Distance water carriers in the roman period. The case of Philippi and Neapolis-Kavala

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Stavroula Dadaki
Ephorate of Antiquities of Kavala –Thasos, Greece
email: st.dadaki@yahoo.gr
Efstathios Iliadis
Ephorate of Antiquities of Kavala –Thasos, Greece
email: stathisheliades@gmail.com
Ioannis Iliadis
Ephorate of Antiquities of Kavala –Thasos, Greece
email: ioheliades@yahoo.com

Summary - In order to supply Philippi with water a distribution system was constructed, which dates from the Age of the Antonines (2nd cent. A.D.) This system began at the Kephalari springs or Boïranes, about 8 km northwest of Philippi. Today, the conduit survives in many places: to the north and south of Kephalari, at Lydia and on the west and north-western sides of the hill of Philippi, above the west gate (the so called Amhipolis Gate). The interior of the conduit is very carefully constructed. The aqueduct of Kavala brought water to the dry rock of Panaghia, where the ancient Neapolis, the Byzantine Christoupolis and now the modern Kavala town is situated, from a place called "the mother of water" at the foot of Lekani Mountain, 11km from the city, at 400 meters altitude.The Water, after collected in a purifying cistern, was channel led in a conduit cut on the rocky field. Its route follows the inclinations of the ground and its form depends on the natural terrain. The course of the aqueduct passes through stone bridges, which were built to bridge streams, gorges and reservoirs.The variety of arches, materials and construction methods indicate towards the probability of a Late Roman phase that constantly restored. The aqueduct supplied with water Kavala until the beginning of 20th century.
Keywords: roman period / Neapolis / Kavala / Philippi

Riassunto - Per garantire l'approvigionamento idrico di Filippi fu costruito un sistema di distribuzione che risale all'epoca degli Antonini (II sec. d.C.). Questo sistema ha origine presso le sorgenti Kephalari o Boïranes, circa 8 km a nord-ovest di Filippi. Oggi, il condotto sopravvive in molti luoghi: a nord e a sud della Kephalari, a Lidia e ad ovest e nord-ovest della collina di Filippi, sopra la porta occidentale (il cosiddetto Amhipolis Gate). L'interno del condotto è costruito molto accuratamente .
L'acquedotto di Kavala aveva origine in una località detta madre delle acque", ai piedi del monte Lekani, a 11 km dalla città, a 400 metri di altitude. L'acqua era raccolta in una cisterna di purificazione e canlizzata in un condotto tagliato nella roccia. Il percorso seguiva le inclinazioni del terreno adattandovisi. Ponti di pietra sono stati costruiti per attraversare ruscelli, gole e *reservoirs*. la tipologia degli archi, i materiali e i metodi di costruzione indicano interventi di ripristino di età tardo romana. L'acquedotto ha fornito con acqua Kavala fino all'inizio del XX secolo.
Parole chiave: periodo romano / Neapolis / Kavala / Filippi

A - Philippi

Since prehistoric times, man has constantly searched for springs, rivers and lakes in order to obtain water, a commodity essential for his development. Of course, there is no reason why the Philippi region should have been any different, especially as it possessed many advantages.

After the battle of 42 B.C, Roman colonist and veterans were settled in the fertile region of Philippi and the city became a Roman colony, which flourished greatly in the 2nd c. AD.

Fig. 1. A Possible route of the conduit. a. Kefalari b. Philippi. C. Archaeological area of Philippi. Source – Google Earth

In order to supply Philippi with water a distribution system was constructed, which dates from the Age of the Antonines (2nd c. A.D.).

This system began at the Kephalari springs, or Boïranes, about 8 km. north-west of Philippi (Fig. 1).

However, where exactly did the Roman city draw its water from? Was it from the modern springs or from some other point? How large was the water supply that reached the city? These are some of the issues that are examined in this study.

Research has revealed that the original springs lay higher up than the modern ones, which supply Kavala, Doxato and Aghios Athanasios. This was originally discovered by an on-the-spot investigation and then later by mapping the visible section of the conduit. For example, the modern springs lie on the 70m. contour line, while the ancient conduit lies on the 80 m. one. Another piece of evidence supporting this proposition is the fact that the landscape around the old springs has changed. In this area there are bare rocks which are devoid of vegetation due to the flow of water from above, which for years has 'swept clean' the whole of the mountainside.

