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The Bell-Shaped Quarries of the Judean Foothills, Israel

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Abstract

The paper focuses on bell-shaped underground quarries, which were rock-cut in the soft limestone of the Judean Foothills during the Late Roman, Byzantine and Early Islamic periods. These large and imposing artificial caves, typical to this region, located south-west of Jerusalem, were first described by scholars and explorers who visited the area in the 19th century, and were extremely impressed by the caves. They suggested various theories regarding their function: cistern, granaries, dwellings, stables and underground churches. The phenomenon was discussed in a pioneering study, undertaken more than fifty years ago by Y. Ben-Arieh (1962) who explained the function of the subterranean caves as quarries, for the extraction of the local soft chalk. Scholars estimate that the total number of bell-shaped caves around Beth Govrin, where the region's biggest quarries operated, is over 800. Others estimate their total number in the region as being c. 3000. The aim of this paper is to present and describe the phenomenon according to new archaeological and speleological surveys. The current study focuses, among other issues, on the method of quarrying and on a re-examination of the chronology of the phenomenon, the carving methods, Christian and Muslim graffiti and inscriptions, and finally, the use and reuse of the caves.

KEY WORDS: Judean Foothills, ancient limestone quarries, columbaria.

Riassunto

LE CAVE A FORMA DI CAMPANA DELLE JUDEAN FOOTHILLS, ISRAELE

L'articolo si concentra sulle cave sotterranee a campana, che erano scavate nella roccia costituita dal calcare tenero della Giudea Foothills nei periodi tardo romano, bizantino e primi periodi islamici. Queste grandi e imponenti cavità artificiali, tipiche di questa regione che si trova a sud-ovest di Gerusalemme, sono state descritte da studiosi ed esploratori che hanno visitato la zona nel XIX secolo rimanendone molto colpiti. Essi hanno suggerito varie teorie riguardo la loro funzione: cisterne, granai, abitazioni, stalle e chiese sotterranee. Il fenomeno è stato discusso in uno studio pionieristico, intrapreso più di cinquant'anni fa da Y. Ben-Arieh (1962) che ha spiegato la funzione delle cavità sotterranee, come cave, per l'estrazione del tenero calcare locale. Gli studiosi stimano che il numero totale di cavità a forma di campana intorno a Beth Govrin, dove erano attive le più grandi cave della regione, è di oltre 800. Altri stimano un numero totale di queste cavità nella regione molto superiore e fino a circa 3000. Lo scopo di questo lavoro è quello di presentare e descrivere il fenomeno in base alle nuove indagini archeologiche e speleologiche. L'attuale studio si concentra, tra l'altro, sul metodo di estrazione e su un riesame della cronologia del fenomeno, i metodi di taglio, i graffiti e le iscrizioni cristiane e musulmane, e, infine, l'uso e il riutilizzo delle cavità.

PAROLE CHIAVE: Judean Foothills, antiche cave di calcare, colombari.

INTRODUCTION

This article focuses on bell-shaped underground quarries, which were rock-cut in the soft limestone of the Judean Foothills during the Late Roman, Byzantine and Early Islamic periods.

These large and imposing artificial caves, typical to this region, located south-west of Jerusalem, were first de-

scribed by scholars and explorers who visited the area in the 19th century, and were extremely impressed by the "enormous caverns", termed by the fellahin: *Arák* (CONDER 1875). The explorers called them by various names: "caverns", "caves", "cavities", "cisterns" and suggested various theories regarding their original function: cisterns, granaries, dwellings, stables, underground churches, dwellings and hiding places of perse-

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cuted Christians (ROBINSON, 1841; VAN DE VELDE, 1854; GUÉRIN, 1868; CONDER, 1875; CONDER & KITCHENER, 1883; BLISS & MACALISTER, 1902; SMITH, 1908). A single plan, rather schematic, of one of the largest clusters south of Beth Govrin was prepared by R.A.S Macalister (BLISS & MACALISTER, 1902; fig. 1).

A rather romantic description was given by W. M. Thomson (1911), who was puzzled by the huge caverns: "[...] I spent the morning exploring those caverns; and though I had heard and read about them, they took me quite by surprise, as something new, strange and inexplicable [...]. When and by whom were these extraordinary excavations made, and for what purpose or purposes? These are questions asked by every visitor, but to which no one can give a satisfactory reply. They were not cisterns, for they could not have been filled, and would not have held water. They were not granaries, for all the harvests of Philistia might be stored away in any of the larger caverns. They were not made for defence, since the occupants could at any time have been driven out or destroyed by throwing down fire from

above. They were not sanctuaries, for there is no indication that they were employed for religious purposes. If designed for Troglodyte Idumeans of ancient times, as has been suggested by Dr. Robinson, they are wholly unique, and must have been extremely inconvenient. They are therefore an unsolved puzzle, and I fear must remain so, for there are neither inscriptions, architectural devices, nor even traditions to explain either their origin or their object".

One of the best description and discussion of the caves' function was given by C.R. Conder, the famous explorer of the Holy Land: "The question of the date of the great caverns [...] is interesting and puzzling [...] in all of these the same disposition is visible – rounded chambers with domed roofs, from 20 to 50 feet diameter, communicate with one another; detached pillars support the roof in places; the height is 30 or 40 feet; and a thin crust only of the hard rock, pierced with a round well-hole, exists above. The walls are sometimes very rough, sometimes coarsely but regularly dressed with a pick diagonally. In two places springs exist within the cave. In many of them crosses of various character are cut on the walls, sometimes 15 to 20 feet from the ground. In one cave is a rude drawing deeply cut, and 10 to 12 feet from the ground. It is so curious that I enclose a sketch. Many of these rounded caves have the appearance of chapels, and have apses facing east. It is possible, therefore, that this may be a rude, unfinished representation of the crucifixion, dating from early Christian times. In all the caves where crosses occur there are also cufic inscription, generally at a low level, within reach, and consisting of short religious ejaculations: "Ya Allah, Ya Mohammed", or: "There is no God but God; Mohammed is the Messenger of God." (CONDER, 1875).

An excellent description of the Dayr Dubban complex was given by the French explorer, Victor GUÉRIN (1868); See also the presentation of this complex and its Kufic inscriptions by SHARON (2004): "[...] In the largest group there are about fifteen magnificent halls opening the one into the other, and their ceiling is funnel-like [...] The light enters from an opening on the top, and their base is round, measuring nineteen paces; their height varies between eight to twelve meters [...] When I examined these beautiful excavations, I was especially excited by one hall, the largest, and the most impressive of them all. In the walls, on the inside, from the floor level up to the middle of their heights, a few parallel rows of small niches, triangular or in a shape of a crescent were dug. They resemble dovecotes, the function of which is unknown to me. It is certain that they did not serve for burial [...] On one of the walls of this hall it is possible to see four crosses engraved into the rock, three large ones, and one smaller than the others. [...] Were they engraved in the Byzantine period, or in the Middle Ages? I do not know. They could not have been later to the time of the Crusades, for Christianity disappeared from this part of the country after the Crusades and it does not seem possible that some tourist have engraved them in a later period, for he would have needed a very high ladder. Besides, the cut in the wall caused by their incision has resumed the colour of the wall, which means

