THE FINNISH JABAL HĀRŪN PROJECT REPORT ON THE 1997 SEASON

by

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The first field season of the Finnish Jabal Hārūn Project (FJHP) in the area southwest of Petra was conducted in October 1997. The combined team of cartographers and archaeologists was led by Jaakko Frösén, University of Helsinki, the director of the FJHP. Henrik Haggrén, Katri Koistinen, Jussi Heikkinen, Saara Mattila, and Jyrki Mononen, all from the Institute of Photogrammetry and Remote Sensing at the Helsinki University of Technology, Finland, as well as Matti Rantanen, Espoo-Vantaa Institute of Technology. Juha Kanto, SITO Oy, prepared the geographical reference data to be used during the fieldwork, while Koistinen, Heikkinen, and Mononen also conducted the cartographic and photogrammetric survey of the site during the 1997 season. Mika Lavento, Jan Vihonen, Erko Mikkola, and Matti Mustonen, all from the University of Helsinki, conducted the archaeological reconnaissance of the mountain and its environs. Two American archaeologists, Zbigniew T. Fiema and Glen L. Peterman, assisted in the preparation of the project. Fiema also served as the chief archaeologist during the 1997 season. Muhammad Salameen was the representative of the Department of Antiquities of Jordan.

Previous Research and the FJHP Objectives

The focus of interest of this project is Jabal an-Nabi Hārūn (the mountain of the Prophet Aaron) located ca. 5 km to the southwest of Petra. According to Jewish, Christian and Muslim traditions, the mountain is considered the place of burial of Moses' brother Aaron. Currently, the peak of the mountain is occupied by a Muslim shrine (*welī*)[1] which contains a sarcophagus (cenotaph) believed to contain Aaron's remains. Despite the significance of the site, marked by its proximity to Petra, and the existence of considerable ruins there, the Jabal Hārūn mountain has received relatively little attention among explorers and archaeologists. To date, the most important and comprehensive description was recently made by Russell, Peterman and Schick (Peterman and Schick 1996). This study also contains all ancient references to human habitation in the Jabal Hārūn region. Most of this information comes from the Byzantine period, and the relevant texts mention not only a monastery but also a church on the mountain. While the exact date of the abandonment of the mountain by the Christians cannot be determined, it must have happened not later than the mid-14th century when the Muslim *welī* was constructed on the peak (Peterman and Schick 1996: 477-78).

Of main interest for the Finnish Jabal Hārūn Project, however, is the extensive ruined architectural complex located ca. 70 m below and ca. 150 m to the west of the peak with the Muslim shrine, on a wide plateau of the mountain, at ca. 1270 m asl. Previous explorers admitted the possibility that the ruins represent a Byzantine monastery. However, it was the 1991 exploration by Russell, Peterman and Schick that resulted in a first sketch-plan of the site, its de-

1. Palestinian grid coordinates of the shrine: 188.64E x 969.667N; UTM coordinates 731200E x 3356470N.

scription, and the proposal that the extant ruins should most probably be identified with the monastery of Saint Aaron mentioned in Byzantine sources.

The origins of the Finnish Jabal Hārūn Project are to be found in the involvement of the Academy of Finland / University of Helsinki with the sixth century Petra Papyri discovered in a Byzantine church complex at Petra during the excavations of the site by the American Center of Oriental Research in December 1993 (Fiema, Schick and 'Amr 1995). The carbonized remains of 152 papyrus scrolls containing documents written in Byzantine Greek were subjected to a conservation process by a team of Finnish conservators. The studies of the papyrus documents conducted by two teams from the University of Helsinki and the University of Michigan, headed respectively by Jaakko Frösén and Ludwig Koenen, led to the assumption that this single largest collection of ancient documents from Jordan would clarify many poorly known or little understood aspects of society and economy in Byzantine Petra and southern Jordan (Frösén and Fiema 1994; Koenen 1996).

The legible texts, dated between AD 528 and 582, are mainly legal documents concerning transactions and registrations of property and settlements of disputes involving several families of Petra during at least two generations. They also mention local towns, churches and dwellings, as well as the agricultural hinterland of Petra. All of this prompted the scholars working on the texts to attempt to relate the revealed information to the archaeological remains and toponomastics in and around Petra. Papyrus Petra inv. 6 (Papyrus Petra Daniel C. and Nancy E. Gamber), which contains the earliest preserved date in the archive (15 June, 528), also mentions "the House of our Lord the Saint High-Priest Aaron" outside of the city of Petra. This institution is mentioned in the will of a sick person as one of the two beneficiaries in the event of his death (*donatio propter mortem*). Because of the terms *hagios oikos*, in Greek, and *domus*, in Latin, used in the Petra Papyrus, and because of the 'occurrence title' of the representative *hegoumenos* (= superior), the papyrus almost certainly refers to the monastery of Saint Aaron. The combination of this information with the aforementioned religious tradition associated with Jabal Hārūn and the architectural remains on the high plateau of the mountain strongly suggest that the latter, which had previously been thought to be the remains of a monastic complex, can indeed be identified as the Monastery of Saint Aaron. In that case, Papyrus Petra inv. 6 is the earliest historical source specifically referring to this monastery.

The historical ramifications of the proposed identification hold great promise in terms of the archaeological and historical data that can potentially be recovered through an intensive archaeological exploration of the area. Not only can a better understanding of the poorly known Byzantine monastic development in southern Jordan be achieved, but also a plethora of new information on Petra during the Byzantine and following periods should become available. The Finnish Jabal Hārūn Project, developed with these aims in mind, is designed to uncover, preserve and publish archaeological remains located on the Jabal Hārūn mountain, recognized as a monastery of St. Aaron. These tasks are to be fulfilled through a comprehensive five-year program of archaeological survey and excavation at the site, and through a geo-environmental exploration of the environs of the mountain. The project aims for a full understanding of the ruined monastic complex, the topography of the mountain, and the history of human settlements on the mountain and in its immediate surroundings, as well as their relations to the city of Petra.

The goal of the first season was twofold. Various cartographic methods, primarily

based upon a video-recording, were to be tested in order to create detailed maps and a 3-D model of the entire mountain needed for further archaeological exploration of the area, and to develop methods which could be used in archaeological recording during future excavation campaigns. This task was performed by the cartographers from the Helsinki University of Technology.

The archaeological goal of the 1997 season was to become thoroughly acquainted with the area and to verify archaeological observations made by previous explorers of the Jabal Hārūn area. For this purpose, an archaeological reconnaissance was conducted rather than a systematic survey. Also, the members of the archaeological team aided the cartographers in their work on the photogrammetric recording of the main site. The following description summarizes the cartographic and archaeological activities which were undertaken during that season.

