Return of Explorers Club Flag # 117

Deep-time archaeology and ancient metallurgy in southern Jordan.

By Thomas E. Levy

Our fall 2011 UC San Diego (UCSD) expedition to the southern Levant's largest copper ore resource zone in Faynan was initially aimed at trying to understand the social and economic organization of the Iron Age (ca. 1200 – 500 BC) copper mining and metallurgy network that spread over this area during its apex in the 10th and 9th centuries BC. This period coincides with the early Hebrew kings (David and Solomon), one of the few Pharaohs mentioned by name in the Old Testament (Shishaq or Shoshenq I), the Edomites and others. Situated ca. 50 km southeast of the Dead Sea and 25 km northwest of hidden Nabatean city of Petra, it is in the Saharo-Arabian desert zone. Our earlier work (2002 – 2010) in the area included large-scale excavations and intensive field surveys that revealed hundred of mines, a copper production town (Khirbat en-Nahas), fortresses, processing sites and more. However, all these sites are located in remote dry valleys (Wadi), far from any water source today. British colleagues, coordinated by Graeme Barker of Cambridge University, had worked in the more water-rich eastern sector of carrying out surface surveys and environmental studies of Khirbat Faynan and its surroundings from 1994 to 2004. They recorded hundreds of ancient agricultural terraces in the vicinity of the mound (Arabic – tell). Massive architectural remains are visible on the site surface today. The British research, and a small excavation of an Iron Age copper smelting area on the eastern edge of Khirbat Faynan by Andreas Hauptmann in the early 1990s suggested that this site was indeed the political and economic center of the Iron Age copper industry in Faynan. How then to tackle excavating a massive ancient mound spreading over 15 hectares (ca. 38 acres) and thick with over 39 meters (ca. 128 feet) of archaeological deposits?

Figure 1. Aerial view of Khirbat Faynan (Biblical Punon) and 2011 excavation trench on western side of the mound. Image taken with new aerial stabilization system designed by undergraduates in UCSD National Geographic Engineers for Exploration program. Photo – UCSD Cyber-archaeology and Levantine Archaeology Labs.

The logistics of excavating Khirbat Faynan would not be easy. After packing up our supplies in Amman in late September, my graduate students and I drove down the Dead Sea valley to the research area in a convoy of 5 off-road trucks and arrived late at night. My research partner, Mohammad Najjar, was waiting for us at his isolated house some 3 km from Khirbat Faynan, on the edge of a Rashaida Bedouin village. Rather than go back to our old base-camp that night, some 12 km downstream, Mohammad suggested we throw our sleeping bags down inside his compound and in the morning build our tents at the old camped. On waking up I saw an abandoned unfinished two-story building on the edge of the property. Undergoing an immediate epiphany (these things happen in this desert!), I asked Mohammad if, provided we finished the building, it could serve as our new research center. He agreed and we were ready to start. Our team spent the next two days moving tons of excavation and camp equipment from the old camp (near the Bedouin village of Quraiqira and our old friends from the Amarin tribe) to the new research center near the Faynan village and our new friends from the Rashaida tribe. We set up our 12 of our army tents in the back of the new center. It would take another month for Egyptian guest workers to finish the building. When it was near completion, we named the 'dig house' – Qasr Faynan (Arabic = the Castle of Faynan).

As soon as the move was complete, we set out to use an RTK (Real Time Kinematic) GPS system, with Fawwaz Ishakat, to establish survey control points for our excavation. In tandem with this, aerial photographs were made of Khirbat Faynan and other local sites with our new stabilized aerial camera platform for a helium balloon. This platform allows total camera control, extended range, and an embedded system that connects with a field computer on the same wireless local area network. Our team, under the supervision of Ian Jones, was also beginning to sample a copper production village called Nuqayb al-Asaymir located in a remote Wadi about a 1 ½ hour off-road drive from our new base-camp. By day-three, fieldwork progressing brilliantly, however, things began to change radically that night when a contingent of Rashaida Bedouin came to call at our camp.

Although the Rashaida and Amarin belong to the same Howeitat tribal confederation (the Howeitat played an important role in the Arab Revolt and are described in T.E. Lawrence's *Seven Pillars of Wisdom*), each has their own Sheiks, territories, and traditions of competition. Our moving into the Rashaida area meant we had a lot of explaining to do, juggling of our Bedouin staff, addressing hurt feelings and more. After a week of delicate late night discussions, suggestions that people could get hurt, endless cups of sweet Bedouin tea, and new alignments, we succeeded in building a new social setting for exploring the amazing ancient mound at Khirbat Faynan.