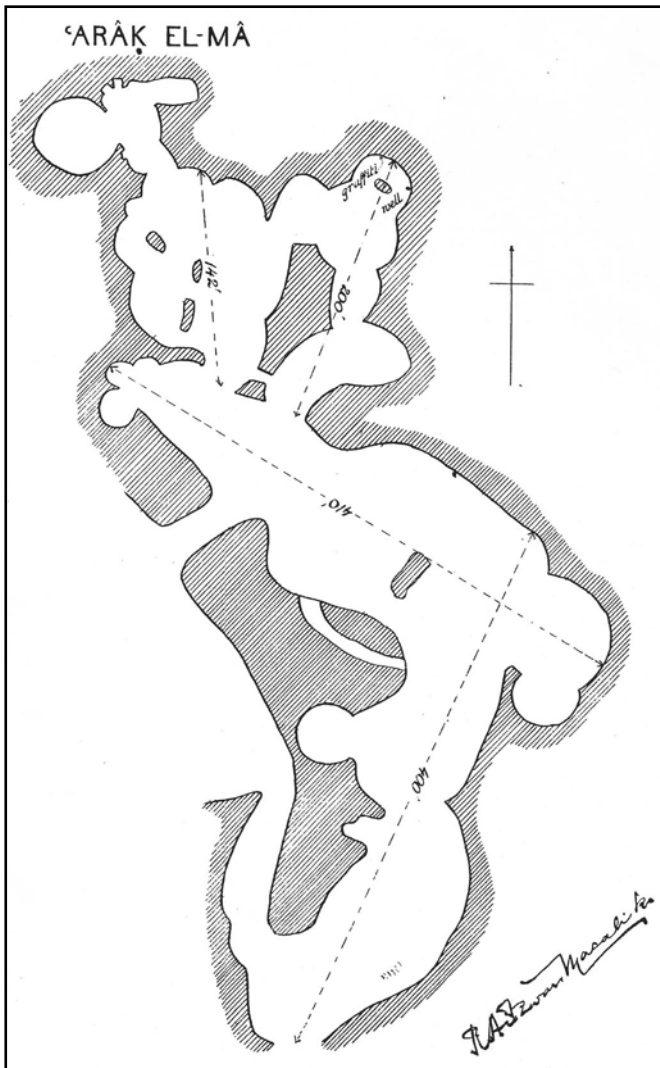


Fig. 1 - Schematic plan of "Avigail Cave" ('Arak el Ma) - the largest cluster of bell shaped caves, situated just south of Beth Govrin (BLISS & MACALISTER 1902: pl. 100).

Fig. 1 - Pianta schematica di "Avigail Cave" ('Arak el Ma) - il più grande gruppo di cave a forma di campana, situato a sud di Beth Govrin (BLISS & MACALISTER 1902: pl. 100).

that they are at least a few hundred years old [...]”.

The phenomenon was discussed in a pioneering study, undertaken more than fifty years ago by Y. BEN-ARIEH (1962) who explained the function of the subterranean caves as quarries, for the extraction of the local soft chalk.

The aim of this paper is to present and describe the phenomenon according to new archaeological and speleological studies. The current study focuses, among other issues, on the method of quarrying and on a re-examination of the chronology of the phenomenon, the carving methods, the use and reuse of the caves.

THE GEOLOGY OF THE JUDEAN FOOTHILLS AND THE QUARRYING METHOD

Judea, a mountainous region situated in central Israel is divided into three distinct north-south parallel topographic units on the basis of its geological structure, rock formations and climate:

1. The Judean mountain, the highest part, a broad anticline located in the center. The central watershed runs from north to south along the mountain. The eastern slopes are drained to the Jordan Valley and the Dead Sea, and the western to the Mediterranean Sea.
2. The Judean Foothills, a syncline located to the west of the mountain.
3. The Judean Desert, a syncline situated to the east of the mountain.

The Judean Foothills are a syncline of soft limestone and chalky formations, extending from the Senonian, Paleocene and Eocene periods. The hilly character of the area is the result of erosion of these rocks. The prevailing bedrock is the chalk of the Maresha detail of the Tzor'a Formation, dating to the Eocene, of a 30-100 m thickness. This white, relatively soft and homogenous rock (known locally as “*kirton*”) is protected from erosion by a crust of harder limestone, of up to 3 m thickness (“*nari*”); (fig. 2).

The fissured layer is harder, non-homogeneous, and has a tendency to collapse relatively easy. This tendency was known to the stonemasons who cut subterranean complexes in antiquity (KLONER, 2003).

All over the Judean Foothills thousands of underground chambers were cut during various periods. Throughout the relatively easy process of cutting the soft limestone, a large variety of artificial subterranean chambers was created. In addition, through the quarrying process, good quality blocks of building material were produced (OREN, 1965; KLONER & ZISSU, 2009).

The subterranean chambers served as quarries, silos, water cisterns, columbaria, oil presses, stables, cult rooms, hiding systems and burial caves (BLISS & MACALISTER, 1902; DAGAN, 1982; for a recent typology of the underground systems of Tell Maresha: KLONER & ZISSU, 2013). The bell-shaped caves are just one of these types of rock-cut chambers.

When the stone-cutters planned to create an extensive quarrying site, they avoided damage to already existing sites and caves. Locations where underground quar-



Fig. 2 - A collapse of some bell shaped caves in the complex known as 'Arak el Haleil, south of Beth Govrin, shows the typical geology of the region (Tell Maresha appears in the background). The white, relatively soft and homogenous rock (B) is covered from erosion by an upper crust of harder limestone (A); photo: B. Zissu.

Fig. 2 - Il crollo di alcune cave a forma di campana nel complesso noto come 'Arak el Haleil, a sud di Beth Govrin, mostra la stratigrafia tipica della regione (Tell Maresha appare sullo sfondo). La roccia bianca, relativamente tenera e omogenea (B) passa verso l'alto per contatto erosivo a una crosta di calcare duro (A); photo: B. Zissu.

rying had not yet taken place were preferred. However, in some quarries, already existing chambers were encountered during the hewing process: many were obliterated, and the only signs of their former existence are parts of shafts, tunnels, corners or walls, now visible at a considerable height in the walls of the bell-shaped quarries (fig. 3).

The location of bell-shaped caves was chosen by carvers who knew how to identify geologically the soft limestone rock deposits suitable for quarrying good quality chalk. Most of the bell-shaped caves were quarried in good quality Maresha “Detail chalk formation” and



Fig. 3 - Remains of an earlier burial chamber, from the Hellenistic period, survived in the upper part of the wall of the bell-shaped quarry at 'Arak el Haleil (photo: B. Zissu).

Fig. 3 - I resti di una camera funeraria, di epoca ellenistica, sono sopravvissuti nella parte superiore della parete della cava a forma di campana a 'Arak el Haleil (foto: B. Zissu).

only a few of them were cut in lower quality chalk, like Adollam and Beth Govrin details. It is also apparent that the carvers chose the appropriate topography for quarrying a cave: slopes or spurs were typically preferred.

At most bell-shaped caves sites', the method of quarrying was rather similar (figs. 4, 5). There are common defining outlines to the whole phenomenon.

The geological characteristics of the region, which combined an upper harder crust and a deeper soft but com-

pact chalk was well known to the stonecutters in antiquity. The first stage of creating a bell-shaped cave was to cut a rounded opening in the upper limestone crust. From the opening a vertical shaft led through the hard limestone layer to the soft chalk below.

The shafts were similar in size and their purpose was the penetration of the relatively hard *nari* crust. The average diameter of the top opening is between 0.8-1.2 m. The depth of the vertical shaft varies from 2 to 4 meters, according to the width of the natural crust. In some caves the round shape of the top opening was not kept, for a number of reasons, as quarrying into an already existing, earlier artificial cavity, which saved the cutters the effort of penetrating the hard crust (e.g. at Kh. el-Ein: ZISSU, 2005).

In other cases, the quality and specific features or defects of local bedrock dictated square or rectangular openings. A reason for the "cylindrical" shape of the shaft not being kept in certain cases derived from difficulties experienced by the stone-cutters trying to penetrate into the *nari*.

Upon reaching the soft limestone layer, the carvers started widening out the cave downwards and laterally in a circular shape. That method of quarrying gave the caves their typical bell-like shape, which created a large but relatively stable underground cavity.

The underground quarrying was carried out using carving tools, as pick-axes, hammers, chisels and crowbars, under natural lighting entering the cavity from the upper shaft. Sometimes, the natural light was enhanced by oil-lamps as attested by tiny triangular niches and soot marks left on the walls.

The systematic quarrying operation has left well-marked traces, which appear as parallel rows of oblique chisel marks on the walls (fig. 6).

The limestone was extracted as rectangular blocks. These were detached from the walls of the cave by narrow and deep channels. Signs of the cessation of quarrying: scars or 'negatives', were left on the walls after the removal of chalk blocks. Sometimes, the last blocks were never separated, due to defects in the bedrock or other considerations (fig. 7).