According to the testimony of a local resident, during the 1960's two water mills used to operate at the base of the rock near the modern springs. The large quantities of water that flowed from above used to move the millstones. The noise made by the water was so loud that it could be heard in the neighbouring village of Aghios Athanasios, which lies 2 km. away from the springs.[1]

1 Aghios Athanasios in all probability occupies the site of an ancient settlement which in antiquity acquired the name Boïrane. In our opinion, the settlement must have acquired this name from the deafening sound (*bouē*) made by the water as it flowed (*roē*) down the mountainside. On account of the *bouē* and the *roē*, therefore, the settlement acquired the name Boïrane.

Today, the conduit survives in many places: to the north and south of Kephalari (Fig. 2), at Lydia and on the west and north-western sides of the hill of Philippi, above the west gate (*the so called Amhipolis Gate*) (Fig. 3).

The interior of the conduit is very carefully constructed. On top of a special foundation layer lie terracotta tiles, which cover the whole of the bottom of the conduit. The side walls, up to a certain height, are formed by a layer of lime mortar coated by a layer of hydraulic plaster. These two layers also cover the bottom of the conduit.

Its internal dimensions in the Kephalari area are: 0.96m. wide x 1.35m. deep. In this area the side walls are not vertical (they are not entirely perpendicular towards the bottom of the conduit, but they bend 10^{o} towards the center). In the Lydia vicinity only traces of the conduit survive. Within the archaeological site the internal dimensions are: 1.20m. deep x 0.80/0.50 m. wide. Here the side walls have been constructed so as to slope inwards.

We can see, therefore, that the form of the conduit near the springs is different to that lower down near the city. Near the springs, the conduit is square in section, while near the city the bottom of the conduit narrows, evidently in order to increase the speed of the water. However, we do not know at what point the conduit changes in shape.

Topographical mapping of these points has revealed that the conduit of course follows the natural slope of the ground and forms zig-zag patterns along the water streams. Its gradient does not exceed the ratio 1:1000. On the topographical diagram we observe that the surviving section of the water conduit south of Kephalari lies just above the 80m. contour line, while in the Lydia area it follows the 80m. contour line itself. At the level of the Amphipolis Gate it is incorporated into the Byzantine fortifications, while near the Archaeological Museum it moves away and follows a lower course than the 80m. contour line.

The cross-section of the conduit and its gradient reveal that the water supply rate was Q = $400m^3/h$ (max quantity) or $100m^3/h$ (min quantity). However, the supply of water reaching the cisterns, due to friction and the low gradient of the conduit, was clearly less. The water supply rate at the cistern is estimated to have been about $150m^3/h$. The quantity of water reaching the city was sufficient to keep the two large cisterns that lay on either side of the entrance to the Forum constantly full, night and day. Their dimensions are: 22m. long x 3m. wide x 3m. deep. Their water storage capacity was about $400m^3$.

The bottom surfaces of the cisterns lie at a lower level than the floor of the Forum and the Via Egnatia higher of it. This means that water overflowing from the cisterns and rainwater would have collected in the square and run away in the channel that crosses the Forum. This channel is almost semicircular in section. The gradient of the channel is: 7mm/1m.; in other words, the difference in height over 50m. is 34cm. Thus the water flowed easily down towards the two north-west corners (exits) of the Forum.

We don't know how the water was conveyed from the conduit into the two large cisterns. If it is examined on the practical side, we believe that there was, at least, another large cistern between the conduit and the cisterns.

There are two versions. a) The Temple – Shaped Building in the centre of the colonnaded court west of the atrium of the Early Christian Basilica A, was dated by its excavators to the Hellenistic period, was converted into a water cistern. Its water storage capacity was about 120 m^3. In this building there is an opening in the middle of the bottom of the south wall and at the same point outside there is a well. The quantity of water reaching the city (it is estimated 100 -$150m^3/h$) was be explained by the fact was a large water storage capacity of this cistern b) In the southwest corner of the atrium, to the right of the monumental staircase, there is a Roman water cistern. According to a tradition this cistern was believed to be '' St. Paul's Prison'' .Its water storage capacity was about $50m^3$. But a question emerges: There are not water openings on the wall. Possibly, they were covered by the Plaster.

