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Environmental Constraints for Human Settlement in the Baq'ah Valley

The Baq'ah Valley is a unique geomorphological feature on the central Transjordanian plateau. At an elevation of 625 meters above sea level, its flat, elliptical area (10 × 5 km.) stands in marked contrast to the surrounding terrain of hills and deep wadis cutting down to the Jordan Valley. The Baq'ah is situated near the midpoint of the large bend in the Wadi Zarqa at the intersection of three flexures in the earth's crust, contributing to its anomalous topographical character. In the Upper Cretaceous, it was the inverse of its present appearance, viz. an upthrust dome (anticline) of Cenomanian-Turonian limestone. The latter has been almost completely eroded away, exposing Lower Cretaceous Nubian Red Sandstone in many areas of the valley. Possibly an inland lake, as surmised by early explorers (such as Schumacher, Conder, and Mackenzie), existed here at various times before a permanent outlet through the Wadi Umm ad-Danānir was created on the northwestern side of the valley.

The end result of these geological processes in the post-Pleistocene period was a valley, appropriately named al-Baq'ah, deriving from the early Semitic root for 'valley'. Substantial amounts of eroded calcareous limestone became the common red Mediterranean soil (*terra rossa*). More technically, a reddish brown *Ap* soil horizon with 1–2 per cent humus is underlain by a brown *Bt* horizon with a higher mineral and moisture content, beneath which is usually a clay pan up to a meter thick overlying bedrock.

The density of perennial springs, which encircle the Baq'ah, is one of the highest on the plateau, comparable with the Jerash and Salt regions. A large aquifer accumulates on the southeast (near Şafūt) and drains to the northwest (towards the Umm ad-Danānir area) at about 120–150 meters below the surface. Consequently, the strongest springs are located on the southeast and northwest sides of the valley. The main Umm ad-Danānir spring, for example, discharges about 3 million cubic meters of water per year.

By combining irrigation with the semi-arid rainfall of ca. 400 millimeters per year that falls between October and May, modern farmers are able to raise two crops yearly in May and September, including a variety of cereals, fruits, and vegetables. Vineyards and olive orchards are restricted to stony

slopes on the surrounding hills. Lines of boulders, which weigh several tons each, along hillsides attest to an extensive terracing system in antiquity; the period(s) of their use has yet to be established. The earliest domesticated plant species thus far recovered is bread wheat (*Triticum durum*) from a Late Bronze (LB) II burial cave. However, the valley's obvious agricultural potential must have attracted human societies from an early date. Neolithic sickle blades with edge patinae from use, which were found in the vicinity of caves on the lower northwestern slopes, are highly suggestive. The earliest animal domesticates are sheep/goat, cow, donkey, and dog from several LB tombs and the corresponding occupation level at the nearby settlement site of Khirbet Umm ad-Danānir, but again this may well have to be adjusted upwards after fuller investigation. Inhabitants of the Baq'ah would not be confined to the valley, and by traveling 30–50 kilometers east to the desert steppes or west to the Jordan Valley, they could have exploited vastly different ecological zones. Spring migration of transhumant pastoralists, who also engage in limited agriculture, from the Jordan Valley to the Baq'ah occurs today, and likely reflects similar movements in the past. A symbiotic relationship between permanent residents and transhumants was probably already well-established in antiquity.

Being centrally located, the Baq'ah is readily accessible from all directions. To the west, ancient routes probably followed the Wadi Shu'eib and particularly the two branches of the Wadi Umm ad-Danānir up from the Jordan Valley. The modern road to Damascus, which cuts through the middle of the valley, may well approximate to the line of the ancient King's Highway. Before a direct bypass was created through the hills straight north, the road descended to the Wadi Zarqa through the northern branch of the Wadi ad-Danānir and then ascended via the Wadi Jerash back up to Jerash. Low rolling hills to the south and east of the Baq'ah are also easily passable.

