

HERODIUM

Final Reports of the 1972–2010 Excavations
Directed by Ehud Netzer

Volume I

Herod's Tomb Precinct

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Israel Exploration Society
Institute of Archaeology, The Hebrew University of Jerusalem



Jerusalem 2015

THIS VOLUME WAS MADE POSSIBLE BY
THE SAMIS FOUNDATION

ISBN 978-965-221-099-9

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Editing by Robert Amoils

Layout by Avraham Pladot

Typesetting by Marzel A.S. — Jerusalem

Printed by Old City Press Ltd., Jerusalem

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THE GEOLOGICAL AND MORPHOLOGICAL STRUCTURE OF HERODIUM AND THE QUARRIES FOR BUILDING STONES AND FILL MATERIALS

Shimon Ilani, Tsevi Minster, and Daniel Wachs

Within the framework of collaboration with the Herodium excavation expedition, detailed geological mapping of the site and its immediate surroundings was carried out in order to comprehend the mount's special conical structure and to determine the types of building stones and fill materials that were used in huge quantities there. Also examined were the rocks that served for the construction of Herod's mausoleum. Two main rock types were determined in the mausoleum. The first is a white limestone, bioclastic, coarsely crystalline, hard and compact, of the *meleke* type, while the second is a light gray limestone, finely crystalline, hard and compact, of the *mizzi hilu* type. Both of these rock types are present in the Shivta and Nezer formations (B'ina Fm) that outcrop to the west and south of Mount Herodium. It is a reasonable assumption that the building stones that were used for the construction of the tomb originated from ancient quarries in the vicinity of Herodium.

The building stones found in the stairways ascending to the Mountain Palace-Fortress, the walls on top of which they were built, and in various architectonic elements such as the round eastern tower were mainly *nari* stones of the Menuha Fm, as well as stones of *nari* composition containing fragments of chert from the Mishash Fm, which originated from the well-compacted colluvium rocks to the east of Mount Herodium.

Within a range of up to 1 km from the site of Herodium were found a few places featuring signs of the early quarrying of these rocks. These quarryings were conducted in limestones of the Shivta and Nezer formations, in the *nari* "layer" that covers the Menuha Fm, in the chalky rocks of the Menuha Fm, and in rock outcrops of the well-compacted colluviums.

INTRODUCTION

The geological study in the area of Herodium, the results of which are represented below, was carried out in two stages. The first stage, conducted in response to the approach of the late Prof. Ehud Netzer (director of the Herodium excavation expedition, from the Archaeological Institute of the Hebrew University) to the Geological Survey of Israel, started in January 2008. Its aim was to examine the possibility whether the building stones in Herod's tomb in particular, and at the site of Herodium in general, had originated from ancient quarries located

fairly close to the site. Also studied were the stones that were used for the construction of Herod's mausoleum.

In the second stage, executed at the beginning of 2012 (following the approach of the excavation expedition), detailed geological mapping of Mount Herodium and its immediate surroundings was carried out in order to gain an understanding of the site's geological structure and the changes that came about following Herod's building projects.

We were aided by orthophotos from the years 2002–2006 on a scale of *c.* 1:6,000 and by an aerial photograph of Herodium and its environs taken in 1967 on an original scale of 1:7,000, as well as by a

detailed survey map (kindly provided by the expedition) on a scale of approximately 1:3,000. The petrography of selected rock samples was studied by means of thin sections and a microscope under polarized light. Some 20 samples of chalky rocks underwent age determination by means of the fossils present in them (foraminifera and ostracods) in order to determine more accurately their position within the geological section.

BACKGROUND AND GEOLOGICAL FINDINGS

The site of Herodium is located in the northern part of the geological map of Hebron on a scale of 1:50,000 (Roth, in preparation). Mount Herodium lies on the northwestern side of the Bani-Na'im Anticline, at a distance of 1–1.5 km to the west of this anticline's axis, which has a general northeast-southwest orientation (Roth, verbal communication).

The lower part of the geological section exposed in the vicinity of Herodium belongs to the Judea Group. The section is built of white limestone, bioclastic, coarsely crystalline, hard, compact, and massively bedded, which belongs to the Shivta Fm of Turonian age, that is known as *meleke*; the Shivta Fm is the middle mapping unit of the B'ina Fm (Ills. A.1–3). Above the rock section of the *meleke* type lies gray limestone, finely crystalline, hard, compact, biogenic, well-bedded, in layers up to 60 cm thick. It belongs to the Nezer Fm of Turonian age and is termed *mizzi hilu* (this is the top mapping unit of the B'ina Fm; see Ills. A.1–3).