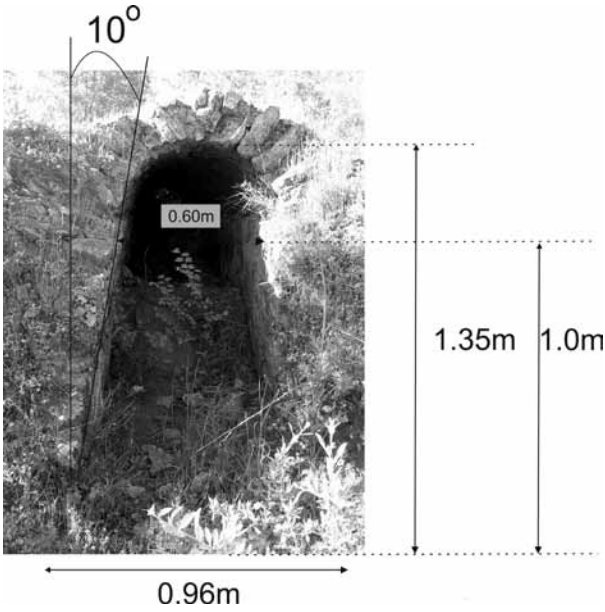

Fig. 2. Geometry of the conduit. Source – Ephorate of Antiquities of Kavala – Thasos.

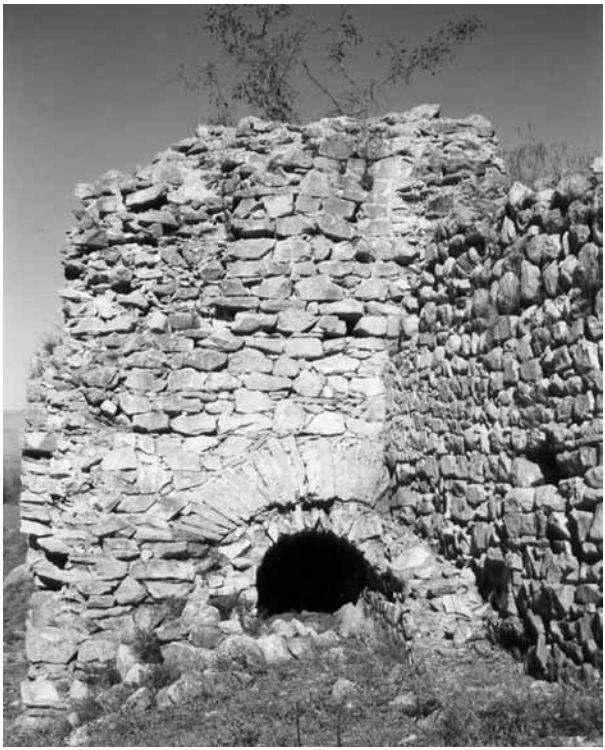

Fig. 3. The conduit in Philippi. Source - Ephorate of Antiquities of Kavala – Thasos.

Water was also used in the operation of the public baths. One example is that of the Balneum, which occupies the northern section of the Octagon complex .

Its foundation should be dated to the 2nd half of the 1st century B.C. and certainly after the refoundation of the colony by Octavian Augustus and the settlement at Philippi of praetorians and many of Antony's Roman supporters, whom Antony moved from their estates in Italy so that he could install his own veteran soldiers in their place (30 B.C.).

During the Roman era it must have functioned as a bath-house for men only. In the middle of the 6th cent. A.D. the bath-house was divided into two in order to cater for both women and men at the same time. It is not known when it finally ceased to operate. While it was originally a public bath, it later came under the control of the Church (at the time that it was incorporated into the Octagon complex).

It is thought unlikely that the Balneum was supplied with water by the two large cisterns in the Forum because these lie at a lower level than the Balneum floor. It was probably supplied with water by the cistern that is supposed to have been St. Paul's prison . The great difference in height (over 7.0 m.) justifies this view, unless we assume that a water tank existed on top of the roof of the Balneum or some other building.

It is also important to take into account the gradient of the water drainage channel, as well as the differences in height between the floor of the Balneum, the Baptistery and the Phiale.

The threshold of the entrance to the Balneum lies 75 cm higher than the floor-level of the Baptistery. Even the bottom of the Baptistery lies 1.63m lower than the threshold of the Balneum, while the floor of the Phiale lies 1.60m lower.

It may be concluded, therefore, that the floor of the Balneum was built at a height of 60 cm above the Via Egnatia in order to create the difference in height that was necessary for the drainage of water.