Settlement patterns

A good soil, the availability of water year-round, an upland climate sustaining diverse plant and animal communities, and

1. *Landsat* view of the central Transjordanian plateau from an altitude of 912 kilometers. The Baq'ah Valley is indicated by an arrow. (Photograph: EROS Data Center.)



2. The spring of 'Ain Umm ad-Danānīr. A late Bronze–early Iron clay source was discovered 10 centimeters below the surface along the stream bed. (Photograph: P. McGovern.)



strategic location would appear to have been the main determinants for human settlement in the Baq'ah. This was borne out by a systematic survey of the northwestern Umm ad-Danānīr area of the valley, which has an unusually high concentration of perennial springs. Archaeological evidence for virtually every period from the late Middle Palaeolithic (ca. 45,000 BP) up to the present was found. Major periods as yet unattested include Early Bronze I, 'Abbāsīd, and Fātimīd; more intensive exploration in other parts of the valley may fill in these gaps.

Pre-Bronze Age remains are limited to clusters of lithics on the lower slopes of Jebel al-Hawāyah and Jebel al-Qeṣīr, which may represent encampments (along a lake shore?) or, more likely, washout from nearby caves. Urban settlement begins at least by Early Bronze II. The very impressive site of al-Qeṣīr ('the fortress'), with the outlines of many stone structures still visible on the surface, covers the 5 hectare summit of the hill of the same name at an elevation of about

800 meters above sea level. A still well-preserved, encircling fortification wall further enhances the site's excellent defensive position. Since perennial springs on the north and south ends of the hill could only be reached by difficult climbs with a 200 meter change in elevation, defensive considerations must have been all-important. Huge cisterns, which were hewn out of bedrock on the four sides of the summit, were probably the principal water sources. Occupation continued at the site through Early Bronze IV.

By the late Middle Bronze Age, settlement had moved downhill on the northwestern flank of Jebel al-Qeṣīr, closer to the spring of 'Ain Umm ad-Danānīr. The site of Khirbet Umm ad-Danānīr is located on a series of terraces which are again highly defensible; a sheer cliff dropping 30 meters separates the lowest terrace from the wadi below. The site is ideally situated to guard one of the northwestern passes to the Baq'ah and monitor movements along the southern branch of the Wadi Umm ad-Danānīr. Based on limited excavation in 1980 and 1981, a stratified sequence extending from the late Middle Bronze Age through the Byzantine period can be projected. The most important periods appear to be LB (ca. 1600–1200 BC), Iron IIC/Persian (ca. 650–500 BC), and Early Roman III (4 BC–AD 73). A probable outer city wall, which was comprised of two lines of roughly shaped boulders with an overall width of 1½–2 meters, was traced by making a detailed surface site plan. The 2½ hectare area enclosed by the wall would make Khirbet Umm ad-Danānīr one of the largest known stratified sites in the Amman region. An indication of the depth of stratified deposits came from an area in which, 2 meters below the surface, a wall of the same type as the proposed city wall was found. The wall had been covered by a thick ashy layer, which continued down alongside it for over a meter. At this point, a deep pit, whose clay lining was contiguous with a surface running up to the wall, was discovered; the pit yielded the charred remains of a variety of animals (cow, donkey, sheep/goat, and a carnivore) and pottery belonging exclusively to the LB II period. Similar pit deposits occur elsewhere in LB Palestine (e.g., Lachish). The pit's direct association with a massive wall points to a well-established sedentary community at Khirbet Umm ad-Danānīr in the Late Bronze Age.

In LB and the late Iron Age, which were especially prosperous, settlement expanded into other parts of the valley, probably to exploit maximally its agricultural potential. Rujm al-Ḥenū East and West exemplify this development. The eastern building (*Quadratbau* type) may have been constructed in LB, judging from the earliest pottery recovered there. It appears to have been subsequently dismantled and its uniformly large boulders (over a meter in length) then used for the corners and towers of the late Iron *qasr* type building to its west. The latter has a single occupational surface (clay above bedrock), which is sealed beneath a 3 meter deep wall collapse.