Most of the Senonian section (Mount Scopus Group) that is exposed on Mount Herodium and its periphery belongs to the Menuha Fm which attains a thickness of some 50 m (Ills. A.1–3). The age of this formation ranges from the Santonian up to the lower part of the Upper Campanian (Gvirtzman et al. 1989). The Menuha Fm is made up of relatively soft chalky rocks with massive bedding. Present in some places in the chalky section are lenses of hard, compact chalk. One of the tunnels dug by the rebels in the upper part of the mount at the time of the Bar-Kokhba Revolt encountered this hard rock and its course was shifted laterally so that it continued into

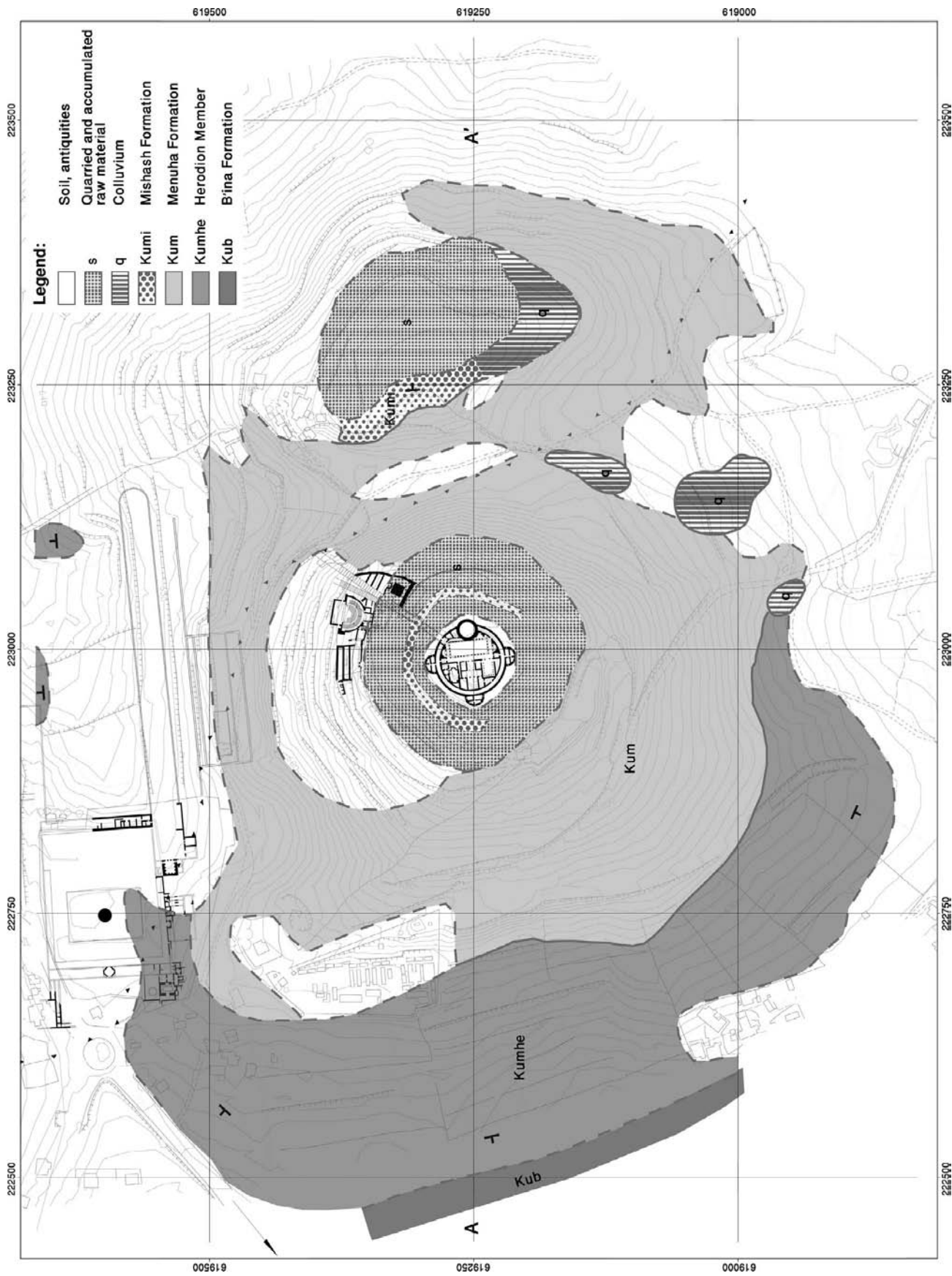
fairly friable rock. Rocks of this formation are characterized by the presence of a *nari* "layer" which forms an upper weathering crust that generally conceals the chalky rock beneath it. The thickness of this *nari* "layer" is 1–2 m. The slopes built of chalk attributed to the Menuha Fm are characterized by natural "terraces" (colluviums) on which has developed a very limy rendzina soil which slides down the *nari* "layer" below it.