B - The Water supply system of Neapolis-Christoupolis-Kavala

Built at the crossroads of maritime and land routes, Neapolis - Christoupolis - Kavala, from its establishment on the rocky peninsula names Panaghia, until the end of the 19th century, maintained the character of an important fortified city. The first colony was established by people from neighbouring Thasos in the mid-7th century BC and it developed into an important city, known by the name *Neapolis*, the seaport of Philippi and a station on the Via Egnatia.

During the Byzantine period the city was a strong fortress, which belonged to the military and administrative theme (district) of Strymon. From the second half of the 8th century, the city was upgraded to a diocese, belonging to the Metropolis of Philippi. During the same period it appears in the sources under its new name, *Christoupolis*.

In 1391 the city was seized by the Ottomans and from the early 16th century, when its third name *Kavala* became prevalent, it was colonized and revitalized. The walls were rebuilt and the city expanded to the northern slope of the peninsula.

Description of the Monument

The water supply of the Panaghia peninsula was accomplished with the use of water springs which are located at the foot of the Lekane mountain range that stands opposite the peninsula of Panaghia in a place known as 'Mother of Water' or 'Soumbasi' or 'Three Oak Trees' at an altitude of four hundred (400) metres. The total length of the aqueduct is six kilometers (Fig. 4). We can follow its course with relative safety all the way from the original water spring to the outskirts of the city. For its most part the aqueduct is a surface conduit, with a rectangular section, carved on the ground and covered with rough and worked slabs. Its route follows the inclinations of the ground and its form depends on the natural terrain. For its route, a trail was

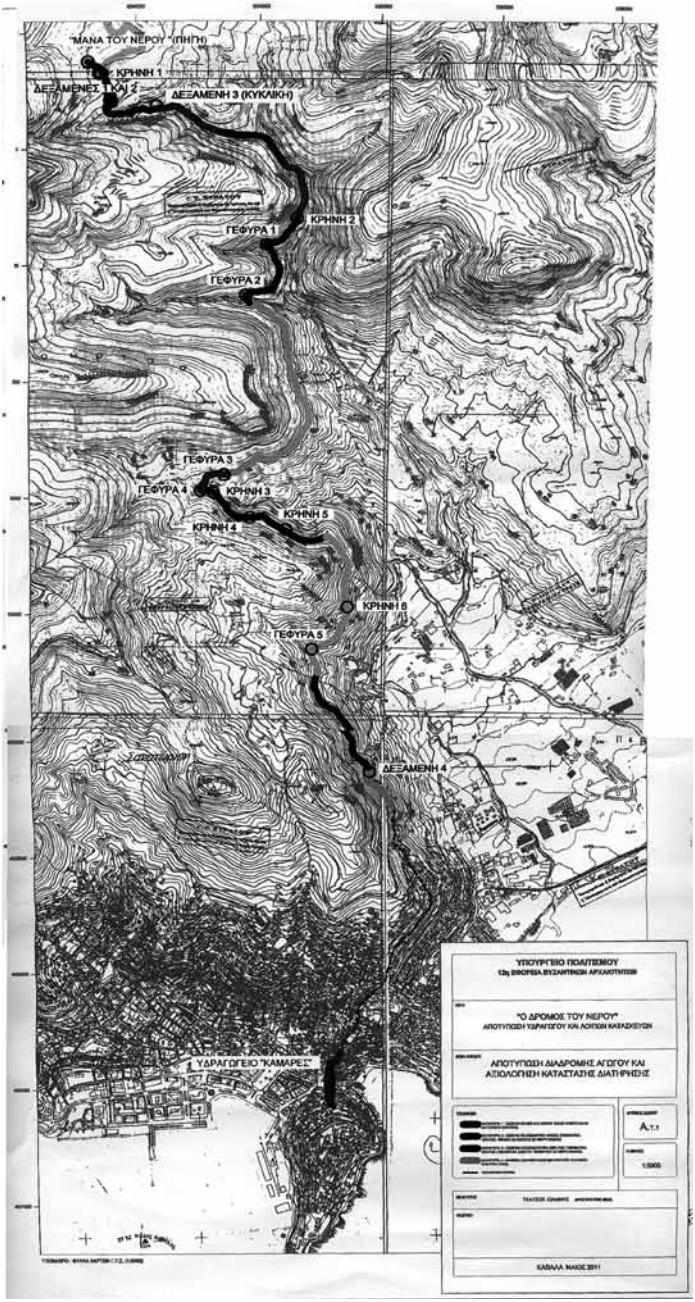

Fig. 4. Map of the Water supply system of Neapolis-Christoupolis-Kavala. Source - Ephorate of Antiquities of Kavala – Thasos.