Numerous Iron IIC/Persian *qasr* and *rujm malfūf* type structures are scattered throughout the Baq'ah, some isolated

3. Wheat fields of the Umm ad-Danānīr region contrast with the more barren surrounding hills. (Photograph: P. McGovern.)



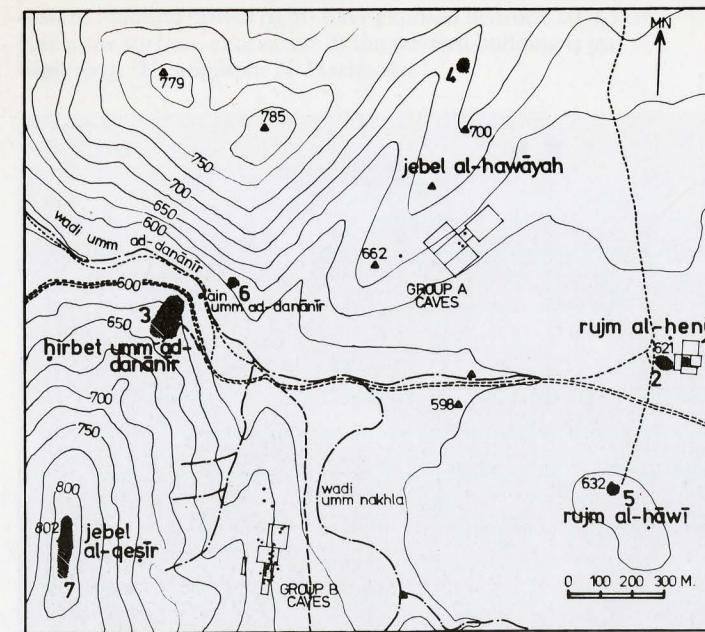
and others combined together to form extensive complexes (e.g., Khirbet Miḏmār near the center of the valley). The settlement pattern correlates with construction on exposed outcrops of bedrock and proximity to arable land. Even Rujm al-Ḥenū East, with no bedrock visible on the surface, was shown by resistivity surveying and test soundings to have been built on a rise in bedrock, which may well have been exposed at the time of construction. Significantly, some of the late Iron buildings are located in side wadis, away from the main routes, and could hardly be border posts, guarding approaches to Amman, according to the standard hypothesis. A defensive function, however, cannot be totally excluded for some of the buildings. Rujm al-Ḥenū West and Rujm al-Ḥawī, for example, are virtually mirror images of one another, equidistant from the main road (which may coincide with the ancient route), and both have towers facing the road and the northwestern Umm ad-Danānīr pass. They are probably best understood as fortified border stations with complementary domestic functions. The roughly shaped boulders

of limestone, chert, and sandstone used in the construction of such buildings could be gathered from wadi beds or quarried from nearby hills. The so-called 'megalithic' architectural style has a long history in the Amman area, extending from at least the Late Bronze Age to Roman times.

Technologies

Natural resources other than water, soil, and plant and animal species invited human settlement in the Baq'ah. The valley has one of the largest deposits of clay in Jordan—a fine kaolin, which is still used to make most of the modern pottery and bricks. Chemical and petrographic studies of a sequence of LB-Iron IA pottery (ca. 1600–1100 BC) from burial caves and Khirbet Umm ad-Danānīr, together with comparable examination of clay, limestone, and sandstone samples gathered in the Baq'ah and its environs, have demonstrated that the same clay bed was used in the Umm ad-Danānīr area throughout this period. It is located in the wadi below Khirbet Umm ad-Danānīr, next to the perennial spring. Considering

4. Umm ad-Danānīr Region, Baq'ah Valley, Jordan.



Legend
 Site
 Grid
 Caves
 Roads
 Wadi
 Spring
 Trig. Point

Ref: 1: 10,000 Zarqa Basin sheets 27/64 & 19/64.
 Jordan Department of Lands & Surveys, 1950.

the ready availability of water, clay and temper, which could be derived either from riverine deposits or outcrops of soft limestone and sandstone, this is an ideal spot for pottery manufacture. Prevailing westerlies would have helped in firing the kilns (not as yet located), besides minimizing air pollution.