At the transition from the B'ina Fm to the Menuha Fm a new mapping unit was here identified for the first time and termed the "Herodion Member." This unit consists of hard, compact, massive chalk. It is *c.* 12 m thick and is of Santonian age. This rock unit parallels the mapping unit previously known as the "Qa'aqule." The rocks of this unit are exposed around Mount Herodium and form a sort of "ring" around it (Ills. A.1–2). The dips of the rocks of this unit are 5–10° from Mount Herodium toward the margins of the mapped area further down. This finding indicates that Mount Herodium has the geological structure of a dome (Ill. A.2).

Above the Menuha Fm lie rocks of the Mishash Fm that are of Campanian age. The latter formation consists mainly of massive layers of chert with an overall thickness of 6–8 m. These layers are also present in the upper part of the mount, at the base of the round eastern tower, as well as in the rebels' tunnels in that part of the mount. The base of the massive chert layers (of the Mishash Fm) on Mount Herodium is at an elevation of *c.* 734 m above sea level. The elevation of the layers of massive chert on which the round tower is based at *c.* 740 m asl.

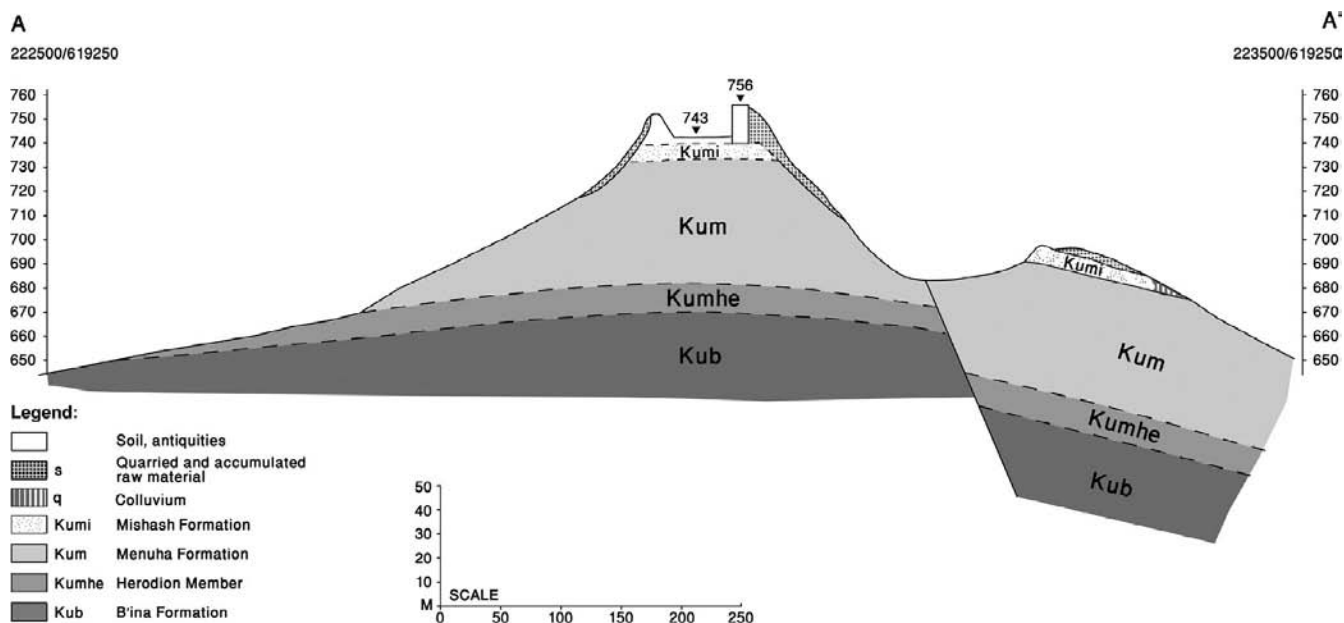
On the "Flat-topped Hill" located to the east of Mount Herodium, the absolute elevation of the base of the massive chert of the Mishash Fm on the side facing Herodium is *c.* 690 m asl, while the base of these layers that was penetrated in the tunnels in the upper part of the mount is located approximately at an elevation of 734 m (asl). There is thus a topographic difference of *c.* 45 m in the lateral continuation of these layers over a horizontal distance of only *c.* 200 m. This finding can be explained by the presence of a normal fault with a vertical throw of some 20 m and a northwest-southeast orientation. The (relatively) lowered "block" is the "Flat-topped Hill," i.e., in relation to the "block" (Mount Herodium itself) that was shifted upward.

