MAPPING AND PRELIMINARY SURVEY IN WĀDĪ FAYNĀN SOUTH JORDAN

by

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Introduction

Wādī Faynān is located on the east side of the Wādī 'Arabah cutting down through the eastern escarpment of the ash-Sharā Mountains, about half way between the Dead Sea and the Gulf of 'Aqaba (Fig. 1). The elevation of the wadi bed within the study area drops from c. 300m to 140m asl and the climate is hot and dry in the summer while the winters are cool with occasional rain. However, winter rain on the highlands causes the wadis to flow intermittently and permanent springs in the area make this seemingly inhospitable area far more habitable than it would appear to be. A reliable supply of fresh water, coupled with the largest concentration of copper deposits in the southern Levant, have led to the human exploitation of the Faynān area from the seventh millennium BC until the present day leaving traces of a wide range of human activities. The most prominent remains are the settlement of Khirbat Faynān, dominating the beginning of the broad bed of Wādī Faynān which is itself covered by an extensive field system, testifying to planned agriculture and water management. The copper deposits were first exploited in the Neolithic period (c. 8500 - 4500 BC) while mining and processing activities stretched from the Chalcolithic (c. 4500 - 3300 BC) until the Byzantine period (324 - 640 AD) when they seem to have stopped. Metallurgical activity reoccurred briefly during the Mamluk period (1250 - 1516 AD), when iron rather than copper seems to have been produced (Hauptmann 1987; Hauptmann, Begemann *et al.* 1992).



1. Location of Wādī Faynān.

Previous Work

Beginning in the late 19th century the region has been visited and described by various scholars, starting with Lagrange (1898 and 1900) who was the first to relocate the ruins of Faynān in 1897 and to associate them with *Punon* mentioned in the Bible (Numbers 33, 42-3) and *Phaino* reported by Eusebius as the place that Christians were sentenced to work in the mines and there suffered martyrdom during the persecutions of the early fouth century (Schick 1996). Musil (1902), Frank (1934), Glueck (1934) and Kind (1965) followed with further survey work done more recently by Raikes (1980), King (1989) and MacDonald (1992). From 1983 onwards the German Mining Museum at Bochum undertook a major research project to study ancient cop-

per mining, ore exploitation and metallurgical technology in the region under the direction of A. Hauptmann and G. Weisgerber (Hauptmann 1987). This work included a number of excavations and test trenches at mines and other sites in the area (e.g. Khirbat an-Nuhās, Barqa al-Hetiye). The Department of Antiquities, in collaboration with the Bochum project, excavated two Neolithic sites Wādī Ghuwayr 1 and Tall Wādī Faynān (Najjar 1990 and 1993). In addition, Adams carried out work at Hamr Ifdān, Wādī Faydān 4 and some other sites (Adams 1991, Adams and Genz 1995). In 1994 the Centre for Field Archaeology (University of Edinburgh) began the Ḍānā Archaeological Survey project on behalf of the Royal Society for the Conservation of Nature in the area adjacent to the Wādī Faynān (Finlayson and Baird 1995). There have been a number of other environmental research projects in connection with the Ḍānā Reserve.

The Wādī Faynān Project

The BIAAH began a long term research project of the area in 1994 and the present report covers phase 3 of the work.

Phase 1 of the project (August 1994) established control points for the creation of an accurate photogrammetric map of the Wādī Faynān covering an area of 20 km^2. The photogrammetry, using low altitude aerial photographs, was carried out by Leoni Blank, University College, London.

Phase 2 (December 1994) was the detailed computerised planning of the South Cemetery (WF3) using Total Station survey equipment and data transfer to Autocad to produce a digitised map of the site.

Phase 3 (March 1995). The twofold objectives of this season were to make a digitised map of the surface remains of Khirbat Faynān and an evaluation of the archaeological potential of the area covered by the photogrammetric map. The mapping was achieved using Total Station survey equipment with PenMap and data transfer to Autocad. The general evaluation was carried out by transect survey, a closer look at the extensive field system, an overview of the area by visiting selected sites and a specific evaluation and test excavation of the South Cemetery. The results of the work on the South Cemetery will be included in a forthcoming article (Findlater forthcoming). The work relied heavily on aerial photographs which clearly show many surface features. Also, a record of the water system on the south bank of Wādī Ghuwayr was undertaken with a view to the potential for possible refurbishment.

Khirbat Faynān

The present phase of work was organised in conjunction with the preliminary surveying of the Wādī Faynān photogrammetric area. The aim was to begin the detailed planning of the visible surface remains on Khirbat Faynān (WF1) in order to prepare for future archaeological work on the site.

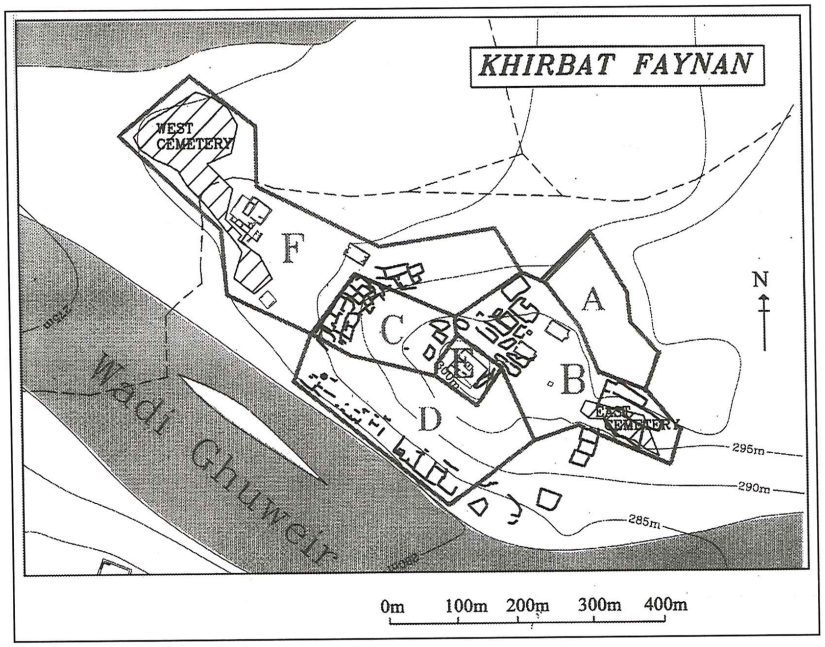
Although sketch plans have long existed (Lagrange 1898; Musil 1907; Frank 1934) showing the positions of Churches 1, 2 and 3, the so-called 'Monastery' 6, the 'Roman' tower 9 (Musil1907), the dam and the boundary of the Khirbat, no comprehensive plan had been compiled (*numbers refer to structure nos.* on Figs. 4:1-2). The visible remains appear to be a large unvariegated mound of orangey yellow, heavily eroded, cut sandstone blocks. On closer inspection, this gives way to fragments of walls visible amongst the tumble and the occasional building whose wall edges can be traced out with difficulty along the rubble ridges formed by their collapse. This section is a description of the remains as they appear on the surface and not a study of the development of the site.