formed in several places after carving the natural bedrock. Afterwards, the collected stones were used for filling gullies and for building the base of the aqueduct, thus creating the required inclination in order for the water to run smoothly inside the conduit. The course of the aqueduct passes through five stone bridges, which were built to bridge gullies and ravines. There are four reservoirs and six built fountains with basins for watering animals. From Saint Konstantinos the aqueduct continues its above ground course but it is not visible today as it is covered by the pavement of the Old Kavala Road and it finally reaches "Kamares", the last and most monumental part of the monument.

'Kamares', the monument which serves as a symbol for the city of Kavala, bridge the lowered portion of land located between the peninsula rock and the course of the conduit. Massive quadrangular pillars span in a length of 270m. The pillars are bridged by arches which support a second row of pillars and arches which in turn form the upper surface where the conduit sits at a maximum height of 26m. The arches of the first row, eleven in total, have a 5.60m opening and are 12m high. Each of the arches corresponds to a smaller arch from the upper row, which has a 5m opening and is 8m high. On both ends there is a single row of arches, three on one side and four on the other. In the second row of pillars two successive small vaults of unequal size are opened resulting in lightening the structure. The two main roads leading in and out of the modern city pass under these arches. From these arches the water was channeled to specific parts of the city, the public fountains, the large reservoir on the Akropolis, the public baths and the cisterns located next to mosques.

The description of the conduit begins from the spring 'The Mother of Water' and follows its course towards the city. The surviving parts, the fountains, the reservoirs and the bridges are numbered in the sequence we encounter them.

ORIGINAL WATER SPRING

The first and most important water source is located at an altitude of 400m, on a relatively smooth plateau and stands in the beginning of the formation of the downward route of the conduit along a ravine with lush vegetation.

Fountain 1 – Reservoirs 1 and 2

A few dozens meters from the spring we find the first fountain and two small built reservoirs, 1.30m long, 1.30m wide and 0.80m deep. The base of the reservoirs is built with stones to the natural ground level while the part that protrudes above the ground is modern and made of three rows of bricks.

The ancient conduit is 0.35m wide and 0.25m deep and is covered with marble slabs 0.70 meters long, 0.30m wide and 0.07m thick.

From this point and for about 100m the ground is steep (about 40% inclination). In this section there is no visible part of the aqueduct. Located about 100m from the fountain and at the base of the slope, a part of the conduit is preserved. It is 0.32m wide, 0.20m deep and it is covered with a slab which is 0.52m long, 0.36m wide and 0.15m high.

Reservoir 3

Situated 265m. south from the 'Mother the Water', in a narrow passage formed in the natural bedrock and inside a ravine, a circular reservoir is preserved with traces of workmanship from the period the aqueduct was in function. Its diameter is 2m and the height and depth of the water is 1m measuring from the orifice of the reservoir.

In a distance of 510m from the 'Mother of Water' at 240m altitude, the conduit continues in a path along the rocky slopes while on the other side there is a quite deep ravine with lush veg-

Fig. 5. Bridge along the Water supply system. Source - Ephorate of Antiquities of Kavala – Thasos.

Fig. 6. Fountain no 5. Source - Ephorate of Antiquities of Kavala – Thasos.

etation. The path is 0.90m. wide. The width of the conduit fluctuates between 0.30m and 0.50m and is 0.20m deep. The conduit is covered with flat and rough slabs measuring 0.80m x 0.30m x 0.07m and 0.30m x 0.50m x 0.15m. The joints between the slabs were reinforced with mortar. As a result the conduit was protected from debris.

Throughout most of the length of the conduit and on the side of the ravine there is a row of semicircular stones with indicative dimensions 0.50m (length) x 0.26m (diameter) x 0.21m (height). This row of semicircular stones protected the passing pedestrians and animals from falling in the ravine.

Fountain 2

Dimensions

a) Reservoir: 2.60m x 2.30m (external dimensions)/ 1.0m x 1.0m (internal dimensions)/ 1.0m (depth)/ 2.20m (facade height).

b) Lateral Fountains: 2.40m (length) x 1,0m (width)/ recess 1.30m (length) x 0.62m (width).

Approximately 1.070m from the 'Mother of Water' at an altitude of 160m there is a vaulted masonry reservoir with two side fountains bearing no traces of spouts. The lower part of the reservoir is dug into the bedrock and the part above ground is built with stones.