APPENDIX 1: GEOLOGICAL AND MORPHOLOGICAL STRUCTURE



III. A.1. Geological map.

HERODIUM I: HEROD'S TOMB PRECINCT



III. A.2. East-west geological cross section A-A' (along latitude 619250).

Stratigraphy

System	Series-Stage	Thick m	Lithology	Lithostratigraphy		
				Mapping Units	Group	
CRETACEOUS	SENONIAN	MAASTRICHTIAN	~40		Ghareb Formation	Mount Scopus
		CAMPANIAN	~60		Mishash Formation	
		SANTONIAN	~50		Menuha Formation	
	TURONIAN	12		Herodion Member	Judea	
		CENOMANIAN		~100		Nezer Formation
	CENOMANIAN		30-50			Shivta Formation
				Derorim Formation		
			Weradim Formation			

Limestone Dolomite Chalk Chert Fossils

III. A.3. Columnar geological section.

It should be mentioned that during the observation carried out at the northern part of Teqoa toward the northern bank of the canyon of Nahal Teqoa, disturbed layers were seen at two nearby sites, one of which could be the southward continuation of the above-mentioned fault.

On the "Flat-topped Hill," above the massive chert of the Menuha Fm and above the "layer" of colluvium that overlies the Mishash Fm, a dumped rocky material is found consisting of fragments and friable material, composed of chalk and chert quarried from the Menuha and Mishash formations. This dumped

material contains numerous ceramic sherds. It forms a fairly flat platform, oval in shape, with a maximum length of some 200 m in a north-south direction, and is about 100 m wide in an east-west direction. The thickness of this dumped material in its eastern part is estimated at more than 20 m. The cross section that was made (A-A' [Ill. A.2]) passes through the southern part of the surface and therefore the thickness of the dumped material visible here is fairly small, *c.* 3 m. The reason for the construction of this platform is still unclear, but it can be assumed that it was connected with Herod's activity and with the operations to process the material that had been quarried and was to be dumped on the upper and middle parts of Mount Herodium. It is possible that in Herod's time the valley presently separating Mount Herodium from the "Flat-topped Hill," in the part that drains northward (in which an olive grove is presently located), did not constitute a significant topographical partition (as it does today). It can be assumed that a quarry in this locality served both for the production of raw material for the fills and the building of the artificial mount (and perhaps also for generating the surface of the "Flat-topped Hill") and also contributed toward shaping the unique conical profile of Mount Herodium in its eastern part. It should also be mentioned that the presence of a quarry in this place, and not in the western part of Mount Herodium, also gains geological support in that the fill material contains fragments of chalk and chert (chert rock is not exposed in the mount's western part), and also for the topographical reason of close access to the upper part of the mount.

Outcrops of a well-consolidated colluvium "layer" are present in the area to the southeast of Mount Herodium. The colluvium consists of *nari* containing angular, unsorted fragments of Mishash chert lacking orientation or distinct bedding. Such fragments measure 1–30 cm in size. The thickness of the colluvium layer is 1–2 m. This layer forms a "blanket" overlying the rocks of the Menuha and Mishash formations with an erosional angular unconformity. In the southern part of the "Flat-topped Hill" to the east of Mount Herodium, we note that the layers of massive chert of the Mishash Fm "fragmented beneath them" slid down the slope that existed in the ancient relief and coalesced to form colluvium with a matrix consisting of *nari*. Visible on the geological

map (Ill. A.1) are four outcrops of colluvium, forming a triangle whose apex points southwestward from the "Flat-topped Hill." In all of these outcrops, one can discern quarrying activities for the production of building stones. Indeed many of the building stones at Herodium originated from rocks of this colluvium, and in many cases the dark fragments of chert within them are clearly visible.

Quarrying Sites

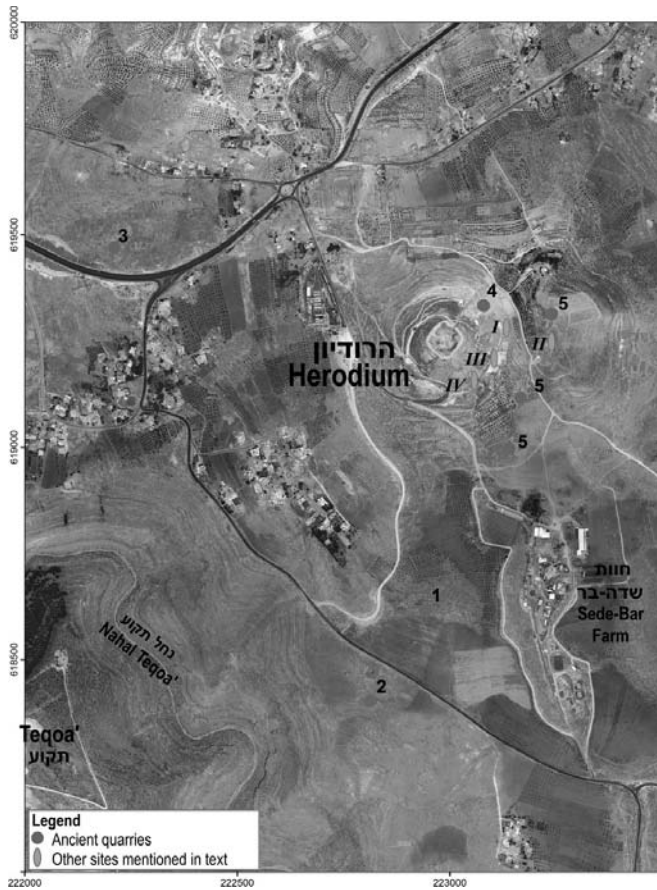
Three places showing signs of quarrying activity, probably ancient, were found in the outcrops of the Shivta and Nezer formations to the west and south of Mount Herodium. Signs of quarrying for the production of ashlar from the *nari* "layer" above the chalky rocks of the Menuha Fm were discerned in the area of the theater and the mausoleum, and a number of quarrying sites were noted in the colluvium "layer" to the southeast of Mount Herodium. Rock samples were taken for determination from these sites. A description of the sites that were examined (the locations are in the new Israel grid) is given below. The distances mentioned here were measured "as the crow flies"; the marking of the site of Herodium relates to the center of the mount's summit.