The straightening and 'finishing' of the cave walls was done by removing limestone chips, apparently burned in kilns and used as a raw material in the manufacture of lime and cement. Nevertheless, lime and cement were only a byproduct of this endeavor. The main purpose was the production of limestone blocks.

The ca. 30-40 cm. high blocks of chalk were transported and employed as building material elsewhere. We should keep in mind that when these blocks are used for external walls, a thick coating of plaster is required in order to protect the material from the elements. Without such a protective layer, when exposed in the Mediterranean climate, blocks of chalk disintegrate in 10-20 years.

This characteristic bell-shaped plan was in our opinion a development and enlargement of an earlier, smaller form of Judean subterranean installation - the typical bottle-shaped silo found at sites from the Iron Age, (e.g. the "winery" at Giveon: (PRITCHARD, 1964) throughout the Hellenistic and Early Roman periods (certain in-

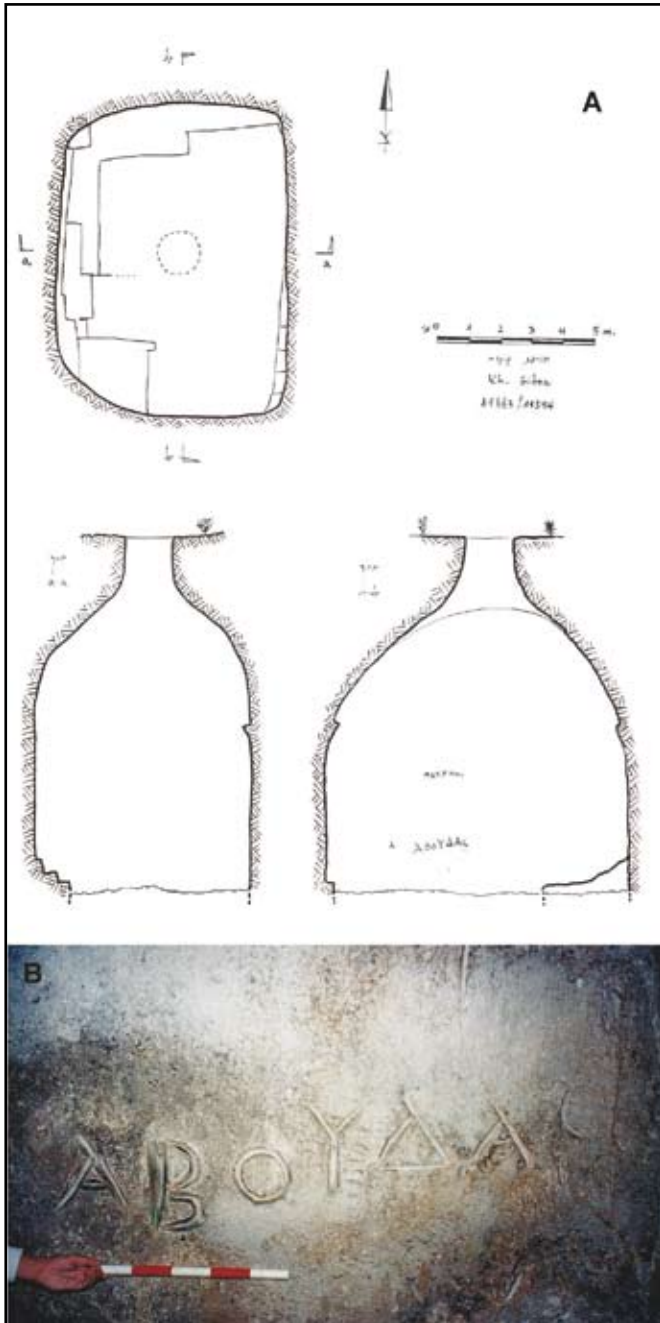


Fig. 4 - (A) Plan and sections of a typical single bell-shaped quarry at H. Gibor. Two names are incised on the wall in Greek letters: Makrinos and Aboudas (B). The first one is a Latin/Greek name; the second is apparently Arab (B. Zissu and N. Graicer). Each colored segment of the metric scale is 10 cms.

Fig. 4 - (A) Pianta e sezioni di una tipica cava a forma di campana a H. Gibor. Due nomi sono incisi sulla parete in lettere greche: Makrinos e Aboudas (B). Il primo è un nome latino / greco; il secondo è apparentemente arabo (B. Zissu e N. Graicer). Ogni segmento della scala metrica è di 10 cm.

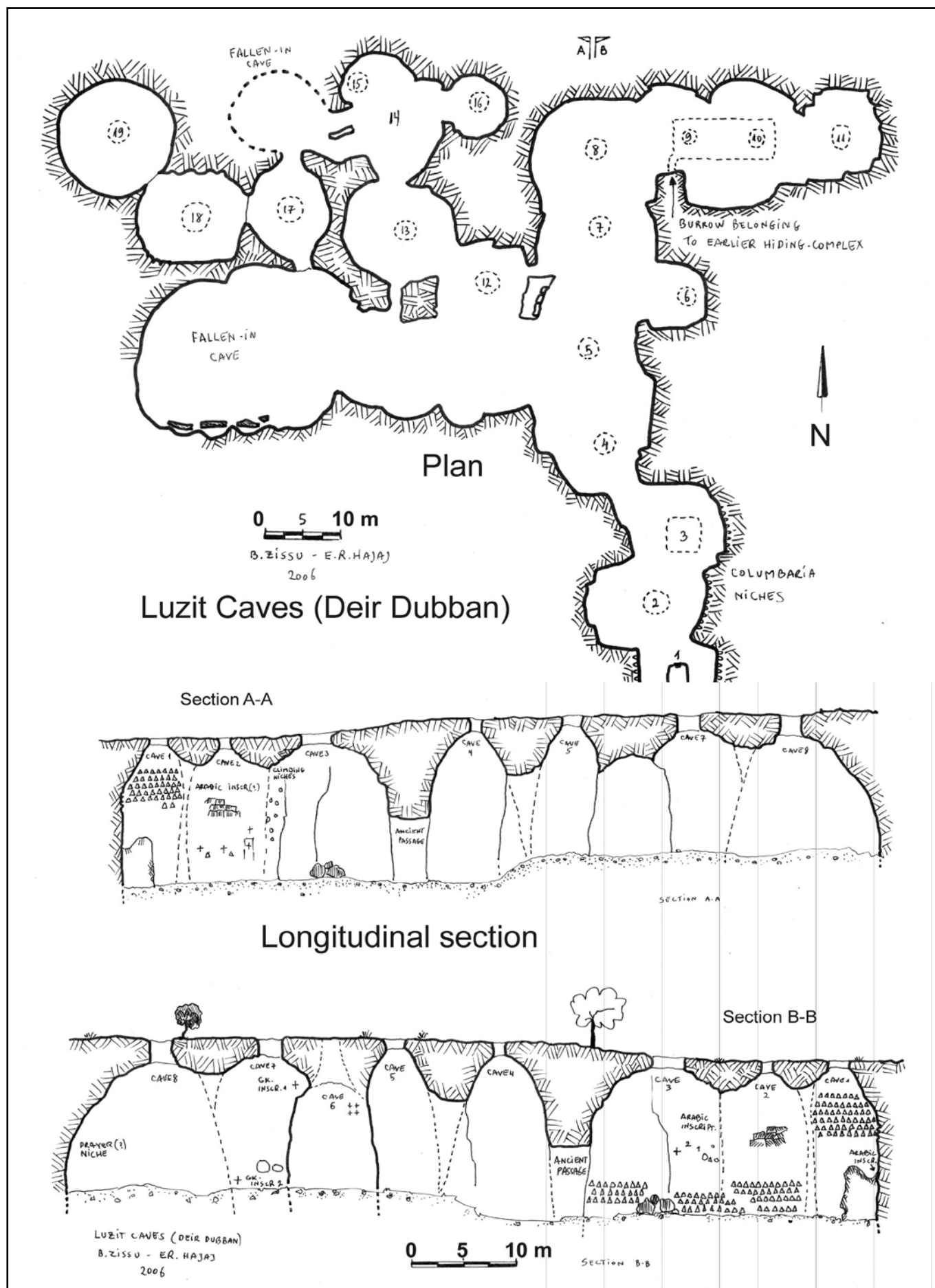


Fig. 5a, b - Plan and longitudinal section of cluster of bell-shaped quarries at Deir Dubban (drawing by B. Zissu and E.R. Hajaj).
 Fig. 5a, b - Pianta e sezione longitudinale del gruppo di cave a forma di campana a Deir Dubban (disegno di B. Zissu e ER Hajaj).