Although the same clay source continued to be used for about 500 years, a gradual transformation in pottery technology during the same period was revealed by petrographic, refring, radiographic, and replicative studies. The fine LB I wares are tempered almost exclusively with 5–10 per cent quartz and/or calcite, and are very well fired (approximately 900°C). In LB II, the absolute amounts of temper increase to as high as 20 per cent. Vessels are also less well formed, and have off-center bodies, very thick ring bases, and careless surface finishes. This trend continues into Iron IA when heavily calcite-tempered pottery is common. Perhaps to avoid calcite disintegration and popping, lower temperatures (only up to 600°C) are now the rule. A marked change in some of the LB types and the appearance of completely new forms (e.g., the round-bodied cooking pot with a single loop handle) may possibly be the result of adapting fabrication techniques to the heavily tempered calcite wares. Hand-made vessels, specifically those built up by coiling, can be made with larger dimensions and thinner walls and bases than is possible on a wheel (e.g., kraters, which become very popular in Iron IA). Preliminary results from a detailed radiographic analysis suggest that a slow wheel or tournette continued to be used

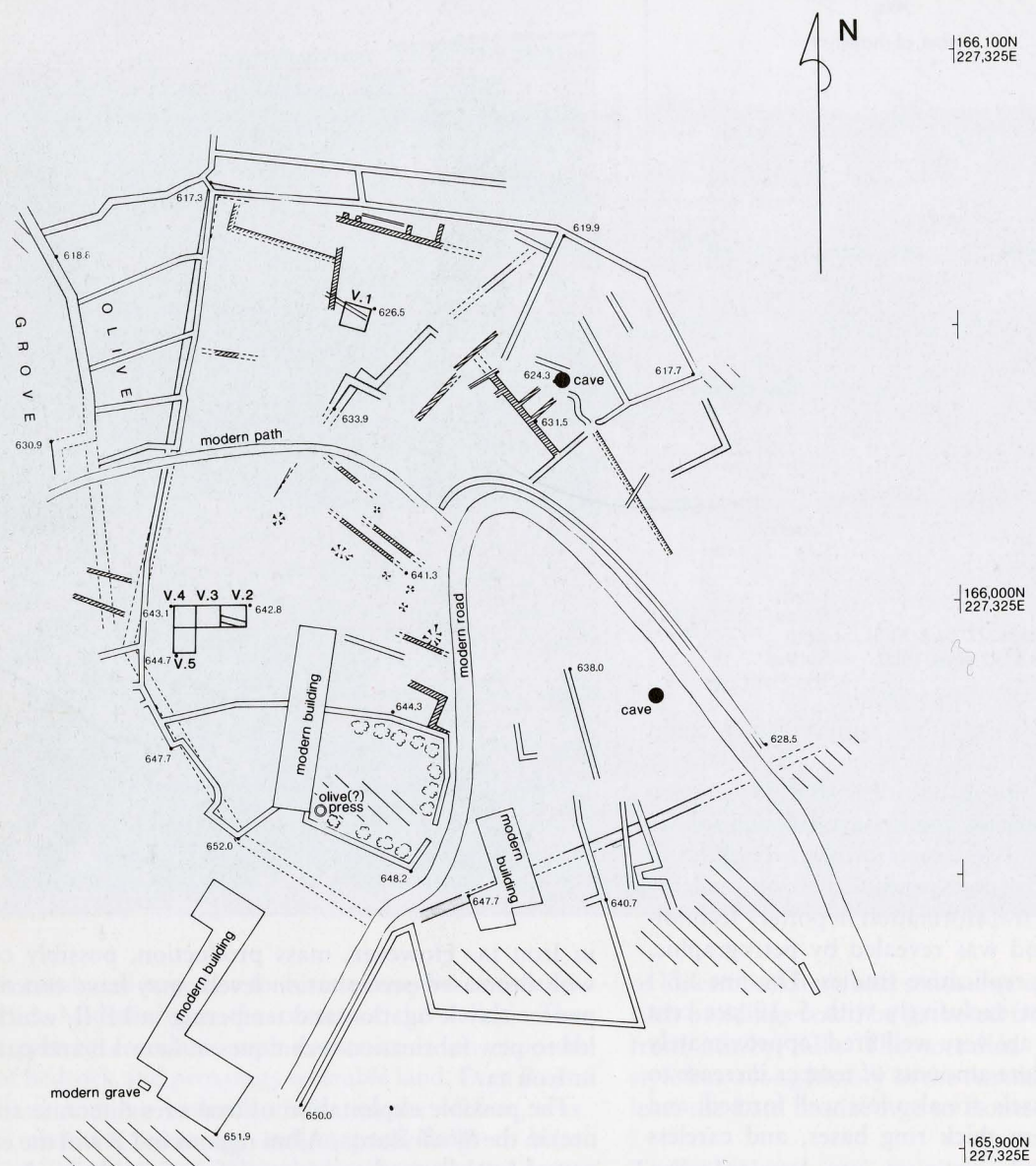
5. Khirbet Umm ad-Danānīr with the Wadi Umm ad-Danānīr visible in the background. (Photograph: P. McGovern.)



