Ain al Ragaye: a tunnel for exploitation of natural spring in Shawbak Castle (Jordan)

Ezio Burri[1,2], Carlo Germani[1], Massimo Mancini[1,3], Michele Nucciotti[4], Mario Parise[1,5], Guido Vannini[4]

[1] *Italian Speleological Society – Artificial Cavities Commission*
[2] *University of L'Aquila – Department of Environmental Sciences*
[3] *University of Molise, Campobasso*
[4] *University of Florence – Department of Historical and Geographical Studies*
[5] *CNR/IRPI, Bari*

Abstract

Description of a manmade tunnel built inside Shawbak Castle for exploitation of a natural spring. The tunnel structure tunnel is quite unusual as it descends using a short helical course combined with a gradient angle to allow ease of water container transportation. This paper is part of the study campaign entitled "Shawbak Project - Archaeology of the Crusader-Ayyubid settlement in Transjordan", managed by Prof. Guido Vannini of the Department of Historical and Geographical Studies at Florence University.

Key words: *Jordan, Shawbak, Transjordan, natural spring exploitation, cistern.*

Riassunto

La galleria di adduzione alla sorgente "Ain al Ragaye" nel castello di Shawbak (Giordania)
Viene descritta una galleria artificiale all'interno del castello di Shawbak, in Giordania, realizzata per raggiungere ed utilizzare una sorgente naturale posta alla base della collina su cui sorge il fortilizio stesso. La conformazione strutturale della galleria è piuttosto singolare poiché, mediante un breve percorso a vite che unisce due sezioni di circa 80 m di lunghezza ognuna, è stato possibile perdere quota e conservare nello stesso tempo un angolo di acclività utile per un agevole trasporto dei contenitori di acqua. La dimensione media della galleria è di circa 2 x 2,5 m e sono ancora evidenti il cunicolo di esplorazione, il fronte di scavo ed i pentimenti avvenuti in corso d'opera. Nell'intero tracciato è presente l'originale gradinata che, tuttavia, è ben conservata solo nella parte iniziale. Il tratto terminale, ovvero quello della captazione, mediante una modesta deviazione immette in una piccola cisterna al cui interno è presente un deposito limoso di incerta consistenza. In tempi più recenti la sorgente è stata captata con una breve galleria artificiale. Questo contributo si inserisce nella campagna di studio "Progetto Shawbak - Archeologia dell'insediamento crociato-ayyubide in Transgiordania" diretto dal prof. Guido Vannini del Dipartimento di Studi Storici e Geografici dell'Università di Firenze.

Parole chiave: *Giordania, Shawbak, Transgiordania, captazione di sorgenti naturali, cisterne.*

Introduction

Shawbak Castle, also called *Crac de Montréal*, is part of a complex settlement system comprising castles, protected areas, quarters and strongholds, whose location allows control of an extensive area called *Jebel-al-Shara*, a key strategic location for all of Transjordan (fig. 1).
Shawbak is famous as a "great Crusader castle", "founded by Baldovino", or "obstacle that stifles hope", as it was described by Fadhel, an Arab chronicler (Shama, 1898). Now recent research of the site has defined it as an extraordinary archaeological-monumental area that is perfectly accessible for stratigraphic and architectural exploration, thanks to its evident layers and a timeframe that is far more extensive and significant for Jordan's history than was initially suspected.
The monumental castle is literally an archive spanning at least 1,600 years of history, covering the Roman-Byzantine, Crusader-Ayyubid, Mamluk and Ottoman

Fig. 1- Localization of the study area (drawing C. Germani).
Fig. 1 - Localizzazione dell'area oggetto di studio (grafica C. Germani).

periods. For centuries, especially from the twelfth to the sixteenth, it played a key role in controlling and connecting, placed as it was at a vital crossroads for the entire Mediterranean Near East, where Great Syria met Arabia and Egypt.

In this perspective and with its specific role of historical "catalyst", Shawbak provides one of contemporary Jordan's archaeological matrices, showing the specific historical outcome of the conditions in which Crusader domination occurred, with the ensuing Ayyubid occupation, and definition of a distinct and enduring cultural identity (which survives today at local level) for the Transjordan region.
This paper is part of Florence University's "*Shawbak Project – Archaeology of the Crusader-Ayyubid settlement in Transjordan*" study campaign, and began almost ten years ago, using specific, innovative analysis methods, with a territorial archaeology approach and in a historicist perspective (Vannini, 2007).