Fig. 6 - Parallel rows of oblique chisel marks on the walls of a bell-shaped cave at H. Burgin (photo B. Zissu).

Fig. 6 - Segni di scalpello obliqui in file parallele sulle pareti di una cava a forma di campana a H. Burgin (foto B. Zissu).



Fig. 7 - Signs of the end of quarrying, appear on the wall of a bell-shaped cave at H. Burgin: damaged blocks, scars and 'negatives', left on the walls after the removal of chalk blocks (photo B. Zissu).

Fig. 7 - I segni del fronte di cava, sulla parete di una cavità a forma di campana a H. Burgin: blocchi danneggiati, cicatrici e "negativi", lasciati sulle pareti dopo la rimozione dei blocchi di calcare tenero (foto B. Zissu).

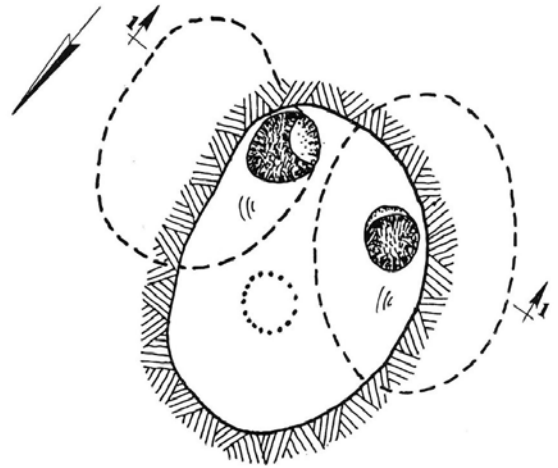
stallations at Horvat Burgin: ZISSU & GANOR, 2008; and Storage System V at Horvat Ethri: Zissu & GANOR 2009; fig. 8).

In some cases, the "classic" bell shape was lost. Changes in the angle of quarrying were made by the stone-cutters due to the appearance of cracks and fear of collapsing. Sometimes, a side opening would have been created because of natural collapse or discovery of nearby artificial quarrying. Such a side opening allowed additional entry, horizontal extraction of quarried material, or both (fig. 9).

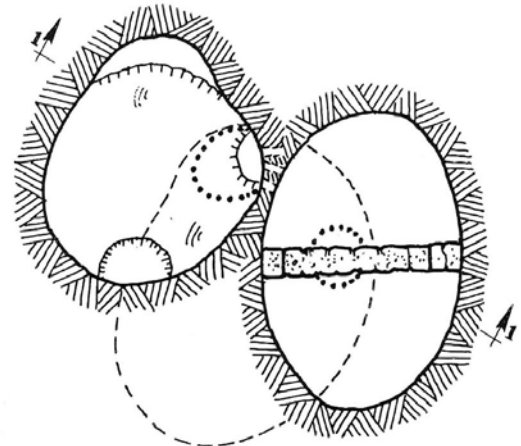
The dimension of caves that functioned as a single quarry is usually smaller than of those which are part of a cluster of bell-shaped caves. The average depth of a cave is *ca.* 5-7 m. and the diameter of its bottom is *ca.* 5-10 m (figs. 10, 11).

The reason for the smaller size caves appears to be the limited ability to extract the quarried material from the caves vertically, through the upper shaft and the mobility of the cutters.

H. 'Ethri - Plans and Sections of Storage System V



Plan of Upper Level



Plan of Lower Level

0 22 m

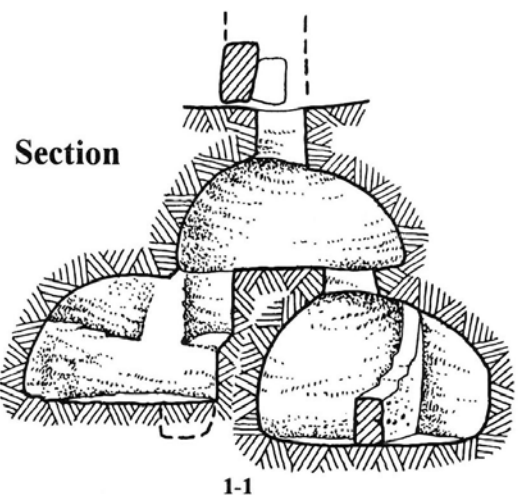


Fig. 8 - Plan and sections of Storage System V at Horvat Ethri - typical bottle-shaped silo from the Early Roman period (B. Zissu, A. Ganor and Israel Antiquities Authority - IAA).

Fig. 8 - Pianta e sezioni di Storage System V a Horvat Ethri - tipico silos a forma di bottiglia di prima epoca romana (B. Zissu, A. Ganor e Israel Antiquities Authority - IAA).



Fig. 9 - A tunnel was cut in order to connect two bell-shaped quarries at "Avigail Cave" ('Arak el Ma) - Beth Govrin (marked A). During the course of time, both quarries were deepened and the tunnel itself was transformed into a quarry (marked B). Photo B. Zissu.

Fig. 9 - Un tunnel di collegamento tra due cave a forma di campana a "Avigail Cave" ('Arak el Ma) - Beth Govrin (A). Nel corso del tempo, entrambe le cave sono state approfondite e il tunnel è stato trasformato anch'esso in una cava (B). Foto B. Zissu.

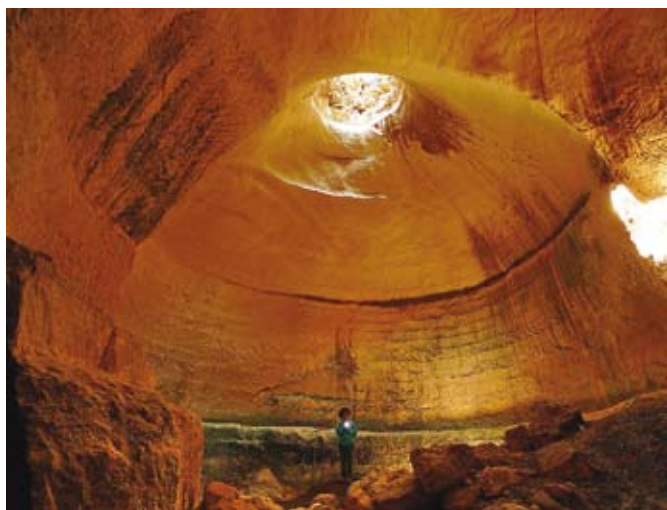


Fig. 10 - Typical medium sized bell-shaped quarry at Horvat Segafim (photo: B. Zissu).

Fig. 10 - Dimensioni medie tipiche di una cava di a forma di campana a Horvat Segafim (foto: B. Zissu).



Fig. 11 - Typical small sized bell-shaped quarry at 'Arak Halla (photo: B. Zissu). Bell shaped caves containing secondary columbarium niches are extremely impressive.

Fig. 11 - Tipica cava di piccole dimensioni a forma di campana a 'Arak Halla (foto: B. Zissu). Cavità a campana contenenti estesi colombari sono estremamente impressionanti.

Certain clusters of bell-shaped caves, especially in the area of Beth Guvrin and Dayr Dubban - Luzit, exceed these dimensions. The caves in such groups are characteristically larger in size. Their average depth ranges from 10-15 meters and the diameter of their bottom ranges from 6-12 m. Few caves are much deeper - up to 25-27 meters. Usually the caves in these clusters were quarried adjacently and were joined to one another in the course of carving, creating an underground maze (figs. 12, 13, 14).