Figure 2. Atalah Rashaida (left) served as dig foreman in 2011. Department of Antiquities of Jordan project representative, Abel'rahim Al Dwikat (right), was of invaluable help in establishing the new expedition camp in Faynan. Photo – T.E. Levy, Photo – UCSD Cyber-archaeology and Levantine Archaeology Labs.

Figure 3. Hashem, Egyptian guest worker in Faynan, applies stucco to new expedition research center – Qasr Faynan. Photo – T.E. Levy, UCSD Cyber-archaeology and Levantine Archaeology Labs.

Figure 4. Expedition tents as seen from new Qasr Faynan research center. Photo – T.E. Levy, UCSD Cyber-archaeology and Levantine Archaeology Labs.

In the shadow of those contentious early days, we carried out an impressive range of field research. In addition to probing the Islamic copper production site, initiating a 3D LiDAR survey, we conducted a geophysical survey at Khirbat Faynan and test excavations behind ten of the agricultural terraces first recorded by our British colleagues. The probes were supervised by Kyle Knabb to clarify the dating and geochemistry of the soils associated with the ancient field systems. This sample will help us understand shifting patterns of land use through time around the mound.

Figure 5. Test pit next in ancient field system reveals an upper terrace wall and lower one. OSL (Optically stimulated luminescence) dating is being applied here. The field systems were linked to Khirbat Faynan in the background (left). Photo – T.E. Levy, UCSD Cyber and Levantine Archaeology Labs.

Under the direction of Spanish geophysicist Alex Novo Lamoso, the lower slopes of the site were imaged using a *Profiler EMP-400* (GSSI, US) Electro-Magnetic Induction (EMI) tool. This enabled Alex, with Matt Vincent, to cover several hectares in a week. The steep slopes and acropolis of the site could not be reached because of the difficult topography that precluded near-surface detection of archaeological features. By the end of the first three weeks, we had made a geophysical map extending over 6 hectares (ca. 15 acres). Since fairly reliable Internet coverage reached Faynan over the past two years, it was now possible to send our data, on a daily basis to our colleague, Gianfranco Morellit of Geostudi

Astier in Livorno, Italy for data processing. This large-scale geophysical map helped us select where to initiate our excavations. We identified clusters of sub-surface architecture, including an area to the north of the site that may be an Iron Age settlement linked to agricultural terrace systems that provided crops for the copper industry in Biblical times. We also carried out more detailed 3D geophysical work using Electrical Resistivity Tomography (ERT) with the aim of recording vertical slices of an open terrace area on the west side of the mound every 0.5 m, along 6 meter sections with 48 electrode arrays and six 'slices'. The EMI results and cluster of walls and depth of archaeological deposits that came to light with ERT, suggested that we establish our major excavation trench in this area.

Figure 6. Geophysicist Alex Novo Lamoso takes ERT geophysical readings on the ancient mound of Khirbat Faynan (Biblical Punon), Jordan. Photo - Photo – UCSD Cyber and Levantine Archaeology Labs.

Our geophysical prospecting paid off. Considering that Khirbat Faynan is over 700 meters in length, a 5 m x 40 m trench may not sound very large. However, it takes a team of about 30 students and workers to carefully excavate such an exposure using the latest cyber-archaeology techniques like real-time GIS recording to do the job right. We had hoped to find extensive evidence of an Iron Age settlement on the mound our first season. However, field archaeology is like a crapshoot and we did not find what we were looking for this first season of exploration. Instead, we found remarkable evidence for other periods linked to ancient mining, metallurgy and settlement in the region – the Early Bronze Age and the Roman/Byzantine periods.