The Cartographic Research and Fieldwork

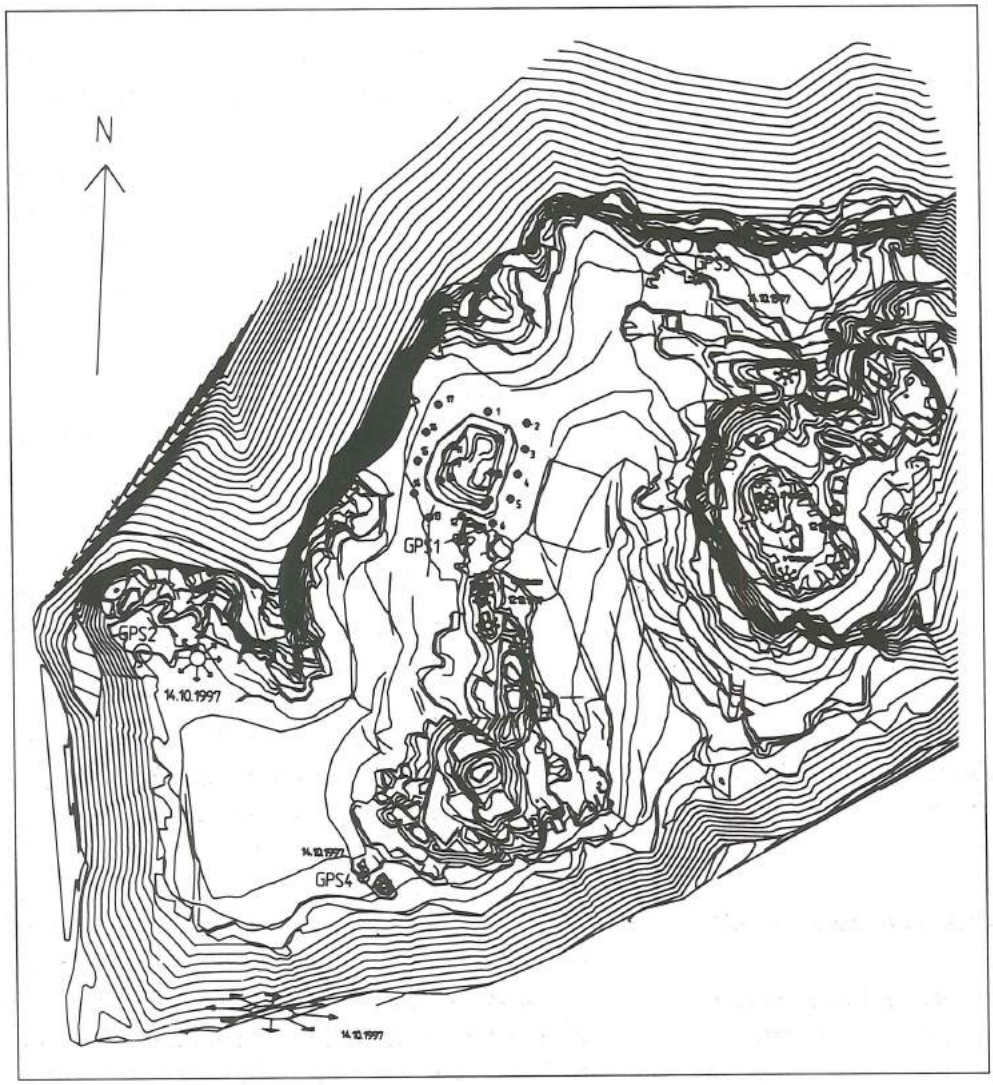
One of the major problems in the preparation of a full-scale archaeological exploration of the Jabal Hārūn area was the lack of detailed maps. The only available means of geographical reference were a topographical map on a scale of 1 : 50 000 and an older set of aerial photographs on an approximate scale of 1:15,000. Taking into account both the actual requirements set for the first season of the FJHP and the future requirements of archaeological documen-tation, the contribution of the Institute of Photogrammetry and Remote Sensing of the Helsinki University of Technology, involved two tasks:

1) the production of a 3-D model of the Jabal Hārūn and the plotting of large scale 2-D maps thereof, and
2) the creation of a comprehensive on-site videographical record for the purpose of developing a prototype tool suitable for on-site archaelogical documentation.

Pre-Survey Research

The initial difficulty centered on the fact that the geographical datum for this project was not well defined, and thus a geo-reference system had to be created using the information available on existing maps and photos. However, once the 3-D model is fully developed, all data already collected and processed can be later transformed so as to conform to any other coordinate system. Meanwhile, the approximate datum could be defined using natural landmarks as control points. The grid reference (X- and Y-datum, or longitude and latitude, respectively) was defined by one point which was exactly identified and located on both the map and the aerial photo images, namely the Islamic shrine located at the south-western peak of the NE summit. The azimuth was defined visually using distant landmarks. The level reference (Z-datum, or height) was defined by summits or hilltops selected throughout the area. The exact altitude datum was defined by the nearest high spot on the map just beside the ruins located on the plateau of the mountain. A block of images was selected for the aerial triangulation in order to produce local control points for stereo models. These will be used for combining the large scale maps and the 3-D model with the selected geo-reference system. The ground control point network was further densified through aerial triangulation.

A total set of 11 images from three strips was selected to form the block for the triangulation. About 10 to 15 tie-points were selected from each image in order to orient the images to each other and, through the ground control points, to the geographical reference system. Based on the aerial photographs a digital terrain model was created (Fig 1). Maps produced from this model were used during the 1997 campaign. This three-dimensional model will be further refined with the video-imagery produced during the campaign.



1. A topographic map of Jabal Hārūn mountain produced from aerial photographs. The map contains countors (5 m intervals), break lines and structures (created by the cartographic team under the direction of Henrik Haggren, Helsinki University of Technology).

The 1997 Cartographic Survey

During the 1997 field season, the image data were collected in order to construct a three-dimensional photorealistic model for the ruins tentatively recognized as the monastery of Saint Aaron. This model consists of a geometrical model and a texture model. Because the video digitizing techniques used for the creation of photorealistic models are still under research, an essential part of the field work was devoted to the testing of several strategies to collect the image data from an archaeological site. The work primarily concentrated on recording the remains of the monastery and its immediate surroundings (sites 1-12; see below). Having accomplished this task, the cartographic team began recording the agricultural-hydraulic installations found during the archaeological reconnaissance in the environs of the mountain (sites A-S). In total, five basic image recording strategies were tested to record the remains of the monastery:

1- Circular sequences photographed with the video camera on a tripod were used to collect image data specifically for the 3-D modelling of the monastery. The video sequences will be digitized and the blocks of video images created will be used to create a 3-D model of the subject.
2- Free movement sequences photographed with a video camera were used to record visible structures or elements targeted according to archaeological preferences. Using this method, the remains of the monastery were video-recorded, con-