This was as a result of the cave walls collapsing naturally, an act initiated by the stone-cutters or a combination of both. The caves were connected by a variety of horizontal or slanted tunnels, aimed to allow easy passage of workers, blocks and other carved material and perhaps even pack mules between the cavities to the surface level.

The smaller size caves appear to be private initiatives located on private plots of land. The larger clusters may be public (civic ?) projects, aimed at a systematic exploitation of the local resources available near the urban center of Beth Govrin - Eleutheropolis.

Staircases were cut into the depth of the wall in some caves (fig. 15).

This particular type of staircase is entirely different from the planned and well executed staircases installed in the Hellenistic period "Maresha type" cisterns and quarries, found in the same region. The "Maresha type" bell-shaped caves have typical steps with parapets, spiraling along their inner walls (KLONER 2005; KLONER & ZISSU, 2013). The staircases cut in the walls of the bell-shaped caves have no common characteristics and they were created *ad hoc* during the hewing process, as a makeshift solution to local mobility necessities.

Quarried into the bottom part of the wall in some of the caves are various niches, hooks for hanging sacks, and devices for holding animals. These features were made when bell shaped cave quarrying was at its peak, or alternatively when the caves were connected to one another. Some of the installations were probably added after the main quarrying activity, for use by dwellers and squatters.

Quarrying the bell shaped caves created large underground spaces. A substantial number of the caves were later converted for a variety of uses. After the quarrying was completed, many underground quarries were transformed into columbaria installations - some of them of a large scale, containing hundreds of niches in neatly arranged rows (see below).

In few caves, agricultural installations such as oil presses were installed. Few caves, usually of smaller dimensions were converted into water cisterns. Other caves were used by squatters for residence.

Quarries which were easily accessed were used by shepherds as animal pens, by addition of partition walls built of fieldstones.

Bell shaped caves containing secondary columbarium niches are extremely impressive (figs. 16 and 17). Niches, of a rectangular, arched or triangular shape, were hewn in neatly arranged rows along the walls. Most researchers agree today that these installations

were used to raise pigeons (KLONER & ZISSU, 2013 and lit cit. there).

We would like to clarify that the term columbarium refers to rock-cut or built structures used for the raising of doves or pigeons. But this the term also applies to subterranean structures containing niches for cremated ashes.

These burial installations - very common in Italy - in

Rome, Ostia, Pompeii and elsewhere are entirely absent from the archaeological record in Israel, where cremation was a rare custom (practiced mostly by Romans originating from the western part of the Empire).

From the Hellenistic to the Early Islamic periods (ca. 4th c. BCE to the 8th c. CE) pigeons' raising was an important source of economic income; pigeons were raised for a triple purpose: (1) their meat was an excellent

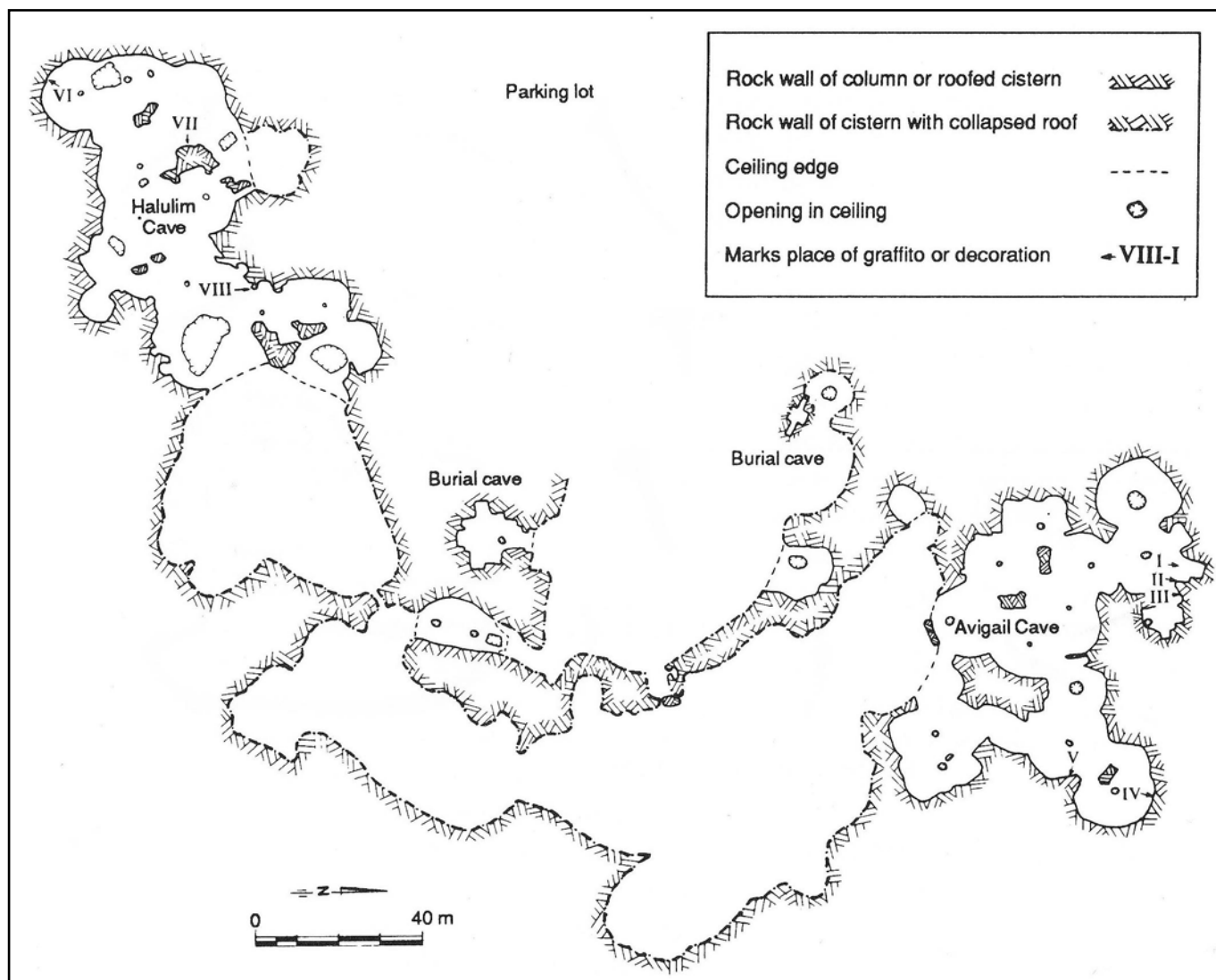


Fig. 12 - Plan of the largest cluster of bell shaped caves, situated south of Beth Govrin ('Arak el Ma); A. Kloner and Israel Antiquities Authority (IAA).

Fig. 12 - Pianta del più grande gruppo di cave a forma di campana, situato a sud di Beth Govrin ('Arak el Ma); A. Kloner e Autorità Israeliana per le Antichità.

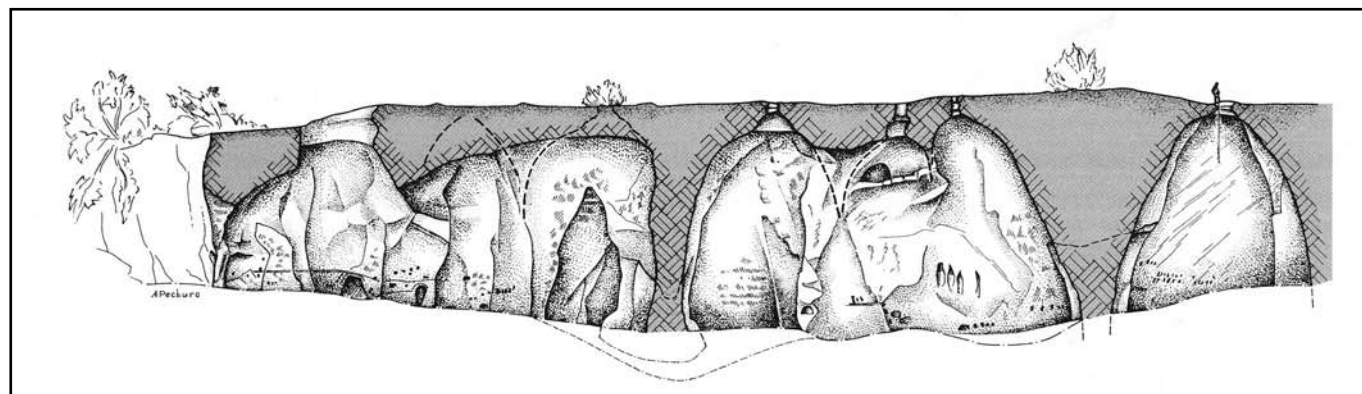


Fig. 13 - Schematic section through "Avigail Cave" ('Arak el Ma); drawing: A. Pechuro and IAA.