The Plan

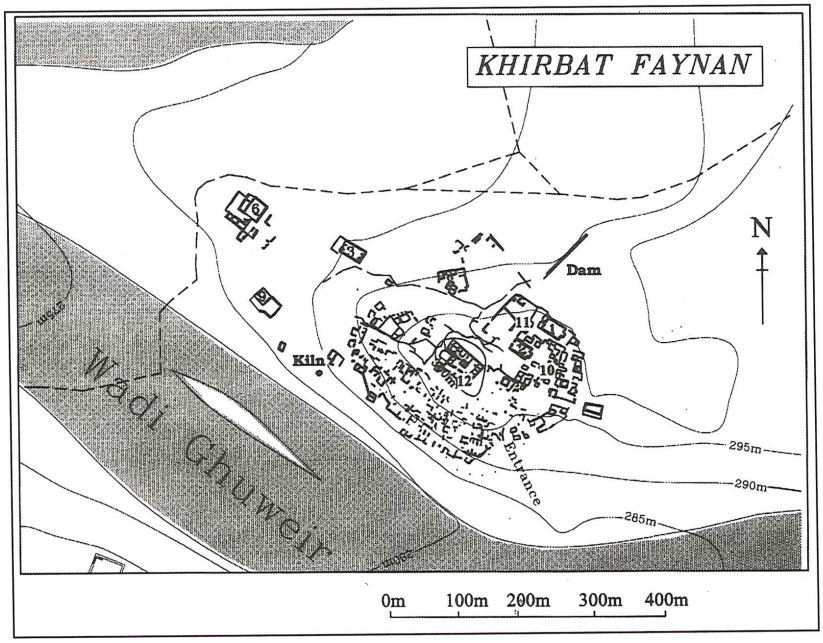
After initial study of the Khirbat, it was

decided to create 5 'layers' within the computerised plan on which to place different kinds of physical features (Figs. 2:1 and 2). The layers are as follows:

1. *Definite walls.* Wall lines with at least one edge visible along some part of their length. Walls and buildings of all periods were recorded together, even though many of them represent later reuse (Fig. 2:2).
2. *Possible walls.* Walls which were indicated by lines of rubble collapse, for which no wall face could be found. The measurements were taken at the assumed centre of the walls (Fig. 2:2).
3. *Terraces.* The terraces can be divided into two kinds: those within the area of urban development and those surrounding it. Most of those within the urban area are located on the north-east and north slopes and are smaller than those which surround the Khirbat (Fig. 2:1).
4. *"Lanes".* This included all tracks and roads on and around the site, both ancient and modern. On the site they seem to go from one 'terrace' to another, but



2:1. Khirbat Faynān: terraces, cemeteries and area letters A-F.



2:2. Khirbat Faynān: buildings and tracks.

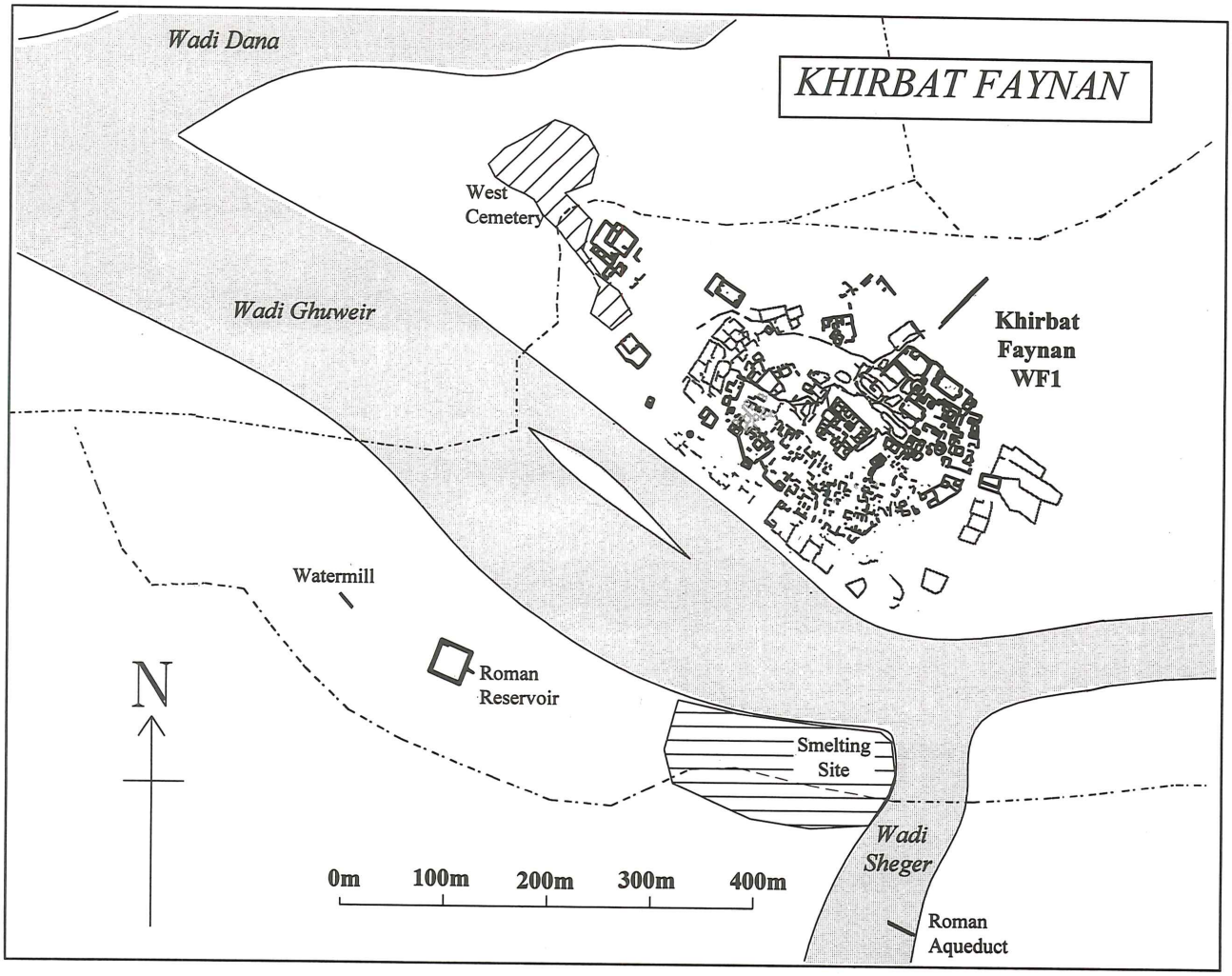
this may only indicate that these 'terraces' make an easier means of crossing the site than the mounds of building rubble (Fig. 2:2).

5. *Smelting and Cemeteries*. This layer was used to record the two cemeteries on the site and the industrial slag heaps from copper smelting in the area (partly shown in Fig. 2:1).