Quarrying Site No. 1:

Coordinates 222960/618610

The site is located some 700 m south of Herodium and *c.* 150 m north of the road leading to Noqdim (Ill. A.4). Here we found signs of ancient quarrying and evidence of the removal of blocks of rock from the original stratum (Ill. A.5). The rock is gray limestone, finely crystalline, hard, compact, and contains fossils of marine snails (of the genus *Nerinea*), locally silicified, with a length of up to 10 cm. Nowadays, quarriers term this rock type *mizzi hilu* and it parallels the Nezer Fm. The thickness of the rock layers at this site is about 60 cm. Here were found blocks of limestone with a length of up to 2 m, detached from their strata. This rock type is present among the building stones in the area of Herod's tomb, as well as in a few buildings in Lower Herodium.

HERODIUM I: HEROD'S TOMB PRECINCT



III. A.4. Map showing the location of the sites, against the background of an orthophoto.

Quarrying Site No. 2:

Coordinates 222810/618400

The site is located *c.* 900 m south of Herodium and *c.* 100–200 m south of the road to Noqdim (III. A.4). Here were found signs of quarrying and the removal of blocks of rock from the original strata (Ils. A.6–7). The rock is a gray limestone, finely crystalline, hard, and compact (of the *mizzi hilu* type), and contains silicified fossils of marine snails (*Nerinea*), up to 10 cm long. Here too, the thickness of the layers is *c.* 60 cm and detached blocks with a length of up to 2 m were found.

Quarrying Site No. 3:

Coordinates 222210/619480

The site is located *c.* 650 m west-northwest of Herodium, north of the course of the new road leading to Teqoa (III. A.4). The rock forming the lower part of the section is of Turonian age and consists of



III. A.5. Signs of quarrying in rock of the *mizzi hilu* type, Site no. 1.



III. A.6. Blocks of rock of the *mizzi hilu* type detached from their original stratum, Site no. 2.



III. A.7. Blocks of rock of the *mizzi hilu* type detached from their original stratum, Site no. 2.

APPENDIX 1: GEOLOGICAL AND MORPHOLOGICAL STRUCTURE

light gray-whitish limestone, bioclastic, coarsely crystalline, hard, and compact, belonging to the Shivta Fm, and quarriers nowadays call it *meleke*. Preserved at this site are “channels” created in order to detach blocks of stone from their original strata; they are *c.* 10 cm wide and are presently filled with earth (Ills. A.8–9). The dimensions of the building stones that these channels were meant to detach were *c.* 1 m long and *c.* 60 cm wide. Similar stones from rock of the *meleke* type are to be found in the podium of Herod’s mausoleum at Herodium. In the upper part of the section of Turonian age, in a sequence above the section of the rock of *meleke* type, is a bedded gray limestone, finely crystalline, hard, compact, biogenic, in layers that are 60 cm thick; it is termed *mizzi hilu*. At Site no. 3, no large and complete fossils of *Nerinea* were found within the *mizzi hilu* (like those at Sites nos. 1 and 2). A large number of present-day quarrying pits were also identified at this site (Ill. A.9), and according to a local inhabitant,



III. A.9. Recent quarrying in rock of the *meleke* type, Site no. 3.

the quarrying activity there started some 60 years ago. In our view, it seems very likely that some of these modern quarrying pits are operating at the sites of ancient quarries and have thus “obliterated” signs of quarrying from early times.



III.A.8. Ancient quarrying channels in rock of the *meleke* type, Site no. 3.

Quarrying Site No. 4:

Coordinates 223100/619300

The site is located in the area of the mausoleum, below it and to its side. Present are signs of quarrying for the production of ashlar, apparently for construction at the top of the mount. The quarrying was carried out in the “layer” of *nari* whose thickness is up to *c.* 2 m; it is well consolidated and covers the chalk of the Menuha Fm (Ill. A.10). The chalk of the



III. A.10. Ancient quarrying in the *nari* layer above the Menuha Fm, Site no. 4.

Menuha Fm at this site, below the “layer” of *nari*, is very fissured and thus unsuitable for the quarrying of building stones.