Fig. 13 - Sezione schematica attraverso "Avigail Cave" ('Arak el Ma); disegno: A. Pechuro e IAA.

source of protein; (2) their droppings were used as a fine fertilizer; (3) some cultures (Jews, pagans) sacrificed doves as part of their cults.

In order to maintain this active economic endeavor, dovecotes were built or hewn in the bedrock. A typical cave has rows of small niches (ca. 0.25x0.25 m each), cut into its walls. The number of the niches varies from a few hundreds to a few thousands.

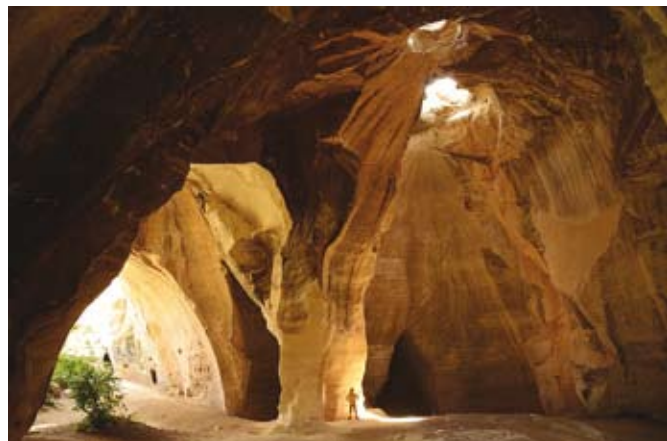


Fig. 14 - Photo of the south-western part of "Avigail Cave" ('Arak el Ma); photo: B. Zissu.

Fig. 14 - Vista del settore sud-ovest di "Avigail Cave" ('Arak el Ma); foto: B. Zissu.



Fig. 15 - Staircase cut in the depth of the wall near Kh. Kidneh (photo: B. Zissu).

Fig. 15 - Scala intagliata nella parete di roccia vicino Kh. Kidneh (foto: B. Zissu).



Fig. 16 - Bell shaped cave containing secondary columbarium niches near Kh. Kidneh (photo B. Zissu).

Fig. 16 - Cavit  a campana con nicchie di colombario vicino Kh. Kidneh (foto: B. Zissu).

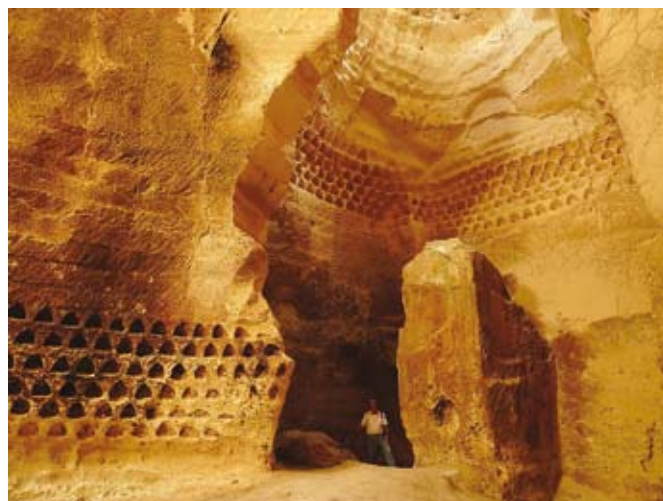


Fig. 17 - Bell shaped cave containing secondary columbarium niches at Luzit-Deir Dubban (photo: B. Zissu).

Fig. 17 - Cavit  a campana con nicchie di colombario vicino a Luzit-Deir Dubban (foto: B. Zissu).

In order to save efforts, another option was to add niches to an already existing subterranean cave, as an unused bell-shaped quarry. This option saved the need to cut a specially devised underground columbarium. The pigeons would fly in and out of the bell-shaped cave through the already existing shaft in their ceilings and find their food in the nearby fields.

Interestingly, the stratigraphic relationship of columbaria niches and crosses incised in the caves' walls, attest to the date of this phenomenon: sometimes the crosses are neatly incised in the space left between the niches - hinting at a contemporaneous Byzantine dating (ca. 4th to 7th c. CE). When niches obliterate crosses or parts thereof, we assume an Early Islamic dating (ca. 7th - 8th c. CE).

From the above mentioned data it is apparent that there are clear typological characteristics of the bell-shaped quarries phenomenon all over the Judean Foothills. The modest sized scattered caves resemble in their characteristics and form the large and impressive cluster of over 800 caves, situated near Beth Govrin, where the areas' biggest quarries operated (KLONER, 1996; 1993).

In order to understand the overall quarry phenomenon, one needs to address other components in the landscape of the Judean Foothills, while discussing the link between the locations of bell shaped caves and the settlements, road network and limestone kilns (BEN-ARIEH, 1962; DAGAN, 1982; DAGAN, 2006; KLONER, 1993).

GEOGRAPHICAL DISTRIBUTION OF BELL SHAPED CAVES

The bell shaped caves are a common phenomenon all over the southern part of the Judean Foothills, from the Elah Valley in the north, the "Through Valley" in the east, the Shiqmah Valley in the south, and the edge of the chalky hills in the west. However, the largest cave-clusters are found in the vicinity of Beth Govrin. Here, in the region's biggest quarries concentration, scholars estimate their total number as ca. 800-1000

(BEN ARIEH, 1962; KLONER, 1996). Ben-Arieh and Y. Dagan estimated their total number in the whole region as being c. 3000 (BEN ARIEH, 1962; BEN ARIEH, 1969; DAGAN, 1982).

Chalk was extracted also in other regions of the country, but from different types of quarries: their typical form was usually a large underground hall or interconnected halls, whose ceilings were supported by square or rounded monolithic columns, left during the hewing process. Such quarries were found north and east of Jerusalem (AMIT et al., 2008; MAGEN, 2002), and in the Galilee, near Nazareth (AMIT, 2010). We are aware of other bedrock types in ancient Israel which were quarried in large underground quarries: limestone (e.g. 'Zedekiah's Cave', Jerusalem; ZELINGER, 2007; "Nahmanides Cave"; ZISSU, 2012), sandstone (Samra Caves, near Jericho; BARADON, 1972) and flowstone (calcite-alabaster in the Te'omim and 'Abud Caves; FRUMKIN et al. 2013). These quarries belong to type E1, according to the typological tree of Artificial Cavities developed by the Commission of the Italian Speleological Society (GALEAZZI, 2013). Quarries in caves are often well-preserved and their environment and contents are relatively sealed from subaerial conditions.

BELL SHAPED CAVES' CHRONOLOGY

Dating the quarrying operations is somewhat difficult due to very few mentions in the written sources and few findings relating to the period the caves were used. A re-evaluation of the bell shaped caves' chronology is desirable by using various features such as crosses, inscriptions and incisions left on the cave walls and the relative stratigraphy of bell shaped caves and adjacent rock-cut caves and installations.

Excluding the "Maresha-type" caves, which belong to the Hellenistic period (KLONER & ZISSU, 2013), the findings show that the bell shaped caves phenomenon post-dates the Second Jewish Revolt against the Romans (The Bar Kokhba Revolt - 132-136 CE).