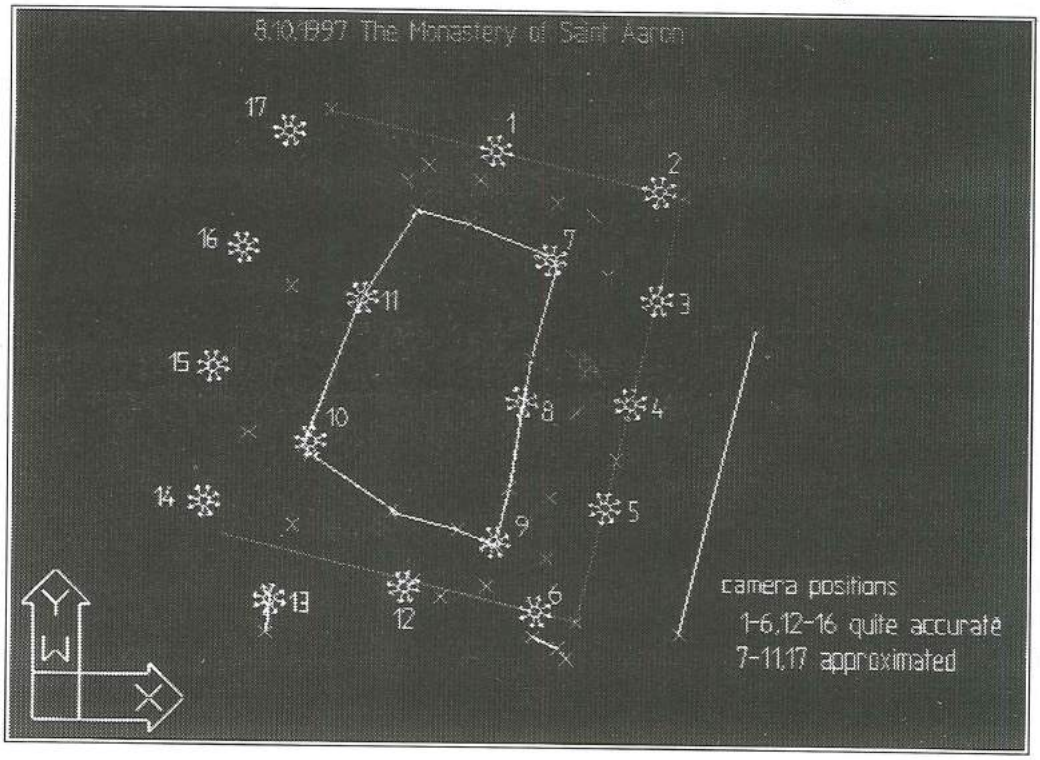
centrating on one recognized spatial element (room or cluster of rooms) within the remains of the monastery at a time.

3- Circular sequences and free movement sequences photographed with a video camera were used to record the environs of the monastery, especially for the purpose of enhancing the texture and refining the model created from the aerial photographs. These sequences were taken from various places around the remains of the monastery.
4- A stereo recording system with two video cameras was tested in relation to small selected parts of the monastic complex.
5- Slide photos of the site using non-metric cameras were taken from most video camera stations and placements.

The preparation for the actual video-recording included the collecting of information related to the geometry and dimensions of the monastery, such as the main breaklines (the highest points of the walls and the lowest points marking the limits of the ruins). Furthermore, tests were performed to find the optimal opening angles of the video image. In all, 17 camera stations were used (Fig 2). Two CCD video cameras (Sony Handycam camcorders) for 8 mm video format cassettes (Hi8) were the main recording devices used. One camera was equipped with a UV-filter. In addition to the video cameras, two non-metric cameras with slide film were used.

For various targeting purposes several signal types were utilized. The most suitable one proved to be white styrofoam balls mounted on small wooden sticks. Two basic types of paper board signals with black-and-white patterns were also tested. In most cases the signals were not used in the traditional sense, since it was decided to use natural targets as much as possible. On the other hand, the signals still served as common points for different images or as scale information for the modelling. In addition, the signals served as markers for particular features, such as ancient walls and installations, as specified and preliminarily interpreted by archeologists.

A test area (the southern part of the monastery) was video-recorded using a convergent stereo imagery, that is, a two-camera system mounted on a wooden



2. Video camera positions during one - day recording around the monastery of Saint Aaron.

frame. To determine the relative orientation, a calibration triangle was constructed from the styrofoam ball signals. The video tapes of the two-camera system were synchronized using flapping sticks. Generally, the image scale was relatively stable. However, possible variations in the scale also occurred, due to the fact that the system was heavy and therefore difficult to carry around while maintaining a constant height above the ground. At any rate, the wooden mounting was purely experimental, and a more convenient, better designed device will be needed in the future.

The remains of the monastery were also recorded from farther away. Imaging was done using both video and normal cameras from several positions. This image data can be further used in the modelling of the intermediate environment and for texture mapping. Some sequences were recorded especially for the definition of horizontal levels. A portable GPS-receiver was also used in the field. However, lacking differential correction, its accuracy was not fully satisfactory for the purpose of establishing the control points. The actual control points will be measured in the future, and the models created will be transferred to a new geo-reference system.

Basically, the same strategies, primarily the circular or half-circular sequences and the free-movement sequences, were used to record the environs of Jabal Hārūn. Sequences were taken from both sides of the wadi and also down in the wadi. In this case a tripod was not used, and all images and video sequences were taken in a mobile manner, and from longer distances, due to the large size of the archaeological sites noted in the environs of the mountain. Because of these factors, the resolution of the video images is quite low. Therefore, slide photography in combination with video sequences appeared to be of help.

The ground control points and the entire 3-D cartographic data can be linked to any additional reference system selected later. For the height reference a local levelling would be preferred. The collected video data will be utilized to create full and comprehensive, photorealistic 3-D models of the monastery site, as well as of the agricultural-hydraulic installations located in the environs of the mountain.

The Archaeological Reconnaissance of the Monastery

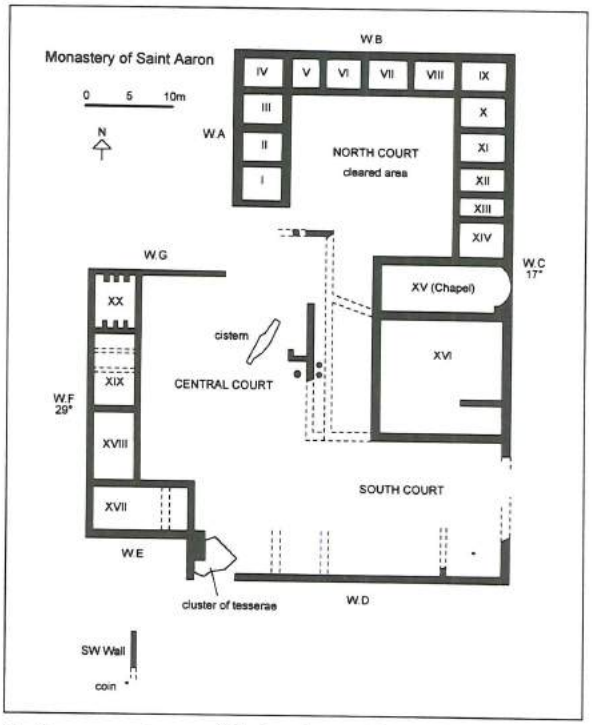
The focus of the activities of the 1997 FJHP archaeological reconnaissance was the plateau in the higher part of the Jabal Hārūn mountain, which contains the ruins of the monastic complex and other archaeological remains. The plateau is dominated by two rocky summits - the NE one and the SW one - in excess of 1300 m asl. The northeastern summit consists of two peaks. The southwestern peak, which is the highest point of the mountain, culminates in a small flat area which is currently occupied by the Muslim shrine. At first, the work of the archaeological reconnaissance concentrated on the extensive ruins on the plateau, which had previously been identified as a Byzantine monastery (Fig 3). That site, roughly 60 m N-S x 50 m E-W, was preliminarily designated as Site 1. No surface material was collected during the 1997 season, except for one, accidentally found surface coin. To avoid unnecessary repetition, the following description of the monastery site will concentrate on the features which are new or which markedly differ from the description presented by Peterman and Schick (1996). The site was intensively explored and a particular effort was made to note the internal divisions, walls, corners and other features. For convenience, all spaces/compartments/rooms of the entire complex, as well as the main external walls of the complex, were designated by numbers or letters respectively. The walls are generally represented by ridges formed of rubble from collapsed upper courses, which occa-

3. The monastery of Saint Aaron (Site 1). View from the east (photo by Jan Vihonen).

sionally display clear wall lines on the top.