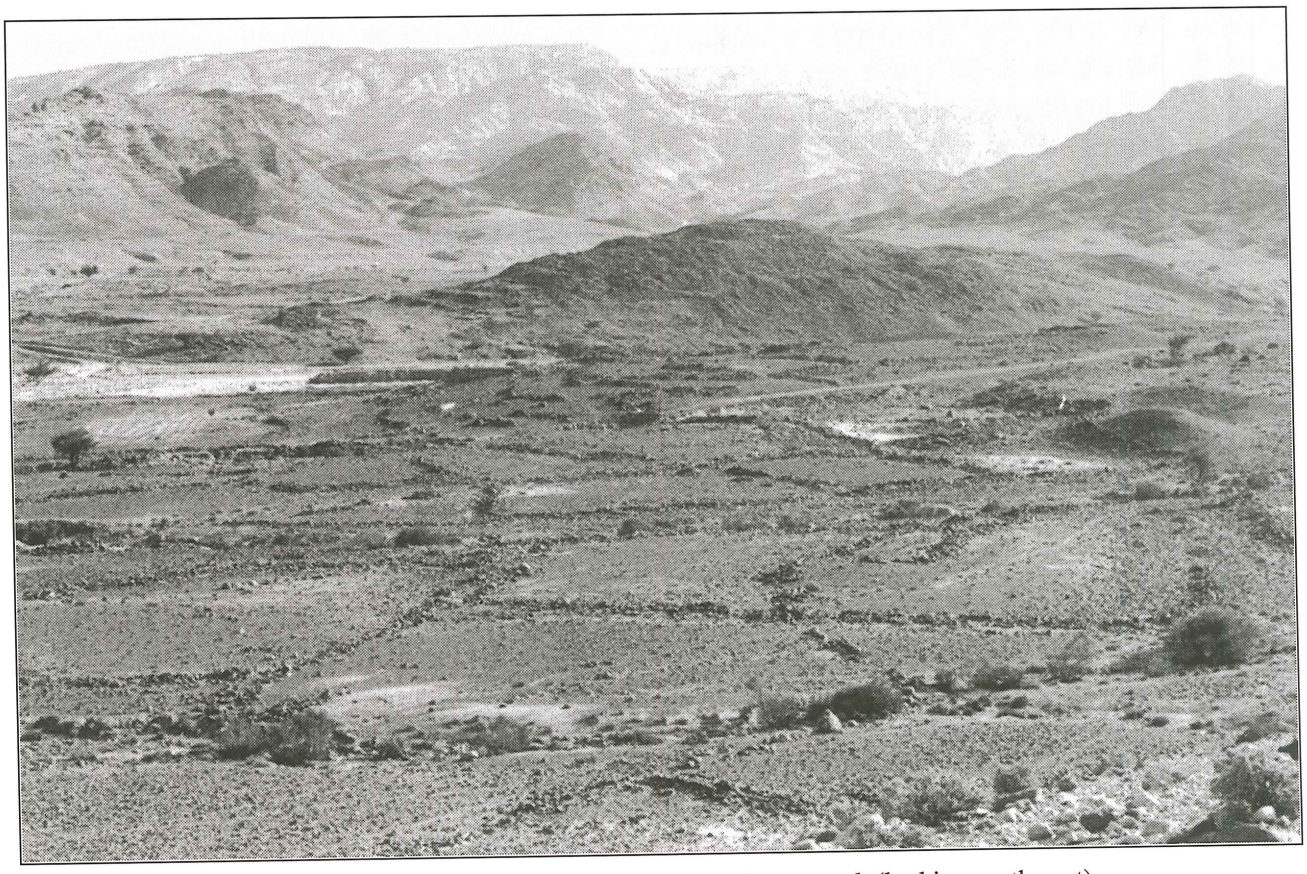
Description of Khirbat Faynān

Khirbat Faynān is situated at the confluence of the Wādī Ghuwayr and Wādī Ḍānā on a rise at the tip of a granitic ridge (Fig. 3 and 4). The site covers an area of approximately 70 000m2 (c.500m north-west to south-east by c.250m north-east to south-west) and it forms a hill with steeply falling sides, the summit of which is at 306m asl. It is connected to the east, via a saddle, to a natural terrace that gradually climbs eastwards to meet the sharply rising ash-Sharā mountains.

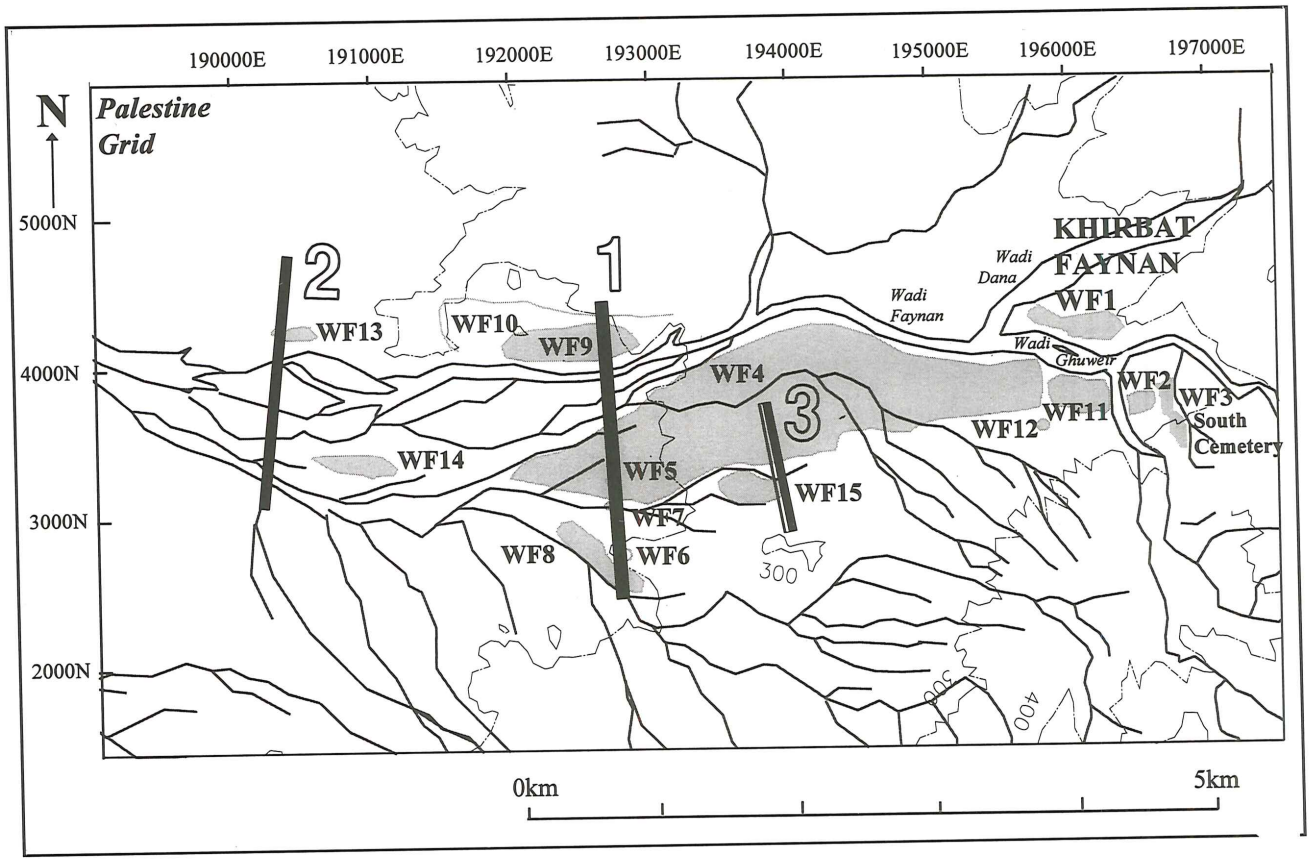
The development of the Khirbat depended, in part, on the surrounding resources and land use. The main field system (WF4) is across the Wādī Ghuwayr to the west and the perennial springs are further up the wadi to the east. There is a large smelting site and a number of structures (WF11) on the opposite bank of the Wādī Ghuwayr to the south (Fig. 3), the South Cemetery (WF3) to the south-east and another area of settlement with structures visible but as yet uninvestigated just south of the Wādī Ghuwayr and east of the Wādī



3. Khirbat Faynān and the water system.



4. Khirbat Faynān, with the eastern end of the field system in the foreground (looking north-east) .



5. Wādī Faynān: location of sites and survey transects.

Ushaykir (WF2; Fig. 5). The copper mines are in the hills both to the north and south and there are numerous processing sites of different periods within 500m of the Khirbat.

In order to explain the site it was divided into areas A-F (Fig. 2:1); A and F being functional divisions and B to E subdivisions of the urban area.

Area A is the dam and its holding area (approx. 5000m^2). The dam itself consists of a wall (approximately 65m long x 2m wide) constructed across the mouth of the gully directly north-east of the Khirbat. Along the inner edge of the dam wall there are fragmentary remains of what appears to have been a walkway 0.80m wide. The reservoir, now completely silted up, seems to have been fed only by the run-off from the high ground to the east and from the Khirbat to the west. There is slag (which is probably medieval in date) abutting the outside of the dam wall that partly spilled over into the inside. On the east side of the dam there are remains of graves or water troughs cut into the bedrock above the level of silting.