The stratigraphic relation of the bell-shaped caves to adjacent caves and features shows that the caves cut into and damaged earlier underground facilities, which were apparently hewn and used by the local population of the area prior to the Bar Kokhba revolt; the bell-shaped caves obliterate hiding systems, burial caves (from the Hellenistic and Early Roman periods near Beth Govrin [cfr. fig. 3] and at Horvat Segafim), agricultural facilities etc. (KLONER & ZISSU, 2009; ZISSU & GANOR, 2008).

In certain cases, Greek inscriptions and crosses cut or painted on the upper, now inaccessible part of caves' walls point to a clear Byzantine date - 4th to 7th c. CE. The complex at Luzit - Deir Dubban has several Greek and Arabic inscriptions as well as many crosses on its walls (fig. 18). Two Greek inscriptions, on a rather monumental scale, are incised on upper part of a bell-shaped cave, just underneath the shaft; the same formula appears on the lower part - now partly covered with dirt.

Both inscriptions bear the same formula: "Holy Isidore,

help Stephanos" (figs. 19, 20, 21). We assume Isidore/os was a local saint. Additional Christian inscriptions we-



Fig. 18 - Forked cross, incised on wall of bell-shaped quarry at Luzit - Deir Dubban. Note the Greek letters IC/XC/A/W which stand for the Christian formula: Iesous Christ, Alpha Omega, (Jesus Christ, beginning and end; photo: A. Graicer).

Fig. 18 - Croce biforcuta, incisa sulla parete della cava a forma di campana a Luzit - Deir Dubban. Notare le lettere greche IC / XC / A / W che si distinguono per la formula cristiana: Iesous Cristo, Alfa Omega, (Gesù Cristo, principio e fine; foto: A. Graicer).



Fig. 19 - Photo of cluster of bell-shaped quarries at Luzit - Deir Dubban: sign "<" marks location of lower Greek inscription; sign "A" marks location of upper Greek inscription (photo: B. Zissu).

Fig. 19 - Foto del gruppo di cave a forma di campana a Luzit - Deir Dubban: segno "<" indica la posizione dell'iscrizione greca posta nella parte inferiore; segno "A" indica la posizione dell'iscrizione greca posta in alto (foto: B. Zissu).



Fig. 20 - Greek inscription, incised on lower part of bell-shaped cave at Luzit - Deir Dubban. The inscription reads: Holy Isidore, help Stephanos (photo: B. Zissu).

Fig. 20 - Iscrizione greca, incisa sulla parte inferiore della cavità di Luzit - Deir Dubban. L'iscrizione dice: Santo Isidoro, aiuta Stefano (foto: B. Zissu).



Fig. 21 - Greek inscription, incised on upper part of bell-shaped cave at Luzit - Deir Dubban. It contains the same formula as no. 20 (photo: B. Zissu).

Fig. 21 - Iscrizione greca, incisa sulla parte superiore della cavità di Luzit - Deir Dubban. Essa contiene la stessa dicitura riportata in fig. 20 (foto: B. Zissu).

re found on quarries' walls at Tel Lavnin (ZISSU, 1999) and at Horvat Basal among other sites. We should emphasize that these crosses and Greek inscriptions were incised or painted by the cutters when the cave was still in a shallow phase (DAGAN, 1982).

In a cave system at Kh. es-Sath, a typical burial chamber with three *arcosolia*, decorated with a forked cross on one of its walls, cuts into the upper part of the wall of a bell-shaped cave (fig. 22, 23). The bell-shaped cave antedates (at least technically) the burial chamber, hinting at a clear Byzantine date for both (ZISSU & LANGFORD, in press).

On the northern wall of a 26 meters high bell-shaped cave (included in the northern part of the huge complex of "Avigail Cave") at Beth Guvrin (the location is marked A on figs. 24, 25), two schematic human figures (the larger is c. 1.2x1.2 m) were carved, at a height of 10.2 meters above ground (fig. 26). In our opinion, this

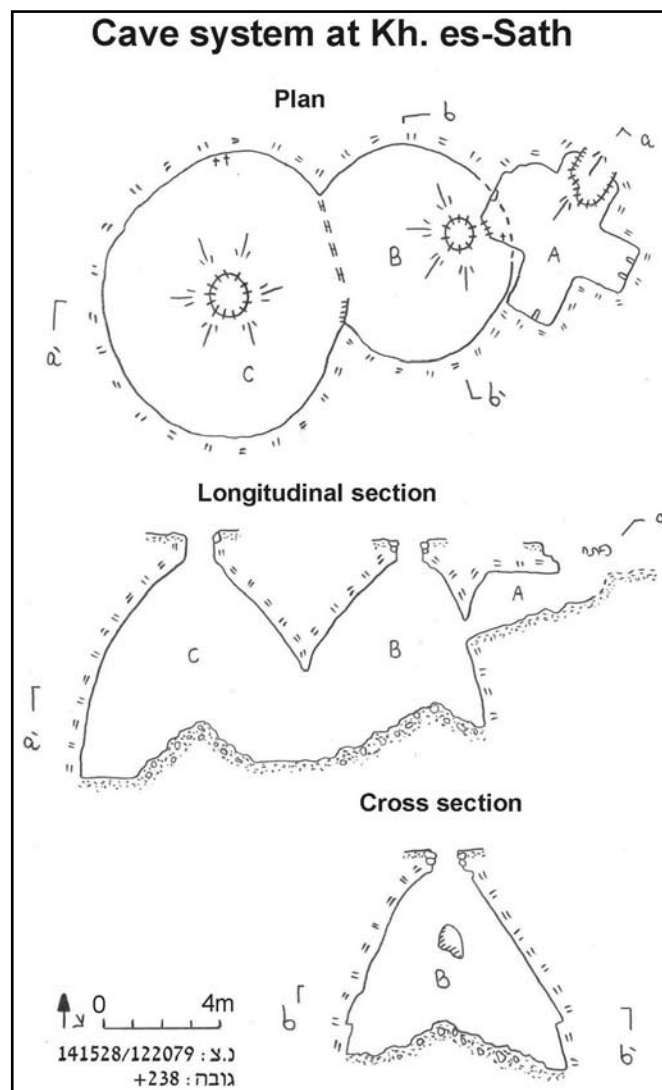


Fig. 22 - Plan and sections (a-a, b-b) of cave system at Kh. es-Sath; A typical Byzantine period burial chamber with three *arcosolia* (A) cuts the upper part of the wall of a bell-shaped cave (B); (drawing B. Langford, B. Zissu and Y. Zissu).

Fig. 22 - Pianta e sezioni (aa, bb) del sistema di cavità a Kh. es-Sat; Una tipica camera sepolcrale con tre arcosoli di periodo bizantino (A) taglia la parte superiore della parete di una cava a forma di campana (B); disegno: B. Langford, B. Zissu e Y. Zissu.

is a schematic and naïve depiction (or rather a double depiction) of the crucifixion.

It seems that both figures represent Christ on the cross, dressed in a *colobium* (a simple, sleeveless white linen tunic). Christ stands erect on a *suppedaneum* (a support for the feet of the crucified) affixed to the cross, his arms held straight horizontally; the arms are apparently nailed to a crossbar (not shown). The rounded element, drawn underneath the lower figure is apparently a schematic depiction of the Golgotha Hill; an additional cross is incised to the right.

Similar depictions of Christ clad in a *colobium*, are known in the Eastern Christian art, e.g. the 6th century CE illumination of the crucifixion in the Rabbula Gospels (CECCHELLI, et al., 1959) and two 7th-8th centuries CE icons from the monastery of Saint Catherine at Mount Sinai (WEITZMANN, 1976).

In other cases, the crosses, carved or incised on the

upper part of the cave's walls, are accompanied by Arabic (*Kufic*) and Greek graffiti and inscriptions, which support the dating of the bell-shaped caves to the Late Byzantine/ Early Islamic period (7th to 11th c. CE; CONDER, 1875; COUROYER, 1964; DAGAN, 1982).

M. Sharon presented fresh readings of all Arabic inscriptions in the complexes of Dayr Dubban (SHARON, 2004) and Beth Guvrin (SHARON, 1999), and classified them as Muslim declarations of faith and short invocations (fig. 27).