Quarrying Site No. 5:

Coordinates 223200/619300

This site is located about 300 m east of Herodium, in the upper western part of the “Flat-topped Hill” and on the southeastern slopes of Mount Herodium (Ill. A.4). Unlike at three of the aforementioned sites (nos. 1–3), the quarryings at Site no. 5 are in a layer built of hard, well-consolidated colluvium that is made up of *nari* (up to *c.* 2 m thick) containing angular fragments of dark brown chert from the Mishash Fm (measuring 1–30 cm in diameter). Quarrying channels 10–20 cm wide and up to *c.* 20 cm deep are present at this site. They were cut in order to detach ashlar measuring approximately 1 m in length and *c.* 50 cm in both width and depth (Ill. A.11). An ashlar with dressed margins was found resting at an angle on top of a neighboring stone, perhaps to facilitate the work of the stone-dresser. The *nari* layer has the appearance of a rock harder than the chalk rock common in the vicinity, in the Menuha Fm, and was therefore suitable for the production of building stones. Ashlars of *nari* containing fragments of brown chert also appear in the early and late monumental stairways built by Herod, leading up to the summit of Herodium, in the retaining walls very close to the tomb site, and in the various buildings on the hill and to its northwest. The quarrying finds lead



Ill. A.11. Signs of ancient quarrying in *nari* rock (colluvium) containing fragments of chert from the Mishash Fm, Site no. 5.

us to believe that the natural topographic elevation of the “Flat-topped Hill” in Herod’s day was similar to that at present and thus its top was not “flattened” by Herod’s workers.

The colluvium layer, whose thickness is *c.* 1–2 m, lies at the top of the “Flat-topped Hill,” above layers of chert of the Mishash Fm whose overall thickness is 6–8 m. Large fragments of chert slid down westward on the slope, in the direction of the topographically low area in which an olive grove is presently located, in the valley separating Mount Herodium on the west from the “Flat-topped Hill” on the east. It can be assumed that on the slope built of chalk (Menuha Fm) and covered by soil and rock fragments, on the southern slope of the “Flat-topped Hill,” and in three outcrops to its southwest (coordinates 223170/619120; 223160/619000; and 223050/618950), the colluvium “layer” is separated from the underlying Menuha Fm by an erosional angular unconformity. Signs of the quarrying of building stones are present in all outcrops of the colluvium “layer.”

Mining and Quarrying on the Eastern Slope of Mount Herodium and in the Valley at its Foot to Produce Fill Materials

The valley in which an olive grove is presently located (Ill. A.12), separating Mount Herodium from the “Flat-topped Hill” to its east, is some 100 m wide



Ill. A.12. View westward from the “Flat-topped Hill” in the direction of the valley and the eastern base of Mount Herodium.



III. A.13. Aerial photograph of Herodium and its surroundings, taken in 1967 (approximate scale — 1:7,000).

at its flanks and has a length of *c.* 230 m (opposite the area from which colluvium was removed on the eastern side of Mount Herodium; III. A.13). One can learn about the composition of the original material that covered the valley, at least in its southern part, from an examination of the quarry walls located on its eastern fringe at coordinates 223250/619250 (no. II on III. A.4). The rock is unconsolidated material, colluvium, mainly containing fragments of chalk and chert, angular and unsorted, as well as lenses of brown soil. This composition probably matches the material that was dumped as the bottom layer in the upper part of Mount Herodium, around the walls, at the time of construction of the artificial mound. This layer was compacted on top of the bedrock which is a layer of *nari* covering the chalk rock of the Menuha Fm. In connection with the mining of the material in

the area of this valley, two scenarios merit consideration.

a) If the material that was used for this bottom layer was brought from the valley in question, then it is possible that at the same time as the mined material was being dumped around the walls of the fortress in the upper part of Mount Herodium, Herod's workers could have been mining and deepening the valley in order to create a greater difference in elevation on the eastern slope of the mount, and also in order to produce material for dumping around the walls of the fortress. If the maximum depth of the mining of this colluvium material is estimated at 5 m, over a length of *c.* 200 m and a width of *c.* 50 m, then one can assess that the amount of material mined in this valley to form the bottom layer was *c.* 50,000 cubic meters.

Since there are signs of the mining of the chalky rock of the Menuha Fm in the lower eastern part of Mount Herodium (Ill. A.12), one can reasonably assume that, prior to the quarrying of the chalk, the colluvium lying on top of the eastern and southeastern slope of the hill was mined. This colluvium mainly contained unsorted fragments of chalk from the Menuha Fm, fragments of unsorted, angular chert (that slid down from the bottom part of the Mishash Fm that is located at the top of the section on Mount Herodium), and also gray rendzina soil. On the assumption that the average thickness of the colluvium "layer" on the eastern slope was *c.* 1.5 m and that it was removed to a height of *c.* 30 m from the base of the slope, over a horizontal distance of *c.* 200 m, the volume of the "layer" that was removed here would then have been *c.* 10,000 cubic meters.