The Shawbak Site

Shawbak Castle is located at the top of a more or less conical hill (fig. 2). The hill slopes (except for the west side) bear strong incisions starting at the north-western quadrants. The incisions converge east of the hill, in a single *wadi*, which develops eastwards. The western side of the hill is cleft by a morphological col created by the uplands to the rear.
The succession of strata that build up the castle hill framework as well as the surrounding reliefs, is formed by carbonate rock, in particular by alternating microcrystalline granite, calcarenites and calcirudites rich in bioclasts, and layers of flint. The latter are quite continuous, in grey-blackish strata ranging from a few millimetres up to 40 cm in height (but usually about 15-

Fig. 2 - Shawbak Castle seen from the west (photo C. Germani).
Fig. 2 - Vista del castello di Shawbak dal lato ovest (foto C. Germani).

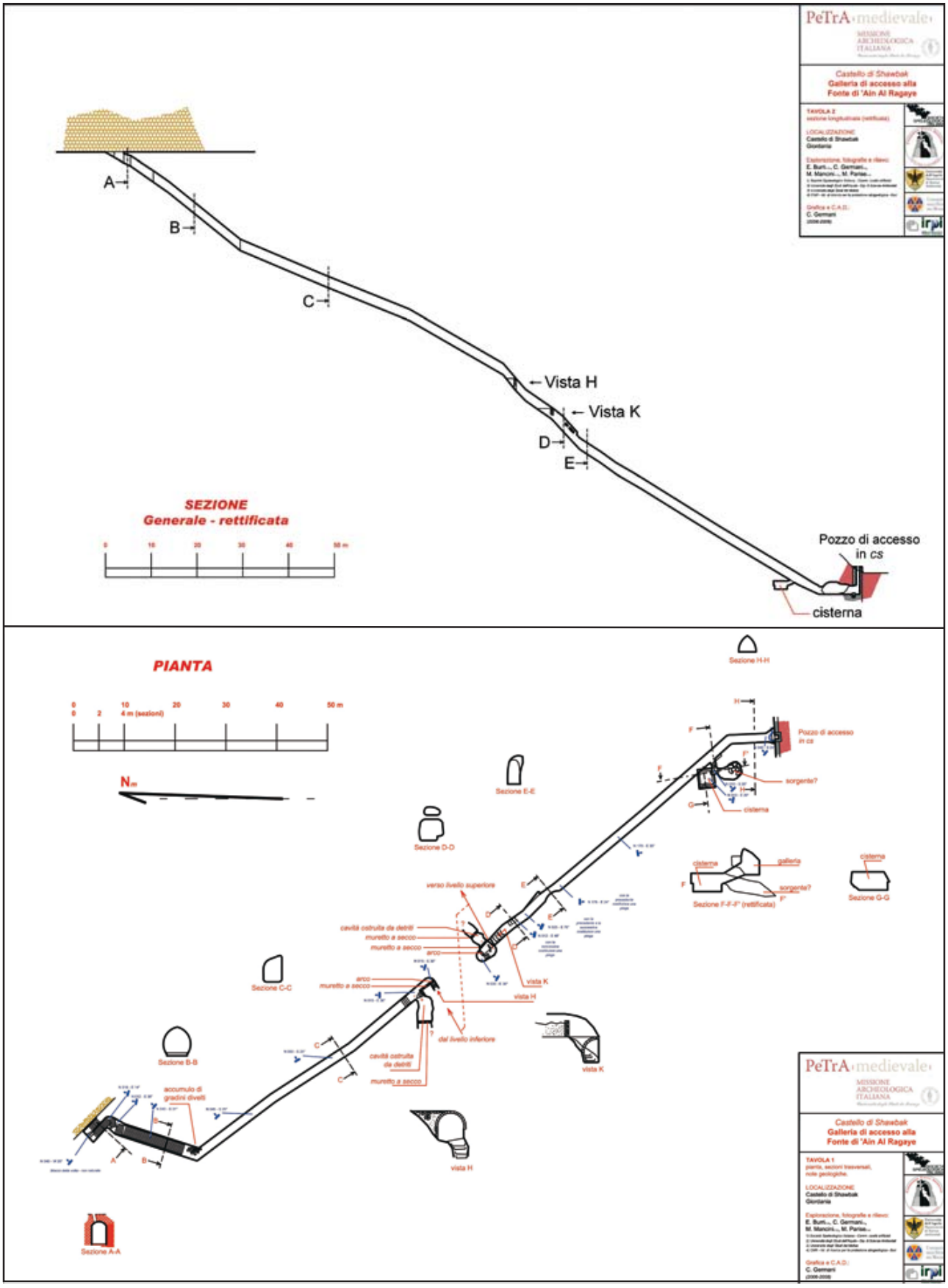

Fig. 3 - Floor plan, cutaways and rectified general section of Shawbak Castle tunnel (survey E. Burri, C. Germani, M. Parise; drawing C. Germani; SSI 2006, 2007).