He has dated the inscriptions, on palaeographic grounds, to the 8th c. CE. The mixed Greek and Arab (*Kufic*) inscriptions, found on the upper part of the walls of some caves testify to the cultural process of the assimilation of the Arabic culture.

Following the Arab conquest of the country in 634-640 CE, during the 7th to 10th centuries, the Arabic language gradually became the language of Christians, Jews and Samaritans (SHARON, 1997). Sharon regarded the combination of the Christian symbols and the Arabic - Muslim invocations as "two layers of civilization connected with these caves" (1999: 126-142).



Fig. 23 - Photo of cave system at Kh. es-Sath; Letter A marks the forked cross, incised on wall of Byzantine period burial chamber, which cuts the upper part of the wall of a typical bell-shaped cave (B); photo: B. Zissu.

Fig. 23 - Foto del sistema di cavità a Kh. es-Sat; si noti la croce biforcuta (A), incisa sul muro della camera sepolcrale di periodo bizantino, che taglia la parte superiore della parete di una tipica cava a campana (B); photo B. Zissu.

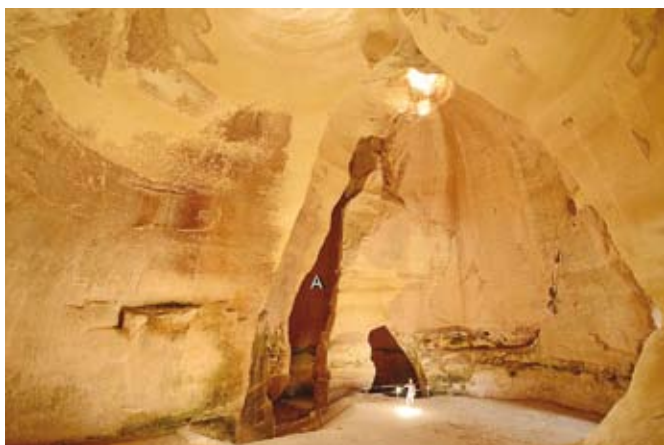


Fig. 24 - Photo of the northern part of "Avigail Cave". Letter A marks the location of the inner quarry (photo: B. Zissu).

Fig. 24 - Foto della parte settentrionale di "Avigail Cave". La lettera A indica la posizione della cava interna (foto: B. Zissu).

Some oil-lamps and pottery vessels found *in situ* in caves east of Beth Govrin belong to the last stage of the initial cutting activity and point to a similar Late-Byzantine - Early Islamic dating (FRUMKIN & KLONER, 1989; KLONER & FRUMKIN, 1989).

The only written source referring to our phenomenon is the Muslim geographer Al-Muqaddasi, who mentioned (985 CE), the "marble quarries" of the Bayt Jibrin

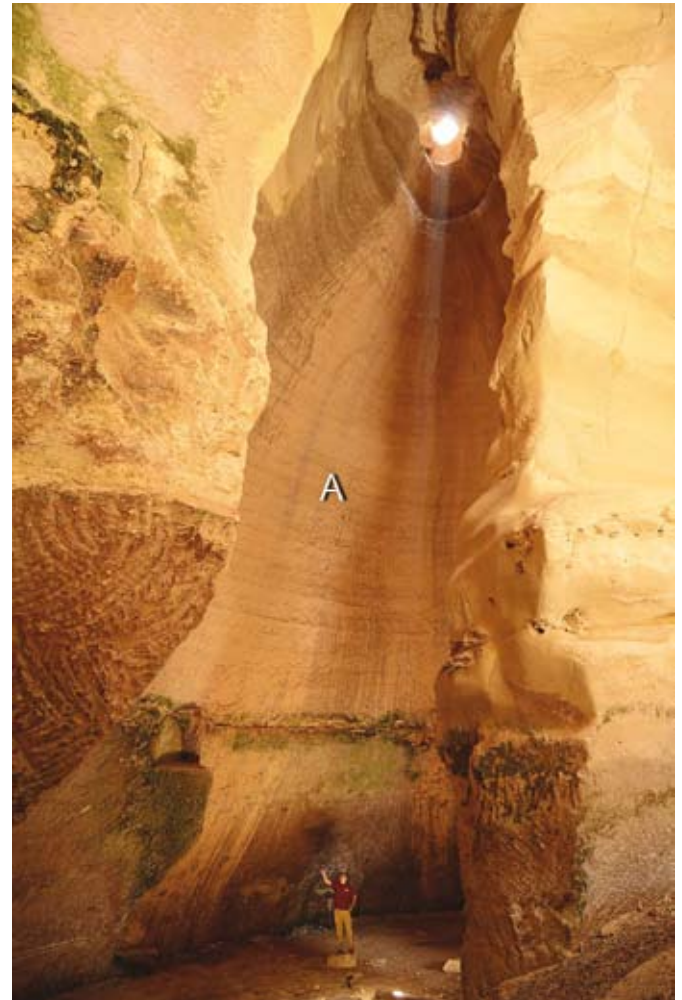


Fig. 25 - The inner quarry in the northern part of "Avigail Cave". Letter "A" marks the location of the schematic human figures, at a height of 10.2 meters above ground (photo: B. Zissu).

Fig. 25 - La cava interna nella parte settentrionale di "Avigail Cave". La lettera "A" indica la posizione delle figure umane stilizzate che si trovano ad un'altezza di 10,2 metri dal suolo (foto: B. Zissu).



Fig. 26 - Detail: the crucifixion (photo: B. Zissu).

Fig. 26 - Dettaglio: la crocifissione (foto: B. Zissu).



Fig. 27 - Kufic inscription, incised on wall of bell-shaped cave at Luzit-Deir Dubban. The inscription reads: "O Allah, forgive Habib's sin" (photo by A. Graicer; SHARON, 1997, 365; no. 7).

Fig. 27 - Iscrizione kufica, incisa sulla parete della cavità di Luzit-Deir Dubban. L'iscrizione dice: "O Allah, perdona il peccato di Habib" (foto di A. Graicer, da SHARON, 1997, 365, n° 7.).

district (LE STRANGE, 1890). A rather oblique reference is found in the "Sefer Nameh" of the traveller Nassiri Khosrau, who visited the region in the year 1035; He described the very soft "marble" of which the city of Ramleh was built - apparently referring to the local chalk (SHEFER, 1881).

Few graffiti were made by hermits, squatters or visitors during or after the Early Islamic period. Of a special interest are two short inscriptions in the ancient Asomtavruli Georgian script of the late 10th or early 11th century, found on the walls of a bell-shaped cave at Horvat Burgin.

These consist of standard Christian formulas in defective spelling. The first inscription reads: "Christos,

have mercy on Tskhrai (Tskhroi?)"; the second reads, "Christos, have mercy on Morchai".

It seems that the cave served Georgian anchorites, who incised their names and other Christian symbols on the walls (TCHEKHANOVETS, 2010).

CONCLUSION AND RESULT

In summary, the re-examination of the findings enables us to suggest some preliminary conclusions:

1. There are clear typological characteristics of the bell-shaped quarries phenomenon. The scattered caves resemble in their characteristics the impressive cluster of over 800 caves, situated near Beth Govrin, where the areas' biggest quarries operated.
2. The main purpose of the subterranean quarries was the extraction of blocks of chalk used for building purposes. The lime was apparently only a by-product of this industry. The "rock scars" and "block remains" apparent on the walls and on the floor of numerous caves may testify to this purpose.
3. The mixed Christian (Greek) and Muslim (Arab, Kufic) inscriptions and graffiti, carved on the upper part of the walls of some caves testify to the cultural process of the assimilation of the Arabic culture in the formerly Christian Holy Land. Following the Arab conquest of 634-640 CE, during the 7th to 10th centuries, the Arabic language gradually became the language of Christians, Jews and Samaritans.
4. Our re-examination of the phenomenon suggests that the beginning of the large-scale quarrying activity occurred during the Late Roman - Byzantine period (4th-5th centuries CE).
5. The peak of the quarrying activity occurred during the late Byzantine (and Early-Islamic periods (7th - 10th centuries CE).

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