The first spike in copper production in Faynan coincides with the beginning of urbanism in the eastern Mediterranean during the Early Bronze Age (EBA; ca. 3300 – 2000 BCE). In 1999 – 2000, we discovered the best-preserved copper manufactory from that formative period in Middle East at a site called Khirbat Hamra Ifdan (KHI) located around 12km downstream from KF. The site was amazing because our excavations revealed over 70 rooms, courtyards, alleys and other architectural units that were connected with copper production. We found thousands of casting molds for final products such as axes, chisels, pins and ingots were clustered in different parts of this EBA III (ca. 2700 – 2200 BCE) site. GIS distribution maps helped us identify the flow of production where casting, hammering and finishing took place. Was this the biggest Early Bronze Age copper production site in the Middle East? Not necessarily. However, radiocarbon dates show that the site suffered an earthquake, sometime between 2500 to 2300 BCE causing the mud-brick walls of the settlement to collapse and seal the thousands of copper production artifacts 'in situ'. This is what archaeologists call the 'Pompeii effect' where a natural castrophe can fortuitously preserve an ancient site. This is what has made KHI the best-preserved and largest assemblage of EBA archaeometallurgical remains in the Middle East. We published this work in the British journal *Antiquity*, which sparked international media attention to this early phase of 'industrialization' of copper production in Faynan.

Figure 7. Aerial view of the Early Bronze III (ca. 2700 – 2200 BCE) copper production village, Khirbat Hamra Ifdan, Jordan. The 2011 excavation probe can be seen bottom, right with excavation team. Photo - Photo – UCSD Cyber and Levantine Archaeology Labs.

As part of our 2011 Flag Expedition, during the early weeks of the project, Aaron Gidding supervised a small sounding at KHI to re-examine the site stratigraphy. During the course of the test excavation, we found the largest EBA III copper axe (over 19 cm in length) to date from KHI. It is remarkably similar to contemporary examples recently found in a hoard of Old Kingdom copper axes in the burial chamber of Qar junior, son of an Egyptian vizier, in Abu Sir by the Mirek Barta of the Czech Institute of Archaeology. Our previous trace element analyses of copper ingots from KHI and contemporary sites in Israel's Negev desert help us identify Faynan as the source of an important eastern Mediterranean copper trade in Old Kingdom times that may have reached the Nile valley. Hopefully, with the recent changes in the Egyptian government, a more open policy will develop that will enable researchers to carryout scientific analyses of samples that will help solve mysteries of ancient trade.

By exposing a beautifully preserved EBA III building complex at Khirbat Faynan this past season, we have identified the place where extensive excavations can possibly reveal the subsistence and perhaps economic, center of copper production when the earliest cities in the southern Levant flourished. A network of rooms was found on a terrace on the mound with typical EBA III Jordanian red-burnished pottery and flint tools typical of this period. The rooms were carefully constructed to take advantage of the topography at the site. This area will be one of the foci of our forthcoming expedition.

Figure 8. A series of small rectangular rooms, dating to the EBA III were found on an expansive terrace in the upper portion of the 2011 excavation. Photo – T.E. Levy, Photo – UCSD Cyber and Levantine Archaeology Labs.

The other remarkable discovery concerns a 'looter's pit' that Ashley Richter found while doing a detailed LiDAR survey of the entire Khirbat Faynan site. When the dust had settled and our new research center was in operation, I found time to visit Ashley who has spent days working on a remote part of the site. The LiDAR point cloud data can serve as a kind of geo-referenced 'scaffold' on which we will drape a

wide range of data – Geographic Information System (GIS), X-ray fluorescence (XRF) non-destructive chemical analyses of artifacts, HD (High Definition) photography and more. Walking over to the 'pit,' I was astounded. There was an opening in a depression at the base of a massive stone-block covered mound. On entering, two beautifully constructed stone arches with plastered walls painted with remnants of color and applied decoration could be seen. Amongst the collapsed stone blocks was a carefully hewn triangular block that may have been part of the burial monument's superstructure. Unfortunately, strewn about the exterior of the pit were broken pottery sherds and human bone. Robbers had penetrated one small room of a much larger mortuary complex whose date falls somewhere in the late Roman or Byzantine period. As a holiday was approaching, we decided to sieve all the back-dirt from the tomb robbers and spend an entire day carefully back-filling the opening to prevent further looting. The tomb is now sealed and awaits our next expedition.

Figure 9. Tom Levy at entrance to the looted late Roman/Byzantine tomb recently found at Khirbat Faynan, Jordan. Photo – UCSD Cyber and Levantine Archaeology Labs.