Evidence of the quarrying of the chalk rock of the Menuha Fm at the base of Mount Herodium is present in the part facing the valley, over a length of *c.* 200 m and up to a height of 30 m from the valley. The quarrying in the chalk rock is notable in the field (Ill. A.14; no. III in Ill. A.4), since the eastern slope of Mount Herodium is "smooth," with signs of quarrying in the bottom third. The colluvium that had been present here (and apparently can be seen to cover the other slopes of the hill) was removed. In Ill. A.14 one can discern quarried areas with a square outline having a length of *c.* 15–20 m, located at the base of the slope. These square areas are bounded by shallow "channels" in which soil has accumulated on which vegetation has grown. On the southeastern slope, the original chalk rocks of the Menuha Fm have remained on the surface of the area; they were not quarried or removed (Ill. A.14; no. IV in Ill. A.4). In a section parallel to the slope, these chalk rocks form a sort of "peg" whose thickness at the base of the slope is 3–4 m and decreases further up until it disappears in the area where the angle of the slope changes (Ill. A.14). On the assumption that the depth of quarrying of the chalk rock of the Menuha Fm was *c.* 2 m along the slope (in a general north-south direction), a close estimate puts the volume of quarried chalk of the Menuha Fm facing the eastern slope at approximately 20,000 cubic meters. The quarried chalk was apparently used for the deposition of the "top layer" around the walls of the fortress and on the top of the upper slopes. This "top layer" was made up



Ill. A.14. Ancient quarrying in chalky rock (Menuha Fm) on the eastern slope of Mount Herodium (no. III on Ill. A.4). In the background to the left is seen a section of the original slope that was not quarried (no. IV on Ill. A.4).

solely of unsorted fragments of chalk rock and does not contain brown soil and angular fragments of chert, as does the "bottom layer," which was deposited beneath it and compacted directly on top of the bedrock. The overall quantities estimated here are *c.* 80,000 cubic meters.

The quantities of material dumped around the walls of the fortress at the top of Mount Herodium are estimated to be of the order of *c.* 380,000 cubic meters (Roi Porat, verbal communication). This figure is very large in relation to the quantities estimated by us above.

b) A second scenario relating to the quarrying to the east of Mount Herodium, in which an attempt is made to bridge the gap between the various quantitative estimates.

It is possible that in Herod's day the "Flat-topped Hill" was joined to Mount Herodium and that the presently existing valley is an artificial one that was formed as a result of the mining of the chalk of the Menuha Fm in order to bring about the special conical shape of Mount Herodium. It has already been mentioned that at the back of the "Flat-topped Hill," at a topographical elevation of *c.* 700 m asl, the well-consolidated colluvium "layer," which contains fragments of unsorted chert of the Mishash Fm and features signs of quarrying for the production of ashlar, is exposed, i.e., no other sedimentary rock covered

this colluvium “layer.” On the other hand, this hill is covered by a dump of quarried fragments of chalk of the Menuha Fm and chert fragments of the Mishash Fm. The thickness of the dump exceeds 20 m in the eastern part of the “Flat-topped Hill.” Thus, it can be estimated that the volume of the dumped materials on the “Flat-topped Hill” exceeds 100,000 cubic meters. The presence of this dump can be attributed to the fact that the colluvium “layer” at the back of this hill and the Mishash Fm rock below it extended up to the eastern slope of Mount Herodium. It is important to mention that outcrops of such a colluvium “layer” are presently located on the southeastern slope of Mount Herodium (Ill. A.1). It can therefore be assumed that the “hump” that once projected on the eastern slope of Mount Herodium was removed in order to create a uniform gradient on the slope, and that mined material from this “hump” was dumped on the eastern side of the “Flat-topped Hill.” At a relatively later stage, during the continued execution of the above-mentioned activity, it is possible that “an order was given” to create a topographic partition *c.* 20 m deep between Mount Herodium and the “Flat-topped Hill,” taking advantage of the material mined in the artificial valley for dumping on the upper parts of Mount Herodium. In our view, if this scenario did indeed exist, then the quantities of the chalky material (Menuha Fm) and the chert layer (Mishash Fm) at its top, which were mined in the area of the present-day valley, can be estimated at *c.* 200,000 cubic meters. It should be mentioned that even according to the second scenario, there is still a discrepancy between the estimates, and this matter merits further study.

The Rock at the Tomb Site and the Petrographic Determination of the Stones of the Sarcophagi

Two main rock types were determined at the tomb site: a) a white limestone, bioclastic, coarsely crystalline, hard and compact, of the *meleke* type, b) a light gray limestone, finely crystalline, hard and compact, of the *mizzi hilu* type. Both of these rock types are present in the Shivta and Nezer formations that outcrop in the area of Herodium. In the stairway ascending to the fortress of Herodium were found building stones of *nari* composition containing

fragments of chert from the Mishash Fm. In the area of Herodium, rock outcrops of the B’ina (Shivta and Nezer) and Menuha formations and of well-compacted colluvium were examined. They could have served as a source for the supply of building stones to the site.