Generally, the complex can be divided into three main components or wings, which in turn consist of rooms located around three courts (Fig 4). The North Court is surrounded by Rooms I through XIV on three sides, while being partially bounded on its southern side by Room XV (the chapel). This court appears to be the most self-contained and compact segment of the entire complex. The Central Court is bounded on its western side by Rooms XVII-XX. A rock-cut cistern is located in the center, and series of parallel walls, probably related to Rooms XV-XVI, bound this court on the eastern side. The South Court is located south of Rooms XV-XVI, which are the largest internal components in the complex. The southern half of this court may have been subdivided into a series of rooms along Wall D.

The actual plan of the site and the internal subdivisions generally correspond with the previously published plan. However, the latter represents an idealized symmetrical arrangement in which walls are strictly parallel or perpendicular to each other. In fact, there is a serious deviation from this picture. Wall F is not parallel to Wall C (17 degrees E from N), but rather follows the direction of 27 degrees. As such, all western



4. the monastery of Saint Aaron located on the plateau of the Jabal Hārūn mountain (as modified from Peterman and Schick, 1996)

rooms of the Central Court (XVII-XX) follow the same orientation. While this deviation is insignificant at the SW corner of the complex, it gradually increases to significant proportions farther north, causing a significant relocation of the northern part of the Central Court versus the previously published plan. Therefore, the entire complex, instead of being roughly rectangular, is

more trapezoidal in form. It is possible that this asymmetrical location of the western rooms of the Central Court versus the entire eastern part of the complex may indicate that the former was added to an already existing design. Significantly, the position of the cistern on the published plan is also incorrect (ca. 10 m too far to the ENE), although this error cannot be a result of the deviation mentioned above. The sketch plan published here does not correct these deviations but only serves to illustrate the approximate location of the architectural elements described below, and to note some significant additions to the original plan, as observed during the 1997 campaign.[2] A new top plan of the site will be created with the use of precise cartographic and surveying methods during the next season.

As opposed to the previously published description of the ruins (Peterman and Schick 1996: 473), the FJHP 97 was able to observe more ceramics on the surface, although the overall density of their presence inside the complex is low. This differential occurrence of sherds may be partially related to the continuous process of topsoil erosion inside and outside the site, a significant natural factor occurring in the area of the mountain. The ceramics observed inside the complex primarily include Nabataean (fine painted and plain) and Byzantine ware, although some possible Roman-period sherds were noted as well. Several lithics and fragments of roof tiles were also present inside the monastery.

Description of Some Rooms in the Complex

Detailed observations of the interiors of rooms in the complex were made during the reconnaissance, but only the most significant are presented here, in anticipation of the comprehensive survey and description to be conducted during the next season. Particular attention was directed to Rooms XV and XVI. Room XV is the second-largest room in the entire complex. It appears to have been a narrow, single-apsed small church or chapel, oriented almost due east. The high ground of the interior is found along the south and north walls, with the depressed area in the center. The offset at the junction between the apse and the south wall is notable, but the curvature of the apse is clearly visible only in its central part. In general, the apse appears to be relatively shallow. The degree and the location of the central part of the curvature would suggest that there should be a parallel offset on the northern side, that is at the connection with the north wall. Further clearance will be required to prove this hypothesis. No traces of internal divisions were noted in Room XV, thus the chapel may perhaps have been of a single-nave type. Concentrations of small-sized sherds, including Nabataean fine painted ware, occur along the south wall, especially in the SW and SE corners. As for the adjacent Room XVI, it is definitely the largest room in the entire complex, even if internally subdivided. Two limestone ashlars and four column drums were noted on the surface. Surface material also includes fragments of roof tiles, fragments of bricks or hypocaust-type tiles, and marble fragments in the SW quadrant, one of which may be a fragment of a post which supported a marble screen of a chancel type. A slightly oval robbers' trench is located in the SE-central part of the room. Its interior displays a fragment of a stone wall or installation.

Room XIX is relatively long but appears to have been internally subdivided, judging from the traces of walls visible on the surface. One E-W wall is located ca. 4.9 m north of the south wall of Room XIX, while the other wall is located at a distance of ca. 6.2 m north from the south wall. The surface of the space between this second parti-

2. Thanks are offered to Glen L. Peterman for his permission to reproduce the original plan.

tioning wall and the north wall of Room XIX features a curious installation consisting of several tightly packed stones bonded by mortar. This obviously intentional cluster of stones is roughly rectangular. It appears to be a top of a pillar – perhaps a central supporting pillar of an internal staircase, an element well-known in Nabataean architecture (Negev 1973). Room XX represents the highest ground within Site 1, which holds promise for the room's preservation up to the upper floor. Outlines of three arches are visible at the surface level. Each is ca. 0.6 m wide and consist of several voussoir stones tightly set one beside the other. Since it appears that these arches are still standing *in situ* the ground floor of the room may be ca. 4 m (or more) below the surface.

The Courts

Several new elements were noted inside the South Court. Generally, the court features a deep E-W depression which runs south of Room XVI. Farther south toward Wall D the surface rises, which may indicate the presence of internal rooms set against Wall D. One subdividing wall which runs perpendicular to Wall D was detected ca. 5.7 m west of the corner of Walls C and D. Another wall appears to be ca. 22 m west of the SE corner, and still another one ca. 26 m west of that corner. Other subdividing walls may be in the area too. In the same area, traces of several stone circular/oval structures were observed on the top of the elevated surface along Wall D. These structures are no larger than 1.5 m in diameter. Some of the circles or ovals have a N-S stone partition. Some seem to occur in clusters of two or four. Possibly, these are top elements of buried installations, perhaps of storage function, but they may just as well represent installations which were dug in only after the accumulation of soil and stone deposit along Wall D. Another explanation of the circles as elements of small domes, cannot be excluded at this point. The area of the SE corner of the court contains little pottery, but farther west small ceramic scatters are better evidenced, including roof tiles. One roof tile had a cross incised on its surface. Byzantine pottery is predominant, although some Nabataean pieces were noted as well. There seems to be a gap in Wall D by the SW corner of the court, and that wall appears to end at this point. The function of the main south wall of the complex is assumed by Wall E, which runs farther north. The gap itself, which is marked by a N-S depression in the ground, might have been a gate. This impression is enhanced by the east wall of Room XVII, which projects southward. This wall features a sort of a buttress–a rectangular, solid offset attached to the eastern face of the wall. The area of the buttress and especially immediately south of it was found to be strewn with stone mosaic floor tesserae. The most common sizes are 3 cm x 3 cm x 2.5 cm, and 2.5 cm x 2.5 cm x 2.5 cm. The tesserae are made of limestone, ranging from pale greenish-grey to light bluish-grey, with various shades of cream. Most of them have traces of mortar bedding of creamy white color. The most intensive concentration occupies an area of ca. 5.5 m (N-S) x 2 m (E-W). The concentration appears to be a dump of tesserae removed from somewhere else, rather than the place where they were originally set.