Fig. 3 - Pianta, sezioni e sezione generale rettificata della galleria del castello di Shawbak (rilievo di E. Burri, C. Germani, M. Parise; grafica C. Germani; SSI 2006, 2007).

20 cm). Since the flint strata offer greater resistance to rock of carbonate origin, the resulting morphology is very striking. Overall, the sequence reveals a general attitude to the east, but this is disturbed locally by folds that cause a significant variability in strata gradient. Evident plastic-type deformation is visible, for instance, on the slopes south of the castle, while attitude variations are also very clear in the tunnel being studied.

The slopes east of the castle hill show similar morphological features, with the greater local pitch near sectors with counter-slope attitude.

There are numerous traces of mass movement on the slopes, basically comprising rock fall in the areas of greatest acclivity and translational slough along the stratification surfaces of the rock mounds. The rock falls were sometimes quite noteworthy and are easy to see along the slope east of the castle hill, to the hydrographical right of the *wadi*.

At the edge of the area where some of these rock falls occurred, a number of cavities have emerged, whose origin may have played a significant role in the phases prior and subsequent to detachment of landslide masses.

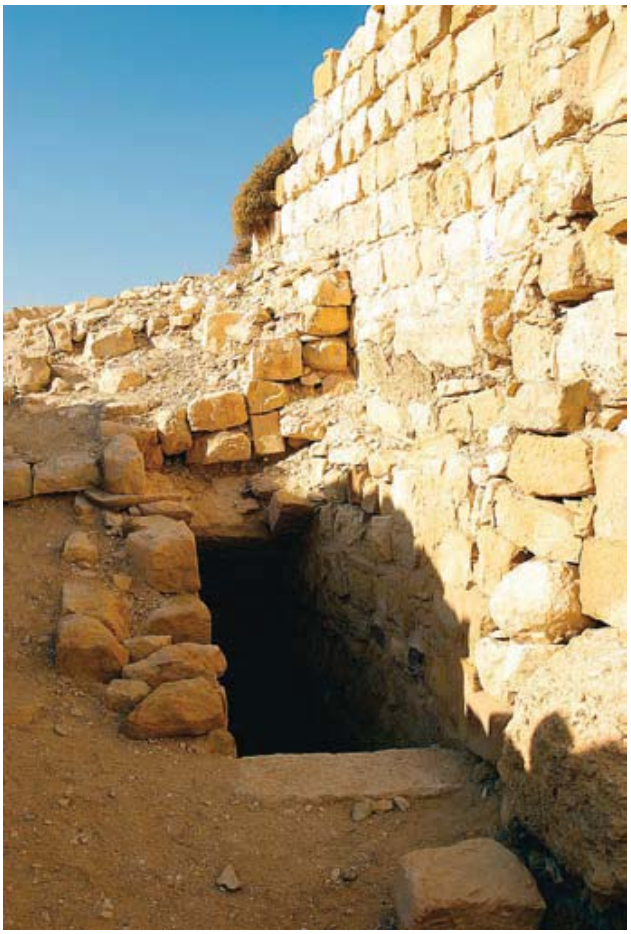

Fig. 4 - Tunnel entrance, between the first and second set of walls (photo C. Germani).
Fig. 4 - Ingresso dell'ipogeo, tra la prima e la seconda cinta muraria (foto C. Germani).

Fig. 5 - Opening section of the tunnel, where steps are still present (photo C. Germani, E. Burri).
Fig. 5 - Il tratto iniziale della galleria, dove sono ancora presenti i gradini in pietra (foto C. Germani, E. Burri).