Area B is the east slope of the Khirbat above the dam. Church 1 measures 25m x 14.7m and still has 2 reused Nabataean capitals and 17 column drums visible amongst the rubble. The apse is constructed within a trapezoidal exterior wall. Church 2 measures 23.4m x 13.6m, with no visible remains of columns or capitals and the apse is constructed within a rectangular exterior wall. These churches, together with what appears to be a tower (11) between them and a second similar tower (10) on the higher ground to the east, are the most prominent buildings in this area. The area to the north-west and south-west of the churches (Fig. 2:1) originally had buildings but was later levelled and terraced. The terraces are small (8m x 20m at most), irregularly shaped levelled areas cleared of stones with retaining walls on the lower and upper slopes. Several of them have been extended at some stage, by tipping and levelling rubble beyond the initial terrace wall on the lower slope. They appear too small for agricultural use (although some of them have later circular rubble livestock pens built on them). The position of these cleared areas and terraces suggest that Churches 1 and 2, if not actually in use at the time, were still standing to a substantial height when the terraces were created. To the east of the churches there are numerous buildings and rooms with rubble collapse in them and these form a continuous line of buildings along this edge of the Khirbat. Area B also includes the high ground on the east edge of the Khirbat, on which lies a single structure (19.5m x 9.5m) probably associated with the adjacent area of terracing. Partly within the remains of this structure and one of the terraces, lies a small graveyard (East Cemetery, Fig. 2:1). Sixty graves were recorded although the cemetery probably holds over 100 burials. They are generally oval stone-lined graves oriented east-west with plain headstones and occasional footstones. No inscribed stones were observed. The graveyard also slightly overlaps the slag remains from a smelting site to the east which has been dated to the Iron Age by Bochum Mining Museum (Hauptmann, Begemann *et al.* 1992).

Area C, located on the western edge and slope, has undergone considerable reuse and clearing. It has the clearest 'lanes' which sometimes run in between visible wall lines. The terracing below the buildings, towards the west, seems to have been constructed initially as a single unit, with later additions to the north and south. Subsequently some rough walling was added to hold back the rubble collapse of buildings from covering the upper terrace, but these walls are not an integral part of the terraces.

Area D covers the steep south slope above the Wādī Ghuwayr. On the east side of the area the buildings are on two high points, the eastern most of which overlooks an entrance to the Khirbat which is one of

the few breaks in the walling around the exterior of the Khirbat. These walls are not primarily defensive in nature but are the exterior walls of buildings and courtyards. The central and west side of area D was terraced in three levels with buildings constructed down the slope and across the level ground. Some rooms, especially on the western side, are filled with building collapse (and very little soil) that includes several door lintels with inscribed crosses. The walls running uphill are in relatively good condition, but the cross walls, where visible, are bowed out by the weight of collapse. It is interesting to note that smelting was carried out within the Khirbat itself before the buildings collapsed, as indicated by tipped slag which is partly covered by building rubble along the south edge of Area D. From the edge of the Khirbat down to the Wādī Ghuwayr there are a series of enclosure walls running down steeply sloping ground. At the western end, just outside the main urban area, there is a circular kiln built of sandstone blocks that show signs of vitrification on parts of the inner face.

Area E, the summit of the Khirbat, is occupied by a single building complex (12) of approximately 900m2 that has been divided into rooms attached to the inside of the perimeter wall. There is some open space in the middle of the complex in which stands a small square structure slightly to the north of centre. On the west side, the exterior the complex has been added to and so heavily reworked on the south side that the original wall line is difficult to follow. The main entrance appears to be through a gate (2.7m wide) on the south wall near the south-west corner but there is also a smaller entrance in the west wall. The ground falls away steeply on the north, east and south sides.

Area F is to the west of the Khirbat. In the centre of this area is a depression bounded by ground 2-3m higher on which three structures have been built :- the 'Roman' tower 9 (13.8m x 12.5m) on the south side above the Wādī Ghuwayr, Church 3 (25m x 14.3m) and the 'Monastery' Church 6 (approximately 28.8m x 18m) which was partly rebuilt during Islamic times, possibly as a khān. In 1898 a Greek inscription was found dating Church 6 to c. 580 AD (Vincent 1898). The West Cemetery seems to be grouped around Church 6 and has approximately 300 burials (oriented east-west), about 60% of which are already robbed. Some of the graves are of similar construction to those found in the South Cemetery (WF3) with sandstone headstones occasionally inscribed with crosses and sandstone capstones covering the body. These can be dated to the Roman/Byzantine period while the other graves are probably of more recent date. In the east of Area F, between Church 3 and the dam and outside and below the area of urban settlement, is a complicated structure with at least two phases of use (Fig 2:2).

The surface remains on Khirbat Faynān are of an almost undisturbed Byzantine town that documentary evidence shows was a bishopric in the fifth and sixth centuries (Schick 1996). The original occupation, however, must date back to the early days of copper exploitation (as evidenced by Bronze Age sherds found on the site). The summit of the site is occupied by a large building (12, Fig. 2:2), the layout of which suggests a military or administrative function. Religious and perhaps administrative buildings take up the more level ground in Areas B and F, while what appear to be smaller private buildings or living quarters are relegated to the steep south and west-facing slopes (Areas C and D). There is a lane on the west side of the Khirbat leading to the open ground delimited by the churches and tower in Area F, an area that was perhaps used for trading. Access to other sites, such as the South Cemetery, the smelting site (WF11) and the settlement (WF2) on the south bank of the Wādī Ghuwayr may have had a bearing on the posi-

tion of the entrance to the Khirbat on its south-eastern side. The factors that influenced the growth and development of the town, particularly the relative importance of the copper and agricultural production, can only be reasonably assessed by excavation of the site along with a broad based-study of the surrounding area.

The complete plan of the Khirbat and the South Cemetery (WF3) will be combined with the photogrammetric plan of the Wādī Faynān produced at UCL London by Leoni Blank and kept at the British Institute for Archaeology and History, Amman, Jordan, to provide background data for teams working on sites within the area covered.

Transect Survey and Selected Sites

Three transects were walked (1-3) of which two (1 and 3) were chosen to cross parts of the ancient field system WF4 (Fig. 5). The first one, roughly in the middle of the project area, included some of the fields newly established by local Bedouin. It was sampled in order to get an insight into the effect of this modern reuse on the ancient wall system. The second transect, further to the east, passed through an area of enigmatic stone heaps laying partly within the field walls. The third transect was located near the western limit where there were no previously known sites. The transects were placed between prominent landmarks, at both north and south ends, to facilitate walking on line.

Each transect was walked twice, with an average of four people spaced 10m apart, thus covering a strip 80m wide. All sites found were recorded immediately and marked on the aerial photograph as well as the 1:50 000 topographic map (sheet 3051 II and 3151 III, see Fig. 5). Diagnostic material was noted on the sites and a minimum selection was collected for reference.

Results

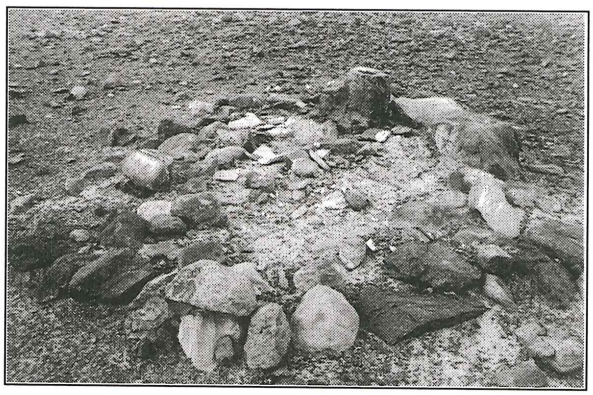
Nine new sites were found which can be usefully categorised as follows:-

i. thin isolated flint and sherd scatters
ii. cairn tombs
iii. cemeteries
iv. isolated building complexes and enclosures
v. field systems