Damnatio ad metalla! Condemned to the Mines! This was a type of punishment described by the Roman historian, Eusebius (ca. AD 263 – 339). He lived in the port city of Caesarea located along the coast of modern Israel. Eusebius writes in detail about Christians condemned to the mines in Faynan – "These had first their right eyes and sinews of their left feet destroyed by branding irons and the sword, and afterward they were given over to the mines to dig copper" (in *The Ecclesiastical History and the Martyrs of Palestine*, MP 13.1). While there is no doubt

that mining and metallurgy was carried out on an industrial scale in the Late Roman period, researchers are divided as to whether it continued in the following Byzantine period. These questions make it compelling to fully excavate the newly discovered enigmatic tomb complex to understand who is buried there, where they came from, and what their role was in Faynan society during the Classical periods.

Figure 10. Surrounded by goat dung, Howeid Sayadin, project member, squats next to one of the pillars in the Roman mine at Umm al-Amad, Jordan. Photo – T.E. Levy, UCSD Cyber and Levantine Archaeology Labs.

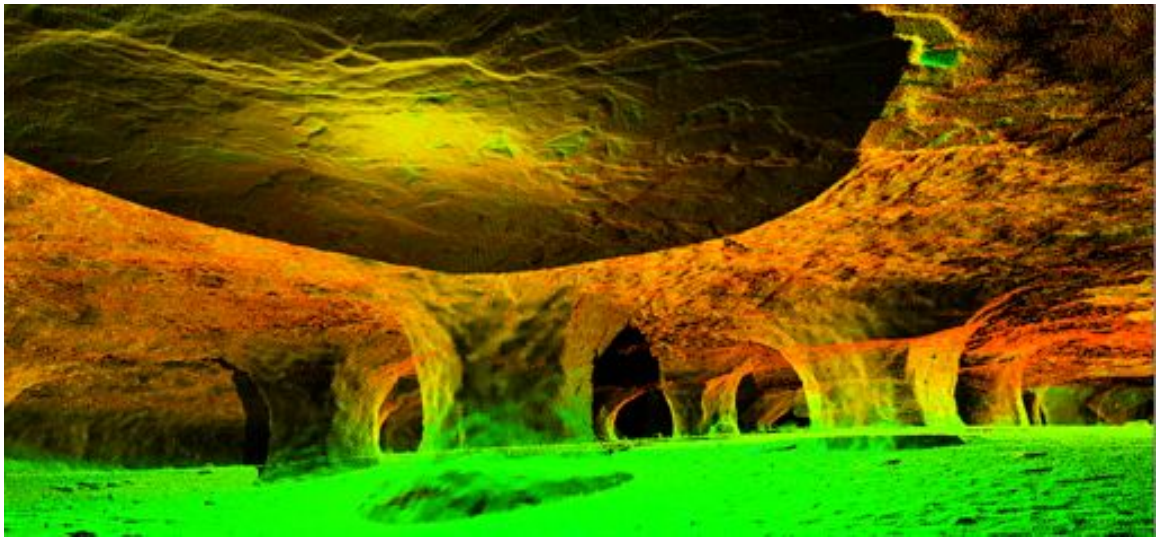

Figure 11. LiDAR laser-scan inside the late Roman period mine at Umm al-Amad, Jordan. The pillars were carved into the native rock and left to hold up the ceiling. Average height here = ca. 1.8 meters. Image – UCSD Cyber and Levantine Archaeology Labs.

Our understanding of the scale of late Roman mining in Faynan was further bolstered at the end of the 2011 expedition. News reached us that a road was being constructed near one of the largest ancient mining complexes in the Roman world and that is was in danger of destruction. The site is called Umm al-Amad (Mother of Pillars) and it is located high up in the mountains overlooking Faynan. First discovered by the American archaeologist Nelson Glueck in the 1930s, it is perhaps the best-preserved Roman pillar mine. Mohammad Najjar suggested we go up the mountain and scan the site. The mine extends into the mountain for over 150 meters, and one has to crawl over centuries of goat dung to enter the labyrinth. Those unfortunate souls who were condemned to work here, extracted the ore body and left bedrock pillars that they carefully carved to hold up the ceiling. Armed with our extremely heavy LiDAR instrument, we hiked from a remote dirt road to the mines and spent a day making the first LiDAR record of this magnificent tribute to ancient engineers and their unfortunate workforce. We hope the road will not reach this spectacular ancient industrial heritage site.

Figure 12. Expedition team with Flag No. 117 in the Faynan district. First row, from right: Co-director, Mohammad Najjar, Alina Levy, PI and co-director, Tom Levy and team. Photo – T.E. Levy, UCSD Cyber and Levantine Archaeology Labs.