The tunnel for exploitation of natural spring

A manmade tunnel with a steep gradient drops down in the southwest sector of the castle, between the first and second set of fortifications, and leads to the natural spring called *Ain al Ragaye* (fig. 3).
That this underground tunnel existed has been known for some time and even the first archaeological guidebooks drawn up in mid-1900s mention it, although indications are vague and not very precise about the actual configuration (f.e., PP Francescani, 1984).
The entrance (fig. 4) skirts a curtain wall and reaches a few steps that lead down to a short section of tunnel. There is a 180°-turn then a further deviation of 90° southeast. Light arrives from small openings set into the right-hand wall, while the steps change shape, both in the drop and the tread. Here the constructed tunnel gives way to the excavated tunnel (fig. 5).
A further set of steps continues with only a minor deviation in the original direction, but this soon bears east-south-east and retains this orientation for the rest of its path (fig. 6).

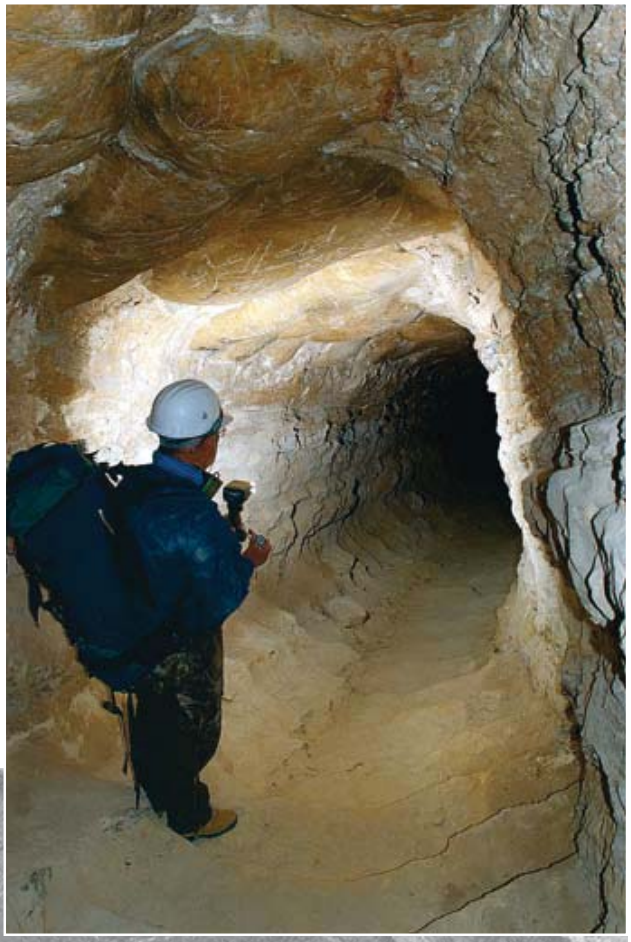

Fig. 6 - The tunnel (photo C. Germani, E. Burri).
Fig. 6 - La galleria (foto C. Germani, E. Burri).

Fig. 7 - Bird's-eye view of the Shawbak Castle area, indicating the *Ain al Ragaye* spring diversion tunnel (drawing C. Germani).
Fig. 7 - Vista dall'alto dell'area del castello di Shawbak con riportata la galleria di adduzione alla sorgente di Ain al Ragaye *(grafica C. Germani).*

Fig. 8 - The helical connecting section (photo C. Germani, E. Burri).
Fig. 8 - Il tratto di raccordo a spirale (foto C. Germani, E. Burri).

Observation of structures has shown that the tunnel was realized to reach the spring that originally rose at the foot of the hill from inside the fortified structure (fig. 7). For this purpose two sections of similar length (about 60 m) and size (about 2 x 2.5 m) are joined halfway along the route by a helical section that allowed for a significant height drop (fig. 8) in a small space. This particular solution meant that the layout and sequence of steps retained a gradient that made it easier for those having to carry water to climb back up.
At this junction point two flattened arches (fig. 9), in well-cut ashlar that sit partly against the actual tunnel walls, support rough, low masonry used to hold excavation or restoration debris of various sizes.
It is likely that several natural sections, caused by the simple dissolution of carbonates, were embraced in this sector, as can be seen clearly lower down (fig. 10). Unfortunately the presence of the abovementioned debris prevents exploration of the other shafts that seem to be present.
The structural profile shows that a preliminary exploration shaft was built and widened to current dimensions only when the objective had been achieved. In the past, the underground layout had stone steps that are still obvious in the first section, while the steps in the subsequent sector are merely etched out and in a very poor state-of-repair.
Excavation of the tunnel was conditioned by the presence of the strata of flint, where there are clear changes in attitude, and possibly were even used as a guide during digging. It will be noticed that the most substantial remain on the left, while there is no lack of small deviations derived to bypass obstacles posed by "anomalous" outcrops.
Direction errors have been revealed, especially in the final section, which appears to have been dug upwards. This seems to indicate how the spring was also intercepted by a specific section of the tunnel, which clearly derived from the site of the source.
The underground cistern hollowed out near the abovementioned spring objectively appears quite small compared to the extent of the works undertaken. Moreover, several construction details seem to indicate that the plan was never completed.
The presence of large amounts of silt residue in the cistern prevent a convincing analysis that defines its real capacity.
At the culmination of the ancient tunnel, a recently-built link leads out through a five-metre concrete well, set at the southern edge of the hill.
It is interesting to note that the original source of the spring was naturally located at the edge and base of the hill outcrop. Its presence may be a good reason for explaining the rural settlement outside the fortifications, which has survived seamlessly, with rock phases, until recent times.
The tunnel was built later, although it is impossible to date the intervention precisely since there may have been later rebuilding and modifications. There was also access from inside the fortifications, obviously to