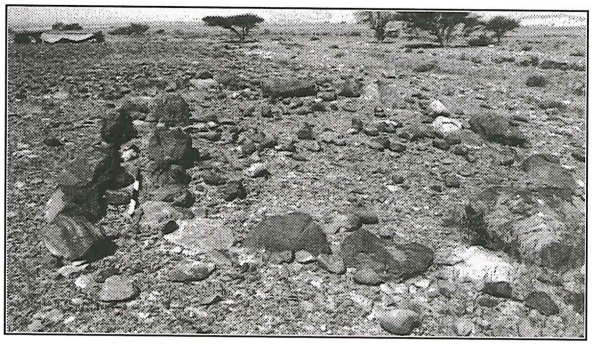
i. Three scatters of very small numbers of heavily patinated flint flakes or small sherds were found lying on the bedrock of the otherwise barren limestone hilltops of the Jabal Madsūs aḍ-Ḍaḥal (on the north side of Wādī Faynān). These scatters were marked on the aerial photographs but were not given site numbers because they consisted of so few artefacts.

ii and iii. and Single cairn tombs of different sizes (up to 6m in diameter) were found on virtually all the prominent high ground but also scattered on the valley floor within field systems and in small groups in the cemeteries. Nearly all of them have been robbed out and dating evidence was scarce. Large cemeteries are often located at the foot of the hills on the highest alluvial terrace. There are various types of tombs within any one cemetery: oval piles of small stones, rings of stones, cists and cairns as mentioned above. Although no specific dating evidence was found, the variation in construction techniques indicates that the cemeteries were used at different periods, with some of the tombs almost certainly dating back at least to the Chalcolithic/ Early Bronze Age (c. 4500 - 1950 BC) (WF8 and WF15). WF15 is situated at the foot of the Zurayq al-Mirāḍ hills on the highest alluvial terrace. It is an area of graves, mostly robbed out, and small independent 'structures'. The graves are either rectangular or roughly circular and are usually defined by double rows of large local boulders (Fig. 6). At the time of the survey one of the rectangular graves had been carefully robbed exposing a rectangular

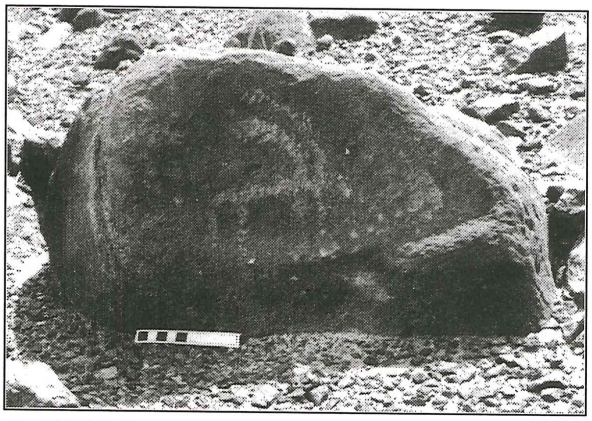
platform within which is a rectangular stone-lined cist. Some of the 'structures' are rectangular, up to 11m long, apparently open ended and in one there is a rock drawing of an ibex (Figs. 7 and 8). Another structure is semi-circular. Since the survey was conducted several more of the 'structures' have been robbed and the scattered remains of human bones indicate that the majority of them are indeed graves. The small amount of surface pottery and flints found on the site are early in date. This site is currently under investigation by K. Wright (Institute of Archaeology, University College, London).



6. WF15, circular grave.



7. WF15, rectangular structure/grave.

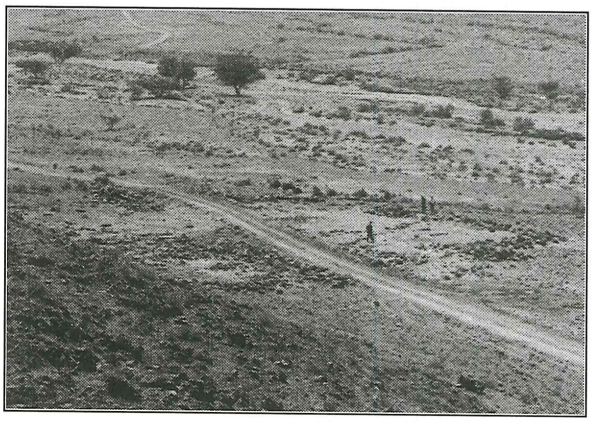


8. WF15, ibex rock drawing in structure wall.

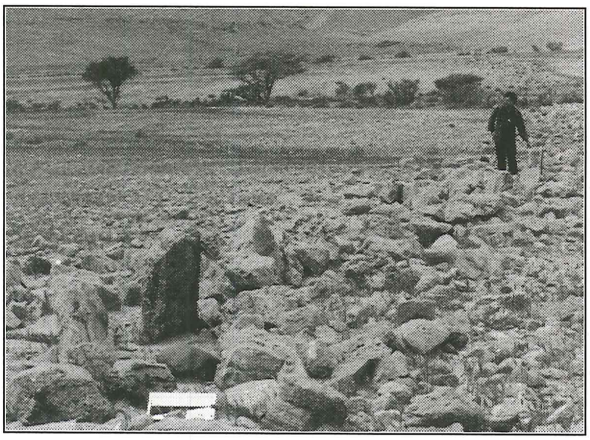
Where tombs occur within field systems, it is difficult to ascertain the interrelationship but they generally seem to postdate the field walls (WF9 and WF13). Other cemeteries are known to exist within the project area but were outside the scope of this field season.

iv. Two isolated building complexes (WF6 and WF12) plus an area of small single structures and graves (WF15) were found. One is a large rectangular enclosure (WF6, Fig. 9), roughly 45m x 50m and it is incorporated into cemetery WF8 which partly post-dates it. It is situated at the foot of the western slope of the Zurayq al Mirāḍ hills on the alluvial terrace above an active wadi channel. Within the well-constructed enclosure wall are traces of internal divisions but no identifiable structures. However the enclosure was clearly reused and extended at least once. The few surface sherds suggest a Nabataean to Byzantine occupation. The second site, WF12, lies outside the transects, in the eastern part of the project area. It is a large building complex consisting of several rooms, courts and an entrance passage, located on a low spur to the south of the main wadi. Surface ceramic evidence suggests that this complex probably dates to Nabataean/Roman times.

Site WF10 is a wall at least 1.5 km long, running along the foot of the high hills on



9. General view of terrain and site WF6.



10. WF10, long wall on south side of Wādī Faynan.

the north bank of the Wādī Faynān (Fig. 10). Effectively it divides the high from the low ground. The wall is constructed of local blocks and boulders, now mostly tumbled down, and it was only possible to detect a wall face in a few places. Some small structures are associated with it and in certain places there are standing stones within the thickness of the wall. Although it seems to enclose/delimit the field system WF9, (see below) no direct link could be made and it is not possible to state at the present level of investigation what its intended function was - enclosure and/or territorial boundary.

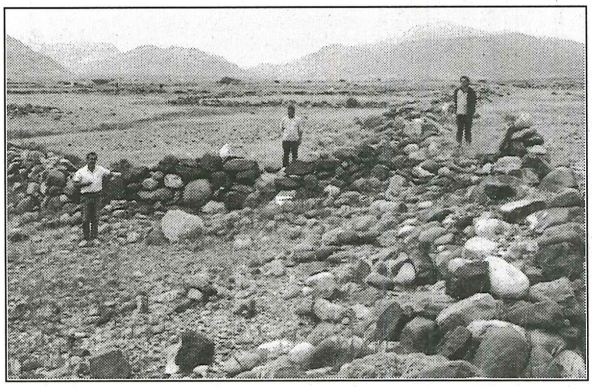
v. The transects crossed three field systems, two of which are isolated systems, WF9 and WF13 and the main system WF4 which will be discussed below. Site WF9 begins on the north bank directly above Wādī Faynān and extends across the highest alluvial terrace. Next to the main wadi channel are some low hillocks over which a number of large walls were constructed that are heavily silted up on the east side. Amongst these walls and especially towards the wadi edge are some knapping stations and extensive flint scatters including a significant proportion of blades, several of which show sickle sheen. The surface pottery is largely Early Bronze Age (c. 3300 - 1950 BC) with a small number of Byzantine sherds. North of these hillocks the land flattens out and there is a small wadi running roughly east-west, parallel to the main wadi. Running down to and across it is a series of low parallel walls (some of them recent) that probably acted as sediment traps and dams for cultivation. There is a small group of cairns within the area of larger walls and on the prominent hilltops around are the ubiquitous robbed cairns, one of which had some Early Bronze Age IV (c. 2300 -1950 BC) sherds next to it. Towards the western end of the site there is a rectangular structure that had some Early Bronze Age sherds and a slag heap nearby. Sites WF9 and WF10 were previously recorded by the Ḍāna Archaeological Survey during their recent work in the area (Sites 66, 67, 69, 70, 71, 80, 81; Finlayson and Baird 1995).