in Iron IA. However, mass production, possibly combined with decreased precipitation levels, may have contributed to poorer clay levigation and tempering in LB II, which in turn led to new fabrication techniques in later LB and particularly in Iron IA.

The possible exploitation of iron ores (limonite and hematite) in the Wadi Zarqa/Ajlun regions in LB and the early Iron period has assumed greater significance with the discovery of over twenty mild steel anklets, bracelets, and rings in an Iron IA burial cave (A4) in the Baq'ah. The specimens are remarkably well-preserved; several have completely intact metal beneath a thin layer of surface oxidation. They more than triple the number of published iron objects from Iron IA Palestine, and represent a seven-fold increase for Transjordan. A careful study of the microstructure revealed that the iron is actually a mild steel with about a half per cent of carbon diffused uniformly through the cross-section of some of the pieces. The metal was worked at temperatures above 700°C in a reducing atmosphere in close contact with charcoal, and then allowed to cool slowly. Since only jewelry was found,

6. Surface architectural features at Khirbet Umm ad-Danānīr. The proposed outer city wall (dashed and solid lines) is most clearly defined on the west and south sides of the site; to the north and east, it either passes under modern terrace walls or has been washed downhill.



UMM AD-DANĀNĪR
Field V: Site Plan



7. Aerial view of Ruĵm al-Ĥenū, looking northwest from an altitude of about 100 meters. Soundings on the interior and exterior of the eastern building (lower right) have exposed bedrock 20–65 cm. below the surface; excavation at the western building is just beginning. (Photograph: N. Hartmann.)