The three sarcophagi from the mausoleum at Herodium were reconstructed at the Hebrew University campus on Mount Scopus and the Israel Museum, Jerusalem, for presentation at an exhibition. Petrographic determinations of the rock types from which these sarcophagi had been made were carried out together with an assessment of the place where they had been quarried. The findings are presented below:

- Sarcophagus no. 1 (the reddish, decorated one): reddish limestone rich in stylolites, of the B’ina Fm.
- Sarcophagus no. 2 (the white, undecorated one): gray limestone of the B’ina Fm.
- Sarcophagus no. 3 (the white, decorated one): gray limestone of the B’ina Fm.

The limestones of the B’ina Fm of Turonian age (Judea Group) are exposed in the Judean Hills and in the Galilee. In these areas quarries dating from the Second Temple period were found, and it can reasonably be assumed that the raw material for the sarcophagi was quarried there. Ancient quarries from the Second Temple period are located close to Herodium and in Jerusalem at a number of sites, such as in the suburbs of Ramat Shlomo and Bet Hanina, and in the area of Shmuel Hanavi Street, the Cave of Zedekiah, etc. Reddish limestone is present in the section of the rocks of the B’ina Fm in a few scattered places, apparently in the upper part of this formation close to the unconformable erosional contact with the overlying chalk rocks of Senonian age. It generally occurs in lenses attaining a size of up to a few meters. Therefore, if such a lens was quarried for the construction of the reddish sarcophagus, it will be difficult to find the place where it was quarried.

Building Stones of Herodian and Byzantine Times at Lower Herodium

The Herodian structures in this area, such as the “Monumental Building,” are built of hewn *nari*

stones. This type of stone does not contain chert fragments and thus most probably originates from the *nari* layer overlying the Senonian Menuha Fm covering the slopes of Mount Herodium. At coordinates 222800/619400, to the south of and near Lower Herodium, there is a prominent cavea-like depression facing northward. Its length is *c.* 80 m and its width *ca* 50 m. The *nari* that covers a layer within this morphological feature is missing although it is exposed on its shoulders. It is thus possible that the source of the aforementioned *nari* stones was within this site, but the recent soil cover and slumping conceal signs of quarrying. Many of these hewn stones were reused during the Byzantine period for the construction of houses and churches at the site.

Three Byzantine churches were revealed at Lower Herodium:

- a. The Central Church, located at coordinates 222820/619510, is built of hewn stones made of *nari* that covers the Menuha Fm, as well as ashlar made of “fresh” limestone of the *meleke* and *mizzi hilu* types, featuring the typical “Herodian” margins. Some of them are decorated with carved rosettes with joined triglyphs, typical of a monumental “Herodian” facade. Thus, it is assumed that these ashlar were retrieved by the Byzantine builders from a Herodian building that probably stood nearby in Lower Herodium.
- b. The Eastern Church is located at coordinates 223010/619500. It stands on a large platform on top of a complex of arches built of hewn *nari* stones of the type that covers the Menuha Fm. The Herodian “Large Palace” probably stood on this platform. Also the church is built of hewn

nari stones, as well as ashlar made of “fresh” limestone of the *meleke* and *mizzi hilu* type. These ashlar lack the aforementioned Herodian margins and are quite similar to the stones found at the site of the mausoleum.

- c. The Northern Church, located at coordinates 222820/619715, is built mostly of hewn stones made of *nari* that covers the Menuha Fm.

Ashlar made of “fresh” limestone of the *meleke* and *mizzi hilu* types are also found in the southernmost room of the substructure of the “Eastern Hall” of the Pool Complex, at coordinates 222860/619550. Some of them feature the typical Herodian margins. The base of the walls of this building is built of hewn stones made of *nari* that covers the Menuha Fm.

ACKNOWLEDGMENTS

We are greatly indebted to the late Prof. Ehud Netzer, director of the Herodium excavation expedition, to Yakov Kalman and Roi Porat, members of the expedition, and Shim'on Gasanov, to Dr. B. Z. Begin, Dr. N. Lanski, Dr. A. Burg, and Dr. Z. Levy for their helpful comments, to Mrs. R. Simon-Tov, Dr. A. Honigstein, and Dr. A. Almogi for age determinations by means of microfossils, to Dr. D. Mevorach of the Israel Museum, Jerusalem, to Mrs. H. Netzer-Cohen, B. S. Cohen, and N. Almog for their contributions in drafting the illustrations, editing, and the production of this report, to Y. Rafael for technological assistance, and to R. Amoils for translating the Hebrew text into English.

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