The second field system, site WF13, occupies the same topographic location as WF9 at the western end of the project area. This system, however, is much smaller than the first, consisting of 10 to 12 low parallel walls running north-south across a small natural run-off channel. Several palm tree trunks (1.5-2.5m long) were noted on the site, some in apparent association with the parallel walls, but their origin is indeterminate. This whole field system has been ploughed in recent years and enclosed with a fence of plastic water-pipe posts and barbed wire. Scattered throughout, sometimes in rough lines, are 30-40 stone piles and robbed out cist graves. Next to one of these were a few Roman/Byzantine and some earlier handmade sherds. Along the edge of the terrace, above the main wadi, were relatively dense scatters of flint flakes (no blades at all), some of which may be knapping stations.

Specific Evaluation of the Main Field System (WF4)

This major field system covers a large part of the bed of Wādī Faynān bearing mute testimony to thriving agriculture here in the past. The fields are bounded to the north by the currently active channel of the

Wādī Faynān and to the south by low hills and outliers. They are the most extensive feature in the local landscape, covering an area of about 250 hectares and had previously been assumed to date to the classical period. The aim of the evaluation was to establish whether variations and special features exist within the system. This was achieved by crossing the fields in transects 1 and 3 (Fig. 5), subsequently investigating a further 35% of the field system, covering most of its western part.



11. WF4, fields and field walls. Each person is standing in a different field showing the differences in ground level.

Results

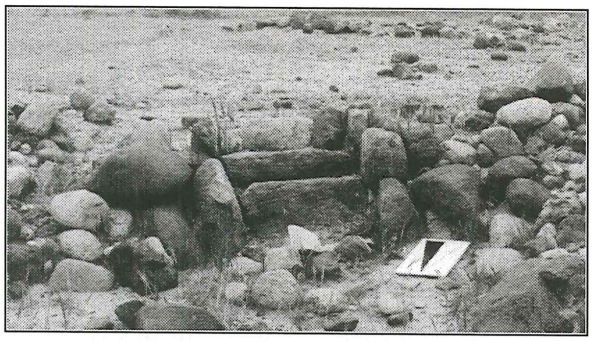
Present-day farming in the area is encroaching on the ancient fields. At the time of the survey some walls had been completely removed to make way for new fields in the south-western part, whilst other new fields had been placed within the ancient walls. Newly installed water reservoirs (ca. 2m high) made of stones and soil from the wadi terrace and lined with plastic, serve as the water supply for the different units of presently cultivated fields in the south central area. On the north side of the main wadi channel and at the western end of the field system, the Wādī Faynān must have washed away a certain amount of ancient fields, but no serious damage has been caused by tributary wadis through the fields since the ancient walls that lined the edges of many of them are still largely *in situ*.

Generally the field walls acted as terrace walls and dams behind which silt accumulated. As one progresses from east to west and from south to north in the direction of the natural flow of the water, the level of the fields drops at each field boundary (Fig. 11). The majority of the fields are roughly rectangular but groups of fields of differing shape can be distinguished. Most of the walls are more or less straight and the others are sinuous or curved.

There are several different construction techniques, though locally derived stones are always used. The most elaborate wall, which perhaps supported a main channel, is well faced on both sides and is still standing 1m high and about 1.5m wide. Some walls are faced only on one side whilst others consist of lines of huge boulders or piles of smaller boulders. The junctions of walls do not usually form a rectangular corner but rather are rounded and join at different angles. There seem to be areas within the field system with a prevalence for a particular kind of wall construction, but there are also parts where all the different techniques appear mixed from one wall to the next. Some walls running parallel, about 2m apart, may indicate trackways.

Structures are occasionally integrated into and abutted against the field walls. Some are rectangular, of roughly dressed rectangular blocks, while other structures are oval and their walls are more roughly constructed. Of special interest are two installations for water management both of which allowed water to flow from the higher to the lower field in a controlled fashion. One consists of two steps lined with upright slabs (Fig. 12) and the other is a small outlet tunnel at the base of a wall.

An inspection of the enigmatic stone piles in the southern central area points to a close connection with the field system itself. They might be the remnants of continuous stone clearance from the fields, which in some places even covered the field walls. However some may be independent



12. WF4, stepped water management installation.

structures such as burial cairns. Similar large piles of small stones have recently been shown to be multiple burial tombs in the Pella hinterland in the north of Jordan (Watson 1995, 1996).

Throughout the field system a continuous scatter of sherds and flints was noticed, which forms very high concentrations in some areas. At the eastern end of the field system near the water-mill, the proportion of wheel-made Nabataean/Roman - Byzantine sherds accounted for up to 90%, the other 10% being handmade, most probably Early Bronze Age sherds. In contrast within an area of bigger walls in the south central part, the reverse percentages apply, for example a random sample of $1m^2$ produced 49 Early Bronze Age sherds, 3 Nabataean - Byzantine sherds and 3 flints. Here the combination of large walls and their attached structures, topographical location on a terrace and some domestic items (pottery and basalt bowl fragments) makes it plausible to postulate that this area was a walled settlement of over eleven hectares and probably of Early Bronze Age date. Its walls would later have been incorporated into the field system. This site (WF100) is currently under investigation by K. Wright.

In the northern central area the proportions of Nabataean - Byzantine sherds to Chalcolithic/Early Bronze Age sherds are about equal. Nonetheless the percentage of prehistoric sherds together with the continuous flint scatter point toward a pre-classical origin for the field walls in the central area, a suggestion supported by the complaints of the local Bedouin farmer that the field walls he removed to create some of his fields had very deep foundations. Excavations on Tall Wādī Faynān showed Neolithic/Chalcolithic occupation (Najjar *et al.* 1990) and taken together, these facts indicate that along the main valley floor there was earlier use of the area that was subsequently superseded by the main field system.

At the very western end, on a now isolated island of field walls, (WF14) there were comparatively few surface finds, the flint flakes outnumbering the ceramics, the majority of which were early handmade sherds.

In conclusion it can be stated that the development of the field system is obviously more complicated than a simple single phase episode. It began earlier and existed over a longer period of time than had previously been suggested. The techniques of water management used in the fields are not immediately evident but a number of walls and installations show planned hydraulic functions. The whole field system and the techniques of ancient water management are currently being studied by G. Barker and D. Mattingly of the University of Leicester and D. Gilbertson of the University of Aberystwyth (Barker *et al.* 1997).

The Water System

Located on the south bank of the Wādī Ghuwayr, opposite Khirbat Faynān, are the substantial remains of a water management and storage system (Fig. 3). The main components of the system are an open channel, an aqueduct across Wādī Ushaykir and a large sunken reservoir. From the reservoir, water was channelled to a watermill and possibly on to the extensive field system (WF4) beyond.

The water sources in Wādī Ghuwayr are a combination of run-off from the ash-Sharā mountains, flash-flood water from side wadis and springs. The water was channelled along the south side of Wādī Ghuwayr in

two types of conduits. One is rock-hewn in the side of the wadi and the other is a thickly plastered U-shaped channel butted against the wadi side. Currently the local inhabitants are using a water pump and PVC pipes to transport water down to the fields in the bed of Wādī Faynān.