The main feature of the Central Court is a rock-dug cistern, the opening of which is ca. 6 m long and more than 1 m wide. No traces of internal plaster coat were noted, however the interior of the cistern is currently filled up with soil, rubble, and garbage. The cistern could have been roofed in antiquity. A water inlet was detected in the northern extremity inside the cistern; probably the water was internally channelled from the roof tops (?) of Rooms XIX-XX. A number of marble pieces (ca. 50 fragments) were found scattered on the ground to the north-east of the cistern. One piece is def-

initely a fragment of a Byzantine chancel screen. Some pavement fragments were also noted. East of the cistern a few roof tiles, marble fragments, sherds, and flints were observed. A few sherds, including some Nabataean and Byzantine, were found around the mouth of the cistern, as well as some small flints, including one point. The area between the cistern and Rooms XV-XVI is particularly unclear. There are at least two long N-S walls there, as well as column drums. One is located to the northwest of the northern end of the cistern and a second sits directly atop one of the long walls. Two drums are located beside this wall which should perhaps be interpreted as a portico's stylobate. The other wall, which is parallel to the "portico" wall, is marked on the plan with a broken line. Significantly, the south wall of Room XVI appears to continue westward (i.e., beyond its corner with the west wall of that room), where it apparently meets the broken-line wall and the "portico" wall. If this observation is correct, it means that Rooms XV (chapel) and XVI are located behind two parallel walls which remain in direct association with these rooms, perhaps forming a pseudo-narthex and/or portico entrance.

The area of the North Court is almost entirely surrounded by the north wing of Rooms I-XV, except for the southwestern corner where the court may or may not be connected with the Central Court. The central part of the court has been intentionally cleared of stones, probably relatively recently. Very little pottery was observed on the surface there.

Areas Outside Site 1

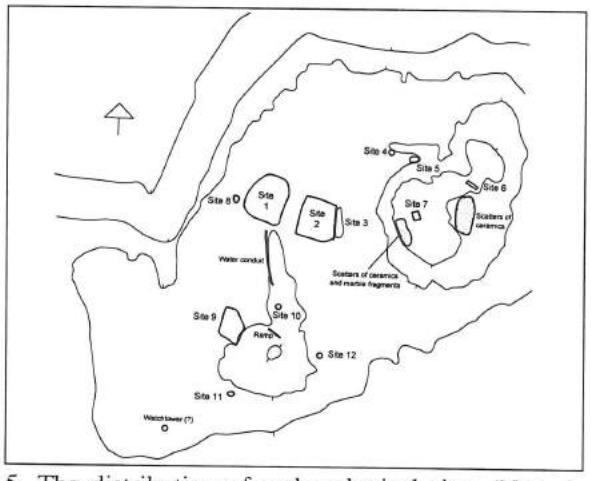
South of Site 1, there is a wall (the so-called SW Wall) which runs south from the area of the corner of the complex. The wall, which apparently stands directly upon the bedrock, is made of irregular and much weathered stones. A bronze coin was found near the determinable southern end of the wall. Judging from its size, the coin is probably a fourth century issue. Two other bronze coins were found previously in this area by the guard of the Muslim shrine. One may be Nabataean, the other of fourth century date. Ceramics were also present in this area, most notably fragments of large storage jars. The roughly rectangular area east of Site 1 is characterized by a high frequency of ceramic occurrence, definitely higher than the deposits inside Site 1. The ceramics include Nabataean, Roman and Byzantine wares. Some pieces of light greenish-glazed ware (Early Islamic?) were also found. Roof tiles, marble fragments, and lithics were observed on the surface.

Remains of a water conduit are located on the western side of the elongated, north-projecting promontory of the SW summit. The conduit, which is carved in the slope of the rock formation, still preserves a rectangular trough section in some places, but in other places the western side is completely eroded. It appears that the channel directed water from south to north, probably fed by rainwater which descended in natural drainage lines down the slope of the summit. The water seems to have been discharged in several places along the route of the conduit. However, the main place of discharge is near the northernmost tip of the promontory, thus very close to Site 1.

Other Archaeological Sites on the Plateau

While the 1997 archaeological reconnaissance was neither intensive nor systematic, altogether 12 archaeological sites or locations of definite past human activity were easily identified on the plateau or in its vicinity (Fig 5). The following is a brief presentation of these sites, in anticipation of their full exploration and recording during the future seasons of the project.

Site 2, being a very large enclosure consisting of four stone walls, has been briefly described (Peterman and Schick 1996: 475). The west, south, and north walls feature ir-



5. The distribution of archaeological sites (Nos. 1-12) noted during the 1997 FJHP archaeological reconnaissance of the plateau of the Jabal Hārūn mountain.

regular courses made of relatively flat rocks. The width of these walls does not exceed 1.5 m. The east wall is very poorly preserved. Gaps exist in this wall at the NE and SE corners, perhaps because of the modern (?) path which runs in that area. The amount of surface ceramics found inside the installation is greater than inside Site 1 but fewer than in the area between Sites 1 and 2. Few Nabataean sherds were found there, but coarse (and much worn) wares which may be Roman or Byzantine were numerous. One piece of Red African Slip ware, as well as some Early Islamic sherds, were also observed. The enclosure appears to be a large corral or pen rather than a cultivation terrace, although the remains of some attempt at terracing inside the enclosure can be noted. Due to considerable erosion in this area, the bedrock is visible in many places. Another large stone enclosure (Site 9) is located at the northwestern side of the SW summit. Its form is basically quadrangular, but the walls, except for the northern wall, do not run straight. The walls are made of irregular stones and the coursing is barely recognizable. The maximum length of the enclosure is ca. 44 m (N-S) on the western side, and ca. 50 m on the eastern side. The maximum width is ca. 40 m. A "ramp" or a rock-cut trough running SE-NW is visible along the eastern side of the enclosure. Perhaps the ramp originally channelled water down from the slopes of the SW summit into Site 9. As such, Site 9 might have been a water reservoir. The predominantly sandy deposition inside the enclosure appears to be water-borne.

Two potential cultic sites have been recorded. One of them (Site 4) is located at the NE end of the plateau, at the foot of the rocky slope of the NE summit. The bedrock directly adjacent to the foot of the slope had been chiselled out to form an incomplete band, ca. 0.3 -0.4 m wide and ca. 4.8 m in diameter, which follows the natural or enhanced curvature of the rock. It is possible that rectangular stones were fitted into the band to form a wall-like semi-rounded enclosure. Ca. 3 m up the slope and in front of the semicircle, are the much eroded remains of a rock-cut installation which looks like two seats, or niches without roofs. Two larger rock shelters and one small half-cave are located on the same level as the niches. Site 10 is located on the western side of the elongated, north-projecting promontory of the SW summit. The site is a natural rift or deep gully in the rock, probably human-enhanced, and ca. 7 m long. In a horizontal section, the rift appears as a trough which gradually widens toward its outlet on the western side. The interior surface of the trough is filled with reddish sand, but also with silt and clay. The outlet or "mouth" of the rift, ca. 1.2 m wide, is blocked by a pile of stones, perhaps originally an attempt at a dam. Both sides of the rift were originally mortared over. Traces of mortar, containing particles of crushed pottery, large-grain gravel, and very small pebbles, are still well visible. Both sides of the rift have niches carved out of the rocky surface: four on the southern side, and either three or five on the northern side. The interiors of the niches are badly weathered, but it appears that originally there were some carvings inside. Probably, the site was once a small water

reservoir (or drainage conduit) associated with some installations, probably of cultic nature. This association of a hydraulic installation with (cultic?) niches allows Site 10 to be tentatively dated to the Nabataean period.