Fig. 9 - Part of the masonry supporting the helical section (photo C. Germani, E. Burri).
Fig. 9 - Una delle murature di supporto nel tratto a spirale (foto C. Germani, E. Burri).

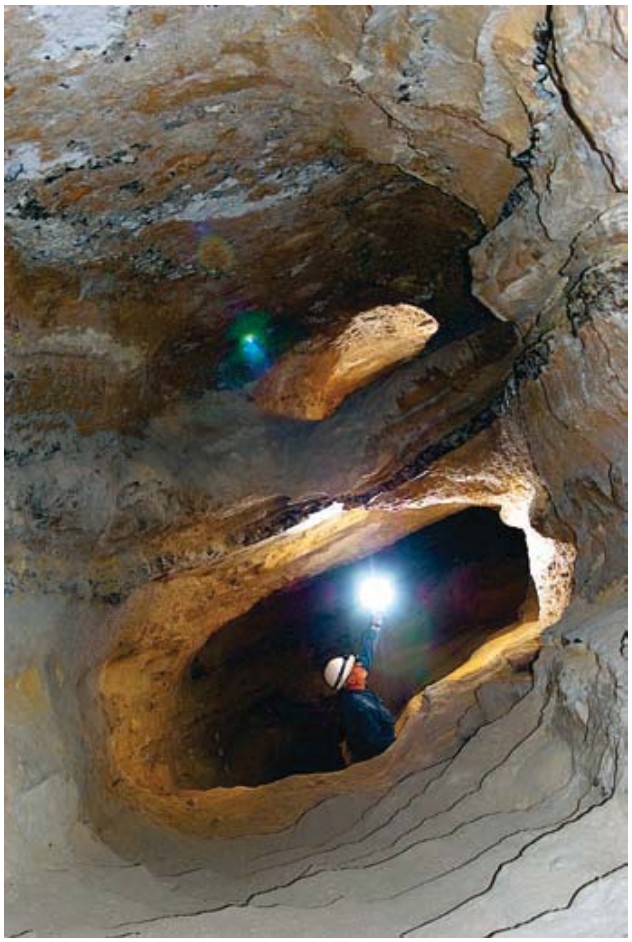

Fig. 10 - The lower section of the tunnel, with a natural caves intercepted by excavation (photo C. Germani, E. Burri).
Fig. 10 - Il tratto inferiore della galleria con una cavità naturale intercettata dallo scavo (foto C. Germani, E. Burri).

ensure a sheltered, protected entrance to this important water supply point.
The spring's name – *Ain al Ragaye* – is emblematic, as it means "chameleon", and might well refer to it being camouflaged.
This type of layout is not unusual - there are a large number of similar structures spread throughout the arid and semiarid areas of the Near and Middle East. They document a consolidated practice that existed for creating tunnels to ensure access to springs, that served not only to decrease evaporation but also to safeguard the water layer from pollution.

References

Padri Francescani, 1984, *Guide to Jordan*, Franciscan Printing Press.
Shama A., 1898, *Le livre des deux jardins. Histoire des deux règnes, celui de Nour ed-Din et celui de Salah ed-Din (sec. XIII)*, Recueil dés histories dés croisades, Historiens orientaux, tomo IV, Paris.
Vannini G. (a cura di), 2007, *Archeologia dell' insediamento crociato-ayyubide in Transgiordania. Il progetto Shawbak*, Biblioteca di "Archeologia Medievale", n. 21, Ed. All'Insegna del Giglio, Firenze.