Further west there are the remains of an aqueduct that originally spanned the Wādī Ushaykir over a distance of approximately 120m (Fig. 13). A series of arches would have been used to span the wadi and when Musil passed through the area in 1898 the easternmost arch, which is now collapsed, was still standing (Musil 1907). The aqueduct is built of faced sandstone blocks bonded with a cement-like mortar around a core of rubble and pebbles bonded with mud mortar. The open channel of the aqueduct shows two phases of use. The original channel was filled with a layer of rubble and replastered, raising the level of the later channel. The channel would have carried water coming from the east, across the wadi, to an open channel on the western side that is currently buried under large slag heaps. It emerges further west, leading right into the settlement tank of the reservoir.

The water reservoir is a partially silted up sunken reservoir that measures c. 30 x 33m with 4m of wall face currently exposed. The sides of the reservoir are constructed of sandstone blocks and a partially demolished stone staircase, supported on a clearing arch, is still visible in the northwest corner (Fig. 14). The eastern and southern walls are almost totally destroyed while the western wall and the western end of the north wall are still standing to the level of the uppermost course. Towards the centre of the eastern wall and abutted to it, is a settling tank that would have collected the water flowing from the aqueduct and open channel. The basin measures approximately 1.6 x 1.7m. Its plastered floor is 1.2m lower than the incoming channel, allowing the water to fall and the residue to settle. There is no evidence, however, for the position and level of outlet from the settlement tank. Along the top of the northern half of the west wall are the remains of a channel 0.5m wide and 0.3m high (Fig. 14). No physical evidence remains as to the starting point of this channel or whether the water arrived directly from the settling tank or from higher up in the system. Nor indeed is it clear whether this channel is contemporary with or later than the reservoir. There is some evidence for an outflow near the middle of the western reservoir wall, perhaps leading water to the mill.

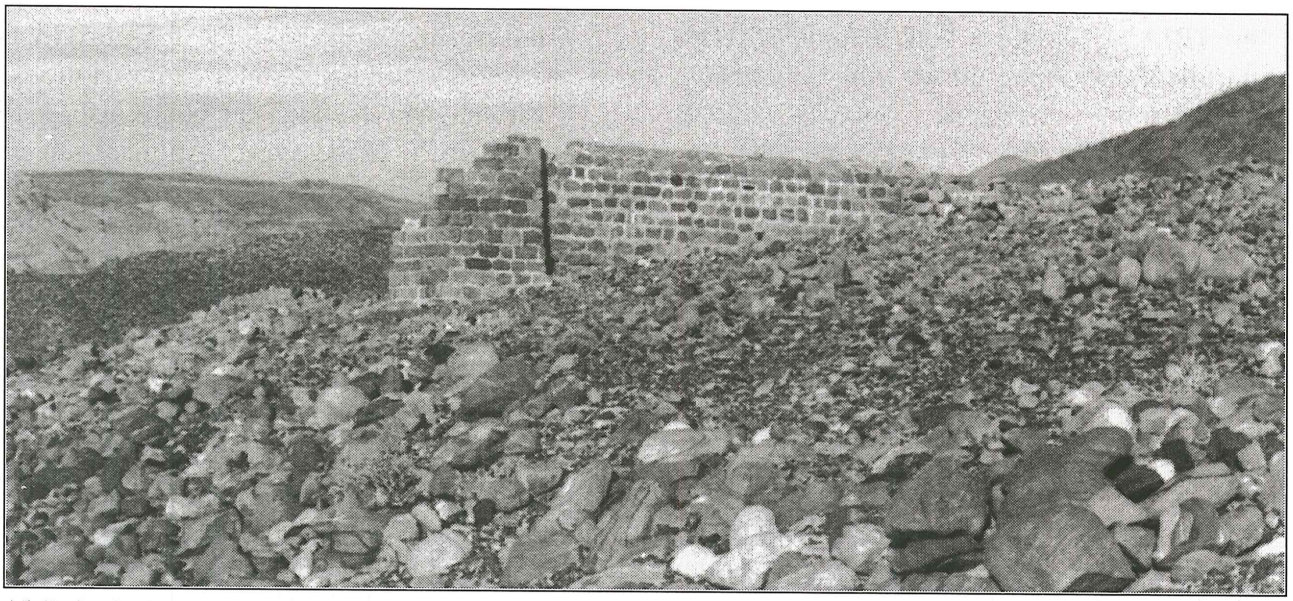
Raised tower mills, also known as the 'arubah penstock mill,' are fairly common in the Near East and in Jordan, particularly in the north, there are both single and dou-



13. Remains of the aqueduct across wadi.



14. Reservoir showing arch for steps and channel on the west wall (looking northwards).



15. Raised mill tower and channel. (Looking north-east).

ble penstock mills (McQuitty 1995). The Wādī Faynān mill (Fig. 15) is an example of a single tower mill whose structure and typology are similar to other mills in the perennial wadis flowing into the Jordan Valley. Remains of the upper channel that brought water to the mill are still visible for more than 11m. It is one course high and plastered on the inside with the plaster forming a half-barrel capping for its whole length. This channel leads to an open chamber at the centre of which is the circular opening of the vertical shaft lined with *cocciopesto* plaster. The well-preserved opening is 0.45m in diameter and at least 3.30m deep. The raised tower is also well-preserved, standing to around 4.0m above ground on the outside. A chamber abutting the foot of the tower is practically demolished, its remaining walls being preserved to a maximum height of only three courses.

Analysis of plaster samples from the channel leading into the settling tank, the channel on the west reservoir wall and the channel leading to the watermill suggest that they are all roughly contemporary and of Roman date (G. Morgan, in Barker *et al.* 1997). It would be logical to assume that the aqueduct and water channels to the east form an integral part of this water system and are therefore also Roman in origin. However, penstock mills in Jordan are generally thought to be of Islamic date and if the Faynān mill proves to be Roman it will be a unique example.[1] Also work by the team from the Bochum Mining Museum has dated the slags from the enormous heaps on the east bank of the Wādī Ushaykir that overlay the channel flowing west off the aqueduct to the Roman period, between the second and fifth centuries AD (Hauptmann and Weisgerber 1992). Clearly further research is necessary to understand the usage and relative dating of the various elements of the water system here.

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1. The German team from Bochum have excavated at the foot of the mill and suggest a Roman date (Hauptmann *et al.* forthcoming).

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Appendix: (Summary of sites)

Site No.: WF1 (JADIS: 1900.001) (Palumbo 1994)
Name: Khirbat Faynān
Site type: Settlement
Co-ordinates: PG: E 197 200 N 004 200 UTM: E 739 100 N 3391 100
Description: Large settlement/Tall site situated on a natural hill at the confluence of two wadis - Ḍānā and Ghuwayr, where they join to form the Wādī Faynān. The site is blanketed by tumbled and eroded sandstone building blocks under which wall lines and terraces are visible. There are also a number of discrete buildings still easily distinguishable, notably a large structure at the very top, two churches, the so-called monastery and tower, a kiln and the dam. There are areas of graves around the main tall as well as small slag heaps. Surface evidence indicates the site was used during the Bronze Age, Iron Age, Roman, Byzantine and Early Islamic times.
The site has been noted and recorded by a number of people since Lagrange first published it in 1898 (see Bibliography).

Site No.: WF2 (JADIS: 1900.020)
Site type: Settlement
Co-ordinates: PG: E 197 550 N 003 600 UTM: E 739 350 N 3390 600
Description: This is an area of buildings, walls and a few graves located on the south bank of the Wādī Ghuwayr, opposite Khirbat Faynān. It is divided from the South Cemetery, which lies to the east, by a small, deep wādī. The site extends onto the flattish area south of the Wādī Ghuwayr. This site was not closely investigated, but surface sherds suggest at least a Nabataean/ Byzantine occupation.