Another water-related site (no. 8) was visited during the reconnaissance but not fully described. This site is located at the western foothill approach to the NE summit in a between-rock depression on the route to the southwestern peak which houses the Muslim shrine. The cistern is a masonry and rock-cut construction consisting of a large rectangular space with a roof supported by a series of arches. The rainwater was probably channelled inside from the surrounding high slopes. Future exploration should determine whether the cistern is Nabataean or Byzantine in date. Site 6, being a long flight of rock-cut steps, is located in roughly the same area between the northeastern and southwestern peaks of the NE summit. This route would presumably have been followed by anyone approaching the Jabal Hārūn mountain from the north or northeast.

Site 8 – a cluster of lithics – is located west of the SW wall described above in a flat area where numerous ceramics were also found. One suspects that erosion had a considerable impact on that area. The substantial concentration of lithics there included flint flakes and retouched flint tools. It is possible that the presence of lithics in this and other areas around the monastery site reflects early human habitation, the remains of which are perhaps still present underneath or close to the ruins of the monastery. Sites 11 and 12 appear to be the remains of very simple shelters or dwellings. The former is located on a long ledge on the southwestern side of the SW summit, while the latter is on the southeastern side of the same summit in a shallow but large rock-shelter. Both feature simple stone walls and small scatters of sherds nearby.

The existence of two other sites has been duly recorded, but no further investigation of them will be carried out. One of these is a graveyard (Site 3) located directly east of Site 2 on low ground which is often used as an alternative route to the high plateau of the Jabal Hārūn mountain. The graves are marked by standing stones - stelae - that lack any signs or inscriptions. The pattern of grave distribution is irregular. Local informants claim that the graveyard has not been recently used. The earlier remains under the Muslim shrine located on the highest peak of the mountain have also been entered in the site list as Site 7. However, as it is a sacral site of current importance and use, this site was not explored, nor will it be in the future. It is apparent, however, that the *welī* had been built on top of an earlier structure characterized by masonry-built walls. The artifacts scattered all around include some sherds and a considerable number of marble fragments. All of these primarily occur on the slopes and ledges in the area west and southwest of the peak with the *welī*. Previous explorers have suggested that a Byzantine church existed under the Muslim shrine (Peterman and Schick 1996: 475-477), a hypothesis which may be correct but will remain untestable.

Despite an intensive search, no new inscriptions or graffiti were found during this reconnaissance. A general lack of epigraphic finds *in situ* cannot be fully explained by the properties of the sandstone formations at the site (fragility, peeling off) combined with the rapid changes in temperature and climate affecting the preservation of the outer skin of the rock. There are numerous epigraphic finds primarily located at the highest point of the alternative (southern) route to the plateau. These are Greek, Nabataean and Arabic graffiti, and foot "imprints." Some must certainly relate to the pilgrimages to the Mount of Aaron. These are not discussed here since all of them were previously recorded. At any rate, there might also be cultural-historical reasons for

the relative scarcity of the epigraphic material in the area.

The Reconnaissance of the Environs of Jabal Hārūn

As for the environs of the Jabal Hārūn mountain, the archaeological reconnaissance concentrated on western and southern environs of the mountain, i.e., its slopes and surrounding wadis. The northwestern, northern, and eastern approaches to the mountain are much steeper than the aforementioned and will be investigated during the next season. The wadis in the area are part of a large catchment area that centers on the Wādī al-Farāsha. This wadi is the main runoff drain between the Jabal Hārūn and the Jabal al-Farāsha. It generally runs E-W, but then appears to turn sharply north upstream, passing on the western side of the Jabal Hārūn mountain. Numerous small-scale natural drainages, such as gullies and deep washouts, on the slopes, also converge on the Wādī al-Farāsha. The most significant ecological factor affecting the current appearance of the area is erosion. Heavy rains of short duration, usage by animals, and the lack of vegetation have all substantially contributed to the rapid progress of topsoil erosion.

The reconnaissance noted that the entire area south and west of the mountain was once a large-scale irrigated farmland which used natural drainages and artificial means of water catchment. The irrigation and cultivation methods observed during the 1997 season and briefly described below are unique neither for the Jabal Hārūn area nor for the entire region. In fact, remains of extensive terracing and wadi farming installations have already been noted in the area between Ṣabra and Jabal Hārūn (Lindner 1986:137-138, 140, Fig 2). Furthermore, variations of these methods used both in ancient times and recently can be found in many areas of the semi-arid lands of the Near East and North Africa. However, the Jabal Hārūn example is particularly interesting, in that it displays an exceptional concentration and intensity of irrigation installations in a relatively limited area, as well as a high level of technological concept, ingenuity in landscape utilization, and a considerable degree of interdependence among the elements of this irrigated farming system. The Jabal Hārūn environs undoubtedly present one of the best preserved examples of such systems in Jordan, if not in the entire region.

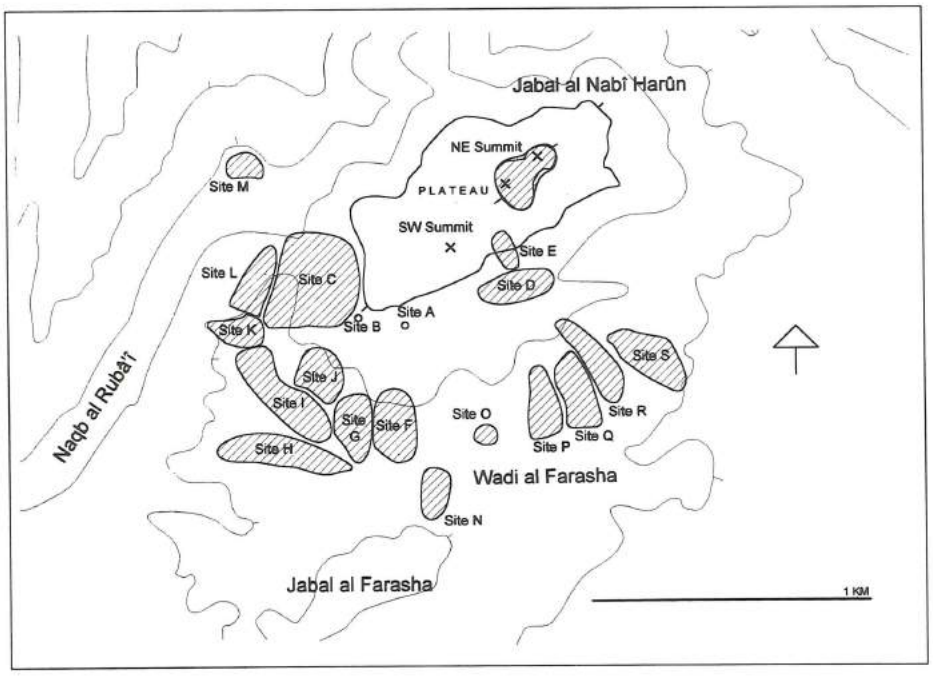
Two basic methods of farming evidenced in the Jabal Hārūn environs - slope terracing and wadi farming - have been extensively described before on the basis of examples elsewhere (e.g., Evenari and Koller 1956: 42-43; Hammond 1967: 38-39, Lawlor 1974: 81-85, Mayerson 1962). The terracing method utilizes retaining walls built on the slopes that support horizontal farming zones. The terraces are built in levels from the top to the bottom of the slope, converting the slope into a series of horizontal steps. The terrace walls retard the flow of rainwater and diminish the soil erosion from runoff. Particles of muddy soil floating in water are deposited on the horizontal levels, creating fertile ground for cultivation that is particularly suitable for orchards, groves, and vineyards.

