate snapping was the main technique for sectioning bladelets. Two retouched truncated bladelets were recovered. The edge-damage patterns were the same as those recorded previously, but it was noticeable that material from outside the field system was less damaged, and occasionally even fresh pieces were collected.

Although there are limitations to what can be inferred from the collection, it is clear that some patterning is emerging. Lithic scatters indicative of sites are being found outside the area of the ancient field systems. In contrast to previous seasons, four sites with collections larger than 80 pieces have been located and sampled. Where such collections have been made, material is less damaged by post-depositional processes and a significant amount of debris, as opposed to tools, is present. This pattern matches more closely that to be expected if locations with *in situ* knapping are being studied. In terms of tool types and utilized pieces, those from localities outside the ancient field systems are relatively blade-rich and tool-poor. Sickles, despite being a blade-based tool type, are less frequent in these collections.

The problem of differentiating period groups within the general mid-Holocene phase remains, but is most likely to be tackled effectively by further study of the extra-field system areas. Gridded survey over specific scatters may also help to answer some of these chronological problems.

#### *The pottery (RA and RT, with HP)*

Following the initial assessment season during 1998, systematic study of the pottery was undertaken this year. RA was responsible for the prehistoric material (at present identified as belonging to the Bronze and Iron Age), and RT and HP for the Nabatean to early Islamic ('classical'). By the end of the 1999 field season all of the 1996–1998 prehistoric pottery was catalogued, together with the c. 13,000 classical sherds from field units WF1–6, 18–19 (both the 'pick' and 'grab' samples from the survey). Pottery of all periods was recorded on the same *pro forma*, designed to target specific broad questions, in order to ensure a compatible minimum level of information for all the material. The acceptable minimum level was established as count and weight of all sherds for the two broad divisions 'prehistoric' and 'classical'. However, within both horizons a more detailed breakdown is available by count. For example, depending on the nature of the sherds involved, count data for the classical period may be available for Nabatean/Early Roman, Late Roman, Byzantine and early Islamic, although in many cases it cannot be refined beyond 'classical'. The purpose of quantification is to provide compositional breakdown of the material by period, and in this way to evaluate whether any patterning in field system use exists through time.

#### Prehistoric pottery (RA)

During the 1999 season, efforts were concentrated on examining the remainder of the pottery from the WF4 field system, the recording of the prehistoric pottery from Units WF4.7–4.20 being completed. In addition, a start was made in examining other WF sites outside the main field system. In general terms the pottery from WF4.7–4.20 was remarkably similar to that recorded in previous seasons, and consisted overwhelmingly of classical and later pottery, with only a few fields being exceptional to this rule (see below). The prehistoric material continued to fall into two primary categories: pottery presumed to date to Early Bronze Age I (EBA I), and a limited amount dating to the later Iron Age (Iron II). The largest concentration of Early Bronze Age pottery came, as was expected, from WF4.13, the area of the WF4 field system where excavations by Wright



*et al.* (1998) have uncovered the remains of significant structures spread over a large area dating to this period, designated site WF100. Most of the ceramics collected in our 1996 survey of this unit were of a fabric and type associated previously with an EBA I date. Perhaps more surprising, however, although also noted by Wright *et al.* (1998, 37), is the fact that the spread of the Early Bronze Age pottery is much more extensive than early transect surveys indicated: significant amounts of Early Bronze Age pottery have now been identified in adjoining units in the WF4 field system, notably WF4.12, WF4.14 and WF4.17, with smaller quantities also in WF4.11 and WF4.16.

In general terms the best preserved diagnostic material consists of large ledge handles, often finger impressed or indented, which come from large open bowls, occasionally with rims attached. Some of these handles may come from larger closed storage containers (pithoi), although indications of larger vessels in the assemblage are difficult to ascertain from the sherds, which are often broken into small pieces and heavily abraded. Rims of other vessels are rare in the collections, as is evidence of pottery from the later Early Bronze Age (EBA II–IV). It needs to be emphasized, however, that at present the vast majority of the Early Bronze Age pottery can only be identified by fabric and not typology, since relatively few diagnostic sherds have been found. This factor makes the precise identification of the pottery to the Early Bronze Age difficult at best, as this material could easily range from the Pottery Neolithic through to the end of EBA I, and a major priority of further study of the prehistoric pottery from both within and outside the field system must be to attempt to establish if there are fabric and surface treatment distinctions that will allow reasonably reliable fabric sequences to be established that are specific to particular prehistoric periods.