Site No.: WF3 (JADIS: 1900.021)
Name: South Cemetery
Site type: Cemetery
Co-ordinates: PG: E 197 800 N 003 600 UTM: E 739 650 N3390 050
Description: The cemetery, first visited by F. Frank (Alt 1935) is situated at the foot of the mountains on a gently sloping covering an area of approximately 36 000m≤ with its northern boundary on the upper terrace of the south bank of the Wādī Ghuwayr. There are roughly 1200 graves marked by small headstones, at least 10% of which have crosses engraved on them, dating the main use of the cemetery to the Byzantine period. (Subsequent excavations have shown that there are also many unmarked graves (Findlater forthcoming). These graves are simple rectangular holes about 1.8m deep in which the bodies were laid and covered by sandstone capstones before being back-filled. Other grave types occur, mainly various forms of cist and cairn tombs. Remains of a few small structures built of dressed sandstone blocks were also located. Surface finds are virtually non-existent.
Close to 60% of the graves in the cemetery have already been robbed.

Site No.: WF4 (JADIS: 1900.022)
Site type: Field system
PG co-ordinates: E 195 000 N 004 000 UTM: E 737 000 N 3391 000
Description: This extensive ancient field system, recorded by N. Glueck (Glueck 1935), stretches over 4km and covers an area of approximately 250 hectares, that was laid out on the terraces of the Wādī Faynān. Local stones were used to make the field walls and a variety of building styles are recognisable. These walls seem to have acted as sediment traps so that the fields eventually became terraces. In a few places there are small structures associated with the walls along with evidence for water management systems. There is a continuous surface scatter of sherds and flints that is very dense in many places with the majority of the sherds dating to both the Bronze Age and Nabataean/Roman times.

Site No.: WF5 (JADIS: 1900.023)
Site type: Cairn
Co-ordinates: PG: E 193 700 N 003 150 UTM: E 735 600 N 3390 050
Description: The cairn is composed of a ring of stones forming a rough circle with a large pile of smaller stones attached to it on the south-west side. Extending from this is a wall of sandstone boulders forming an elongated oval around the cairn. Nearby is another small cairn/ stone pile and both of these are situated within the major field system (WF4).

Site No.: WF6 (JADIS: 1900.024)
Site type: Enclosure
Co-ordinates: PG: E 193 850 N 002 600 UTM: E 735 750 N 3389 500
Description: A series of long double-course walls form a roughly rectangular enclosure that has smaller walls dividing the inside space. At least two wall phases are discernible. Within the enclosure there are a number of cairns and the whole site is set in a large cairn field (WF8). It is probable that the cairns post-date the enclosure. The few surface sherds are of Nabataean/Byzantine date.

Site No.: WF7 (JADIS: 1900.025)
Site type: Wall

Co-ordinates: PG: E 193 700 N 002 950 UTM: E 735 600 N 3389 850
Description: This site is a wall of local boulders in a disused wadi channel. This may originally have been part of the extensive field system (WF4) but now is an isolated wall to its south.

Site No.: WF8 (JADIS: 1900.026)
Site type: Cairn field
Co-ordinates: PG: E 193 650 N 002 700 UTM: E 735 600 N 3389 750
Description: This is a large cemetery with over 200 graves of different types. Many are cairns, some large, but most are small and the use appears to be multi-period, given the different styles of cairn construction. The cemetery is between a wadi bed and the foot of the outlying hills, Zurayq al-Mirā448. Along the edge of the wadi is an extended flint scatter, probably unassociated with the cemetery.

Site No.: WF9 (JADIS: 1900.013)
Site type: Field system, cairns and settlement
Co-ordinates: PG: E 193 500 N 004 150 UTM: E 735 250 N 3391 100
Description: On the north bank of the Wādī Faynān there is a large area of walls and artefact scatters. Some walls, nearest the wadi edge, are on low mounds and were probably associated with settlement, while the walls across the small tributary wadis were probably of agricultural use. The site is deflated as seen in the recent wadi cuts next to some of the big walls where there are no buried artefacts in the sections but many on the adjacent surfaces. The ubiquitous graves and cairns are to be found on the site, with one group of cairns within the 'settlement'. This widespread site is effectively enclosed by the long wall WF10. The Ḍānā Archaeological Survey recorded this site as sites Nos. 66, 69, 70, 71, 80 and 81 (Finlayson and Baird 1995).

Site No.: WF10 (JADIS: 1900.014)
Site type: Long enclosure wall
Co-ordinates: PG: E 193 000 N 004 450 UTM: E 735 500 N 3390 950 - E 735 800 N 3391 250
Description: This is a wall that goes across the landscape for at least 1.5km, delimiting an area on the north side of the wadi and enclosing site WF9. It runs along the base of the hills and across side wadis and low spurs, ending to the west on the edge of Wādī Faynān, and has some small structures attached to it in places. This site was recorded by the Ḍāna Archaeological Survey as site No.67.

Site No.: WF11 (JADIS: 1900.017)
Site type: Industrial and settlement
Co-ordinates: PG: E 197 100 N 003 850 UTM: E 738 900 N 3390 750
Description: This is a multi-period and multi-use site that is located on the south bank of Wādī Ghuwayr with its eastern limit being eroded by Wādī Ushaykir. There was industrial activity here which resulted in a large slag heap which has been sampled by the Bochum Mining Museum. Water was harnessed and used leaving an aqueduct, a reservoir and a water mill; a variety of buildings, some of which might be domestic, are to the west of the slag heap and to the north are some eroded field walls. To the west and slightly down-slope of the water mill is the beginning of the extensive field system WF4. Site WF11 is a large and complex area that would repay more thorough investigation than time allowed on this survey.

Site No.: WF12 (JADIS: 1900.015)

Site type: Isolated building complex
Co-ordinates: PG: E 196 850 N 003 500 UTM: E 738 700 N 3390 400
Description: This isolated building complex (marked on the 1:25000 topographic map sheet 195/995 El Muqariiya) sits on the top of a small spur at the edge of the plateau above Wādī Faynān. It consists of a square compound with internal dividing walls, areas that might be courtyards and what appears to be an elaborate entrance to the compound. There is an enclosure wall attached to the compound running from the west round to the east side closing off part of the slope below. Surface sherds indicate a Nabataean/Roman occupation.

Site No.: WF13 (JADIS: 1900.016)
Site type: Walls, cairns and flint scatter
Co-ordinates: PG: E 191 450 N 004 200 UTM: E 733 300 N 3391 100
Description: This is a multi-period and multi-use site on the actively eroding north bank of Wādī Faynān. There is an extensive but thin flint flake scatter (no blades) right on the edge of the wadi and a little further north there is a series of small walls running north -south across a minor run-off channel. These, like in other similar sites in the area, acted as sediment traps and several have palm trunks associated with them (probably more recent). The area has been ploughed recently. Also scattered in rough lines is a series of some 30-40 stone cairns and a few robbed-out cist burials. Very few sherds were found and these were of Roman/Byzantine and earlier date

Site No.: WF14 (JADIS: 1900.018)
Site type: Field system
Co-ordinates: PG: E 192 000 N 003 500 UTM: E 733 750 N 3390 200
Description: This is almost certainly a remnant of the main field system (WF4) that has become isolated by later erosion of the area. There are less surface sherds here than in the main fields but there are some piles of flints that may be knapping stations. The field walls are low lines of boulders.

Site No.: WF15 (JADIS: 1900.019)
Site type: Structures and stone grave structures
Co-ordinates: PG: E 194 750 N 003 150 UTM: E 736 600 N 3390 100
Description: Directly south of the main field system at the foot of the Zurayq al-Mirā449 hills is an area of up to twenty small rectangular and roughly circular grave structures. These structures are up to 10m long, usually with double walls of local boulders and some are apparently open at one end. In one of these is a small rock drawing of an ibex. At the time of the survey several of them had been robbed and one was carefully robbed exposing a rectangular platform within which is a rectangular stone-lined cist. Since then, unfortunately, several others have also been robbed, confirming by the scattered human bones that these rectangular structures are indeed graves. The small amount of surface pottery found on the site is of early date, probably Chalcolithic and/or Bronze Age.
There is also a semi-circular structure consisting of a wall on the edge of a low bank with a platform and internal wall associated.

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