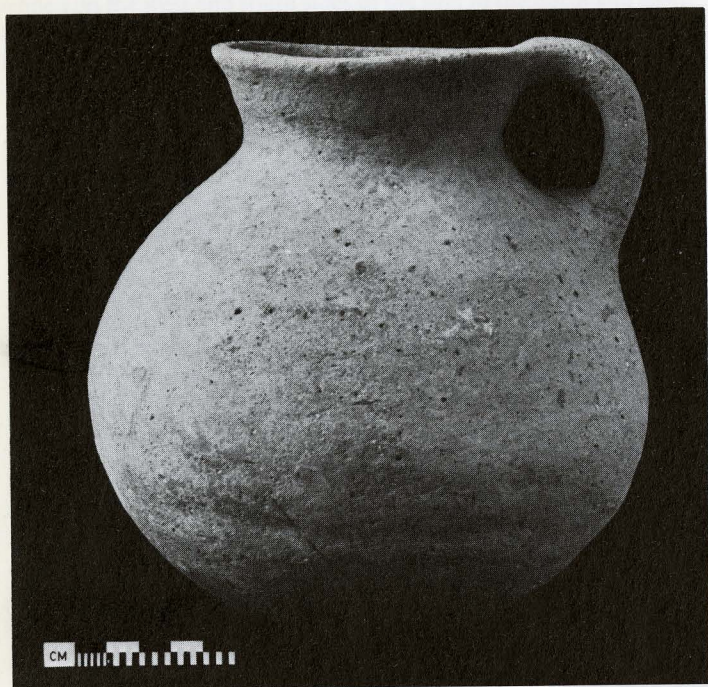
aesthetics may have been the prime motivation in this major technological innovation. Perhaps the goal was a certain color, surface texture, or the sound of two pieces (anklets and bracelets were normally worn in pairs) jingling together. This might help to explain the total lack of weaponry and tools, including those of copper or bronze, in the tomb. On the other hand, their absence is in direct contradiction to the usual interpretation that the transitional LB-early Iron period on the central Transjordanian plateau was a time of disruption and war. The steel jewelry does appear to have been produced locally, since, apart from various species of Mediterranean and Red Sea molluscs, the remaining burial goods in this tomb, associated with 227 individuals, are most likely local (e.g., 72 whole vessels, as confirmed by chemical and petrographic analyses). As a working hypothesis then, more intensive survey work in the Wadi Zarqa/Ajlun regions

may well lead to the discovery of Iron I iron ore smelters and iron and steel workshops, which should clarify some of the problems raised above. An oxidized fragment of an iron anklet/bracelet from an LB II tomb in the Baq'ah further suggests that the iron/steel industry predates 1200 BC.

A high level of technological sophistication is also evidenced from the consistently high levels of tin (averaging 11 per cent) found in the Iron IA bronze jewelry. In view of the much wider chemical variation of the LB bronze artifacts, the melting down of old tin bronzes does not seem likely. If the tin trade routes were indeed cut off around 1200 BC, as some argue, then imported tin would not have been available to add in fixed amounts. In some still undetermined fashion, the early Iron metalsmiths were apparently able to achieve what earlier and otherwise more sophisticated societies could not.

Although the glass/frit/faience industry declined signi-

8. Iron I cooking pot. Note the undulating sidewalls, suggesting that they were coil-built. (Photograph: N. Hartmann.)



9. Mild steel anklet with overlapping ends. (Photograph: N. Hartmann.)



ificantly after 1200 BC, seven examples of a dark red glass had extremely high levels of iron oxide (up to 50 per cent; by contrast, 5–10 per cent is standard for LB red glass). Their limited numbers indicate that they were not the main goal of production. It is possible that they derive from iron ore slag, and represent a spin-off from the metals industry.

Conclusion and future prospects

As a relatively self-contained geographical entity, the Baq'ah Valley is a logical regional unit for reconstructing settlement patterns, economic resource exploitation, and other aspects of environmental archaeology. Future work at Khirbet Umm ad-Danānīr and the Early Bronze site of al-Qeṣīr will focus on the social and economic underpinnings of the more important archaeological periods by excavating workshops in particular. This data must then be dovetailed with environmental and archaeological data from the rest of the valley. Concurrent work on the southeastern periphery of the Baq'ah at Tell Ṣafūt, which is delimited by similar environmental constraints (perennial springs, defensible position, clay deposits, etc.) as the Umm ad-Danānīr area, will be especially important. For understanding wider ranging trade connections and the movement of transhumants, a survey north and northeast of the Baq'ah as far as the Wadi Zarqa is planned. This will include the iron smelting site of Abū Thawab, which may have some bearing on the early Iron iron/steel industry. Quite possibly, other LB or early Iron sites will be found in this expanded survey area that may shed light on the origins of the early Iron Age Transjordanian kingdoms.

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