Wadi farming is sometimes combined with the slope terracing method, but it has its own specific dynamics. A particularly informative description of this method was presented with regard to Nabataean-Byzantine irrigation technique in the Negev, where it was conveniently divided into tributary wadi cultivation and main wadi cultivation (Mayerson 1962: 212, 231-246; Figs. 4-6). Tributary wadi cultivation is employed in smaller wadis, ravines, as well as in the larger slope gullies or deep washouts that are often naturally created by runoff water. As the wadis are the natural rainwater drainages, winter rains generate substantial amounts of fast running floodwater

which converges upon the wadis and follows their dowstream orientation. The watercourse of a wadi is crossed by stone walls creating small plots of land at different descending levels, which are limited by the sides of the wadi. The walls serve to retard the velocity of rushing water at each level, while allowing for the deposition of fertile mud on the plots of land. Since the walls also raise the level of rushing water, its excess spills over laterally to higher areas along the sides of the wadi or is intentionally diverted there. Since hillslope terracing is not common in the Negev, the walls built across the wadis there were called "terrace walls." Technically, these walls are not dams (although they may look like them) and they often combine the function of terrace wall and check dam (Mayerson 1962: 233, note 1). To avoid terminological confusion with the retaining walls used in slope terracing, the terms "wadi terrace wall" or "barrage" will be used here. The Negev examples also feature stone walls which run parallel to the course of the wadi, but at varying heights of the slopes. If these turn in, and their ends run down the slope and link up with the wadi terrace-walls, the entire irrigated area of the wadi is enclosed.

Main wadi cultivation utilizes large wadis, usually being the centers of large catchment areas, and fed by several tributaries or slope gullies. The watercourse of such a wadi is an eroded, often stone-strewn channel which generally runs below the level of the soil-beds to its sides. In this case, rainwater is diverted from the watercourse and directed into terraced soil basins located along the banks of the wadi (Mayerson 1962: 241-246). Ancient barrages and diversion dams, which served to divert water higher up to the basins, are usually very poorly preserved in archaeological records, having been washed away and destroyed.

During the archaeological reconnaissance of the area west and south of the Jabal Hārūn mountain, well-preserved examples of the methods described above were observed. To avoid confusion, the sites described below are designated by alphabetic letters (Fig 6). Only Sites A (tool production station) and B (watch-tower?) represent different categories of archaeological sites in this list. All other sites (C-T) are variations in scale and combinations of slope terracing and tributary wadi cultivation. As such, these sites should be understood as relatively



6. The distribution of archaeological sites (A-T) noted during the 1997 FJHP archaeological reconnaissance of the western and southern environs of the Jabal Hārūn mountain.

large, intensive farming zones with hydraulic installations that border on each other and are often functionally interlocked, rather than as strictly delineated sites. It is less certain whether the main wadi cultivation method was practiced in the area. However, it is probable that Wādī al-Farāsha, the main drainage of the entire southern catchment area, once possessed installations characteristic of this method, especially in its main, southern section, which runs E-W.

In particular, Sites C-L reflect variations of tributary wadi cultivation, sometimes combined with slope terracing, based upon small tributary wadis of the Wādī al-Farāsha or upon deep gullies in the slope of the Jabal Hārūn mountain that also converge on that wadi. Considerable concentrations of fine alluvial deposits - silt, sand and mud - are much in evidence in the small, artificial fields created by the wadi terrace walls. In some cases these layers can reach a thickness of 5 m. Sites P-S are characterized by the predominance of slope terracing. The southern and southeastern gentle, lower slopes of the mountain would have provided a maximum of exposure to the sun, particularly conducive to the cultivation of specific crops there, even of horticulture or viticulture.

7. The system of wadi terrace walls, as preserved at Site C (photo by Jan Vihonen).

Site C appears as the most developed and best preserved example of tributary wadi cultivation. The area includes what appears to be the northernmost end of the main wadi itself. Two natural drainage gullies on the western slope of the mountain are cut by a series of barrages that are connected to the adjacent slope terraces. The main part of the system, which uses the bed of the Wādī al-Farāsha, includes at least 24 wadi terrace-walls[3] that created wide farming plateaus across the wadi course (Fig 7). An oval area partially surrounded by poorly preserved low walls exists at the northern extremity of the wadi. This seems to be a main catchment area for the rainwater from the western slope of the Jabal Hārūn, which then was directed downstream in the wadi. The northwestern hills contain small tributaries of the Wādī al-Farāsha, one of which has at least 6 barrages. There are remains of stone structures on the tops and slopes of the hills and hillocks which flank the Wādī al-Farāsha. Some may be threshing floors, and others shelters. Concentrations of sherds (mainly Nabataean and Byzantine) and some lithics were noted in the area. The continuation of Site C in the SE direction of the Wādī al-Farāsha is Site I.

No clearly defined habitation sites, either isolated dwellings or small farmsteads, were observed during the reconnaissance. A great number of caves of various sizes exist in the area, but most of them are "half-caves", that is, shallow rockshelters not suitable for occupation because of their small size, poor accessibility, or for topographical reasons. The caves visited during the 1997 season did not possess soil layers which could contain any cultural material. However, there are still some larger caves in the area which were certainly used for habitation during various periods, but these were not explored

3. Together with the adjacent Site 1.

during the reconnaissance.

Preliminary Conclusions

The earliest periods of human occupation in the area are difficult to discern, yet these left some tangible remains behind. The amount of lithic tools and refuse observed during the reconnaissance is considerable and points to human presence there during prehistoric periods. Prehistoric sites might have been located on the lower slopes of the Jabal Hārūn mountain, where numerous caves and rock-shelters exist, as well as in zones close to the banks of the Wādī al-Farāsha. Some of these find concentrations indicate only short-term human occupancy, but others may represent remains of more permanent habitation. However, no clearly defined dwelling site has been located, which may be due either to erosion and accumulation processes that either washed away or hid the site, or to the non-systematic character of the reconnaissance. The resources for tool production are easily available in the area. Flint and chert pebbles and nodules were sometimes visible in the bedrock but were even more often scattered on the soil surface. A variety of tools – scrapers, retouched blades, burins, points, "saws," "knives," borers and fragments of arrowheads–were noted. Some notched and denticulated implements, as well as microliths, were also found. On the basis of a rough evaluation of the flint and chert material, it seems probable that there was Middle Palaeolithic occupation in the area, exemplified by Levallois-technique tools, as well as Epipaleolitic occupation. Furthermore, fragments of some arrowheads and tools may indicate the presence of the Aceramic Neolithic and Neolithic industries, which are otherwise well-attested in the Petra area (e.g., Gebel 1986). On the plateau which contains the ruins of the monastery, only a thin layer of soil covers the sandstone bedrock. Hovewer, prominent concentrations of flint and chert tools and flakes were encountered there. The most considerable flint and chert clusters were observed on the southern and eastern side of the monastery. Other lithic material, such as fragments of polished stone utensils or assemblages of ornaments, were found in comparatively small quantities.