Within the WF4 system there continues to be a consistent number of diagnostic sherds which at present is being attributed to the Iron Age. The range of Iron Age material in the Faynan area was discussed in the previous report (Barker *et al.* 1999, 282–5), but in general terms the Iron Age pottery from the western end of the field system is likely to be related to late Iron Age activities, and not to be associated with the potentially-early Iron II pottery reported last year from site WF424, the area of structures, industrial activity and fields immediately below Khirbat Faynan. A final assessment of this Iron Age material will only be possible once the entire range of material can be assembled and studied together, but it is hoped that ongoing excavation work in the western Faynan drainage, where a large

amount of Iron Age pottery and other finds have recently come to light (Adams and Levy 1999; Levy *et al.* 1999), will assist in placing the prehistoric pottery from the Wadi Faynan Landscape Survey in a better context.

Perhaps the most intriguing aspect of the prehistoric pottery analysis in the 1999 season has come from examination of the WF sites outside the principal field system WF4. Although only about one-third of this pottery has been examined to date, the percentages of early prehistoric pottery are substantial, and suggest that, in addition to the concentrations of Early Bronze Age pottery in Unit WF4.13 and surrounding fields, the prehistoric landscape was very widespread and included outlying areas which have to a large degree remained free of the destruction caused in the main field system by Nabatean/Roman/Byzantine and later farming activities (see above, Between Faynan and Fidan). Many of the WF sites examined which have prehistoric pottery may be related to structures and orthostatic wall lines which may in fact prove to be of an early date. It is perhaps too early to be definitive in this regard, but it is clear from the pottery examined this year that the overall picture of prehistoric occupation, largely from the Pottery Neolithic through the end of EBA I, has yet to be adequately defined. Further clarification may result in the definition of a very large and densely settled landscape throughout these periods.

#### Classical pottery (RT, with HP)

Initial quantification as described above has already confirmed, as expected, that ‘classical’ pottery (that is, almost exclusively, Nabatean, Roman and Byzantine pottery) dominates in the south-east quadrant of the WF4 field system nearest Khirbat Faynan (WF1) and is virtually absent in the north-west quadrant. The use of both count and weight in the quantification allows average sherd size to be calculated, which should contribute to our understanding of the depositional processes for the region. Presently, average sherd size for the classical period ranges between six and ten grammes for the ‘pick’ samples, with nine of the ten units measuring between six and seven grammes. It may be that a greater contrast exists between the material from the field systems and the WF sites, rather than between the different field system units.

Within the broad chronological groupings, pottery types are recorded by both fabric and form. For the classical periods, these are itemized within the normally-accepted functional groupings: fine wares, table wares, cooking wares, and amphorae. In this

way a detailed fabric and form series is being constructed for both the local and imported wares. At present, most of the identifiable types belong to the later part of the classical sequence, indicating intensification of occupation during this period. As reported previously (Barker *et al.* 1999, 283–6), the majority of classical pottery is thought to be regional in manufacture, although a range of imported types can be identified in sparse numbers, mostly from the eastern Mediterranean. Of particular interest this year is the identification of growing numbers of both coarse wares and amphorae associated with production at Aqaba (Melkawi *et al.* 1994), which provide important evidence of pottery being supplied to the region from Transjordan in the Byzantine and early Islamic periods.

During the final season, in 2000, the remainder of the pottery will be catalogued for both the field system and the WF sites, and the illustrated typology will be completed.