More uncertain is the evidence for pre-Classical habitation in the area. Some of the sherds noted in the environs of Jabal Hārūn possibly date to the Bronze or Iron Ages. There is no doubt, however, that the Jabal Hārūn area was inhabited during the Nabataean period. The impressive array of rain-water catchment installations which were found in the area, such as barrages, terraces and dams, may easily date to that period. Close parallels for such installations can be found in the al-Bayḍā area, although not on such an extensive scale when compared with the size of the area under cultivation. Slope terracing is also well evidenced in the area of the Wādī al-Ḥasa. The extensive waterworks and cultivation installations known from the Negev and comparable to the examples from the Jabal Hārūn area are considered to have been built when the region was most intensively inhabited and exploited during the Nabataean and Byzantine periods (Mayerson 1962: 232).

The nature of the farming activities in the area is worth further investigation. The intensive farming zones discerned during the reconnaissance appear as one large-scale complex, probably interconnected to utilize the natural resources to the maximum. The size and the obvious relationships between the installations in the adjacent zones may suggest large project under common administration and management. The possibility of a large estate, possibly royal, should not be excluded. The Nabataean remains on top of the Jabal Hārūn do not appear to be extensive and are primarily represented by the ceramics. However, it is possible that Site 1 could have developed in some form already in Nabataean times, per-

haps as a residential and/or administrative structure. The origins of the structures at the top of the southwestern peak may date to the Nabataean period as well; and that location would be particularly suitable for a large watchtower. On the other hand, small-scale supportive installations, such as storage facilities, threshing floors, cisterns, watchtowers, etc., probably exist in the area around the mountain and on the lower ground.

At any rate, it is evident that the area of Jabal Hārūn should be understood as a significant part of the agricultural hinterland that supported the existence of a large urban population at Petra and caravans of traders. Equally important is the understanding of the significance of the Jabal Hārūn area within the local settlement pattern in the entire area south of Petra, in which not only the settlement in Ṣabra but also the major southern caravan trails would seem to have played prominent role (see Zayadine 1992 for discussion).

One expects that the intensive farming in the environs of the mountain continued throughout the Roman period. However, the Byzantine period was definitely another period of extensive use of the mountain and the environs. There is little doubt that Site 1 was either built as or later converted/ modified to be used as a monastic establishment. The marble fragments found in association with Sites 1 and 7 indicate furniture usually associated with a Byzantine church. It is most plausible to think that in addition to a chapel or a small church which existed within the limits of the monastery located on the plateau, a church was also built on the top of the southwestern peak of the NE summit, as already postulated by earlier explorers. The monastery apparently continued the economic activities in the area already initiated during the previous periods. If the irrigation farming installations were not built in Nabataean times, they were certainly constructed during the Byzantine period. More probably, they were continuously used and maintained from the Nabataean period on through the Byzantine period. This economic relationship between monastery and attendant farming installations located in a mountainous environment may find its best parallels in the Byzantine monasteries located in the high terrain of southern and eastern Sinai and in some areas of the Judaean Desert (e.g., Finkelstein 1985; Hirschfeld 1992). The economic standing of the monastery would also have been enhanced by the pilgrimages and pious donations. The archaeological evidence for pilgrimages is not abundant, yet it is convincing and includes the already published short inscriptions, crosses and outlines of pilgrims' feet. While no new evidence for pilgrimages was found during the 1997 FJHP season, the already known examples were noted, especially in the area of the south-eastern approach to the mountain.

The written sources indicate that the monastery appears to have continued its existence at least up to the time of the Crusaders. Ceramics from the Islamic period were indeed found in the area. One may also assume that agricultural production also continued in the area, although perhaps not on the same scale. The time-period of the demise of permanent habitation of Jabal Hārūn will have to be established through archaeological excavations. Low-level farming activities in the area appear to have been continued in one form or another, and local informants possess a substantial knowledge of the agricultural exploitation of the area in the past 80 years. Comparative information from the Negev indicates that wadi farming methods continued to be used by the local Bedouin population there, as exemplified by the repair of the ancient installations, overlaying them with new ones, or constructing new installations fashioned after the ancient ones (Mayerson 1962: 232).

Future Research and Fieldwork of the FJHP

The archaeological reconnaissance has largely confirmed the historical interpretation of the area previously offered by scholars, but the results of the 1997 season allow more comprehensive statements concerning the past utilization of the area than before. The major new element in the interpretation concerns the evidence for the subsistence strategy pursued by the ancient inhabitants of the area. The ancient habitation of Jabal Hārūn should undoubtedly be understood in close connection with the extensive irrigation-enhanced farming in the western and southern environs of the mountain. The 1997 fieldwork of the FJHP has also substantially contributed to a better formulation of the research questions previously posed. At the present, the goals of the project may be fully defined in the following terms:

1- the nature of human occupation and its spatial and temporal variations in the area of Jabal Hārūn mountain throughout the ages, with special emphasis on the extent and nature of occupation at the site situated on the plateau of the mountain and recognized as a Byzantine monastery;
2- the patterns of human adaptation in the area, that is the techno-economic aspects of land utilization, including studies on ancient agriculture and resource exploitation;
3- the significance of the Jabal Hārūn area in a larger historical perspective, including especially the relationship of the site with Petra during the Nabataean through the Islamic periods.

These research goals will be addressed in a series of post-fieldwork seasonal reports to be submitted to the Department of Antiquities of Jordan and its annual publication. The final comprehensive publication of the project will be completed after the conclusion of the 5 years of fieldwork. Simultaneously, the non-research objectives of the project include the preservation of the monastery site, in terms of both its structural and artifactual remains, as well as the protection and presentation of the site for future researchers and visitors. To properly address all research questions and to fulfill all proposed objectives, the project will utilize the following multi-disciplinary means, understood in terms of methods, personnel, and equipment.

-*Archaeological study and fieldwork* will include selective excavations of the monastery site, test excavations of other structures and installations on the top of the plateau and in the area around the mountain, a total survey of the environs of the area, the analysis of the recovered data, and the preparation of the cultural history-oriented synthesis of the project.

-*Cartographic research and fieldwork* will be concerned with the preparation of visual locational tools needed in archaeological analysis (environs and site maps, 3-D computer-generated models), the creation of site ground-plans prior to and during the fieldwork, and the preparation of an operational computerized database for storing all archaeological data.

-*Architectural and historical studies* will concentrate on the uncovered architectural entities at the monastery site. The studies will include the general layout, the construction methods, and the known structural and functional parallels. Architects will also study the issues related to the landscape architecture, that is, relationships between the terrain and human-made structures. The historical research will be continued in order to find further information concerning Jabal Hārūn derived from written sources, including the Petra Papyri. Additionally, it will include studies of any new epigraphic material to be found.

- *Ecological studies* will include research related to the natural environment of the area, that is geomorphology, soils, rainfall

patterns, natural water-catchment areas, fauna and flora of the area, and natural resources - all with reference to past and present natural conditions. Studies will also be undertaken to better understand the irrigation and cultivation installations in the wadis in terms of actual food production. To this end, the project will also pursue comparative studies of parallel ethnographic examples of village-level hydraulic agriculture and statistical studies on the average yield from fields of particular size will be among the ecological studies undertaken in connection with the project.

- *Conservation of the site* will be carried out to preserve and protect not only all artifacts and features that will need special attention during and after the fieldwork; also, comprehensive site protection and presentation plan will be undertaken after the end of the project.

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