### Conclusion (GWB, DJM)

The 1999 season made substantial progress in all five of the objectives defined for the final two seasons of the project (1999 and 2000). The first objective, the survey of the area outside the field system WF4, was completed thanks to Herculean efforts by the field team working in exceptionally demanding conditions and rugged terrain. Although much more analysis of the data is required, involving their incorporation into the project GIS and integration with the structural information recorded within the field system and by other Wadi Faynan sub-projects, it is clear that the methodological approach adopted has achieved its main objectives. A thousand 'sites' have been recorded. The considerable number of new prehistoric sites, many of them probably dating to the Early Bronze Age, represents a major advance in knowledge of the study area. Variability in these sites is suggestive of a complex landscape with clearly defined zones for agricultural, pastoral and metallurgical activities – the extent to which these were or were not integrated is clearly a significant research question we hope to be able to address in the future as the data from within and outside the field systems are combined. Petrographs, especially images of ibex pecked onto boulders, cluster in the south-east sector of the survey area, especially at the entrances to the wadis that lead up to the plateau. Similar complexity is emerging for the classical landscape too: for example, several Nabatean/Roman farmsteads are located on promontories along the southern margins of, and overlooking the WF4 field system,

and are presumably associated with it, but the survey has mapped another series of small settlements high on the gravel fans to the south, at the foot of the mountain wall, not associated with field systems. Whilst further analysis can only follow from the study of the finds, it is already clear that the prehistoric and classical landscapes around the field system were far from uniform in their archaeological patterning and that the exploitation of the different environmental zones across time, and the extent to which they have articulated together, have varied considerably. We can now begin to consider long-term landscape and settlement change in the Wadi Faynan at a new level of precision and knowledge. In the final field season in 2000, it is intended to carry out detailed study and recording of a representative selection of the sites mapped in the 1999 fieldwork.

The ethnoarchaeological survey, the second focus of the season, has recorded all recently-occupied Bedouin sites within the survey area, and made detailed studies of a representative sample. Clear differences have been established in settlement location and architecture, and related to factors such as seasonality and gender-based behaviours. Laboratory studies of sediment samples taken from recently-occupied Bedouin sites will now proceed, building on informant descriptions of site use, to attempt to isolate archaeological signatures in sediments of behavioural variables associated with pastoral land use. The same approach is to be extended to arable settlements. These studies can then be applied to sediment samples from some of the archaeological sites recorded by the survey teams within and outside the field systems.

With the primary recording now completed of all the field systems in the survey area, their detailed study, the third focus of the season, is revealing divisions within the system variously reflecting functional and socio-economic patterning. The 1999 investigations have also provided positive evidence from test excavations of putative water channels in support of the hypothesis advanced in earlier reports that an important component of Roman floodwater engineering in the Wadi Faynan was the capability to channel water long distances over very low-angle slopes, a technique that seems to have been critical in the development of a coordinated farming strategy for the entire field system.

The fourth objective was successfully achieved, the completion of the principal fieldwork in the palaeo-environmental programme, generating a large number of sediment and biological samples for analysis for palaeoecological indicators and absolute chronology. The continued programme of EDMA analysis of sediment geochemistry is providing intriguing point-

ers to the likelihood that environmental pollution affected the Roman-period population of the study area both directly in terms of health and indirectly through its negative impact on crop farming and pastoralism. Finally, substantial progress has been made in the finds studies, so that the study of all remaining categories of material from the fieldwork programme can be completed in the final season in 2000.

In sum, the team's integrated, inter-disciplinary, approach to landscape analysis has laid firm foundations for the completion of the fieldwork in the 2000 season. The indications from our preliminary studies are that the data we have accumulated will allow us to model a holistic landscape history of the Wadi Faynan over the past 10,000 years in terms of, for example: the different effects of climatically-induced and humanly-induced environmental change; the development of arable, pastoral and industrial activities and the changing interactions between these three sectors of land use; human responses to their perceptions of environmental degradation; and the balance between internal and external dynamics as agencies of social and economic change. Understanding this landscape history in detail, in terms of factors such as the scale and duration, transience or irrevocability of different kinds of human impacts, will also make an important contribution to the study of dryland settlement history and desertification processes more generally.

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