The water entered from the north side and exited from the south exit. The reservoir still holds water today, reaching 0.50m high. An arched opening, 0.90m high, in the middle of the eastern side was used for inspecting the reservoir.

Bridge 1 (Fig. 5)

This is the first bridge over which the conduit passes. It was constructed over a small gorge which intersects the path. It is preserved in an excellent condition. It is a single-arch bridge with the arch slightly semicircular in shape. The front of the arch is formed in retreat from the rest of the masonry and framed by small stone slabs. It rests on small protruding pedestals. The masonry is characterized by elaborate stonework with no use of bricks.

Bridge 2

The second bridge has three arches and spans over a wide ravine which crosses the course of the conduit. The height in the middle of the ravine reaches 11.80m and its width is 2.55m. The total layout of the ravine is 29.70m. The central arch is the widest and tallest and pointed in shape, whereas the other two are smaller and semicircular in shape.

Bridge 3

From this point and at a distance of 440m we find again the conduit passing over a single-arch bridge. Both the height and the opening of the arch is small. However, the wall length exceeds 30-40m. The foundation has been destroyed in one place due to rainwater and runoff water from the modern Egnatia Road.

Bridge 4

In a small distance from the location mentioned above we meet the fourth single-arch bridge whose construction details lead us to the conclusion that it may be older than the conduit. Its length is estimated to be 22m and its width 2.75m. There are two characteristic features observed in this bridge: a) the arch is made of solid ceramic bricks and b) the level of the bridge was raised by one meter to accommodate the conduit route. The width of the construction of the conduit is narrower than the one of the bridge and, including the semicircular stones which are 0.20-0.25m long, was measured at 1.75m. Therefore the conduit retreats 0.40m from the west and 0.65 from the east. The angle of inclination between the conduit and the horizontal plane was calculated to be 5 degrees.

Fountain 3

In a small distance from the fourth bridge there is a stone fountain – watering place shaped like 'Π', with the flattened horizontal side towards the conduit. The length and height of the horizontal element were measured at 2.30m and 1.0m respectively whereas for the vertical elements the measurements are 0.55m (width) and 0.95 (length). At the fourth side between the

vertical elements there is a stone bloc whose top side is rounded. The length and height of the bloc is 2.30m and 0.43m respectively. At the path level, the fountain is covered by large squared stone slabs.

Fountain 4

A small distance from the previous fountain, a fourth fountain can be found. On the side of the path, the length of the wall was measured at 2.75m and its height at 1.15m The width of the basin is 1.70 m and its height is 0.90m. In the middle of the basin's height a square groove prevented the water from overflowing.

Fountain 5 (Fig. 6)

Within approximately 100m from the previous one, there is another fountain-watering place covered, however, by dense vegetation. The fountain's dimensions are: 1.50m (length), 0.65m (length of sides) and 1.20m (height).

Fountain 6

In the next 100m we find the last fountain. Its dimensions are: length on the side of the path: 2.12m, wall thickness: 0.73m, wall height: 2.18m, water basin height 0.45m. A curvature is formed on the top side with an arch 0.40m high.

Bridge 5

As we approach the first houses in the north of Kavala we find the last bridge. The length of the bridge is 20m and its width is approximately 2.15m to 2.50m. It is a single-arch bridge with morphological features similar to the preceding ones. The conduit passes through the middle of the width of the bridge and only the slabs covering it are visible.

From this point to the limits of St. Athanasios region, only scant traces of the conduit are still preserved and only in a few areas.

Reservoir 4

It is the last still visible reservoir.
Internal dimensions: 1.0m x 1.0m x 0.5m (depth)
Facade:
Base length: 1.45m. Height: 1.25m.
Dimensions of the input-output section of the conduit: 0.50m x 0.60m.

The conduit, with dimensions 0.30m x 030m, ends in the north and upper part of the reservoir. The exit point is in line with the entry point and slightly lower than it. The reservoir is incorporated into the south east angle of a newer building from which only the side walls still stand. The walls of the reservoir, made entirely of stones, have many similarities with a nearby building dated to the Ottoman period which is surrounded by a tall stone enclosure. The ground plan of the building is square and the side walls are taller than the enclosure. It is covered by a stone vault, half of which has collapsed.

On the west side of the reservoir, there is a quadrilateral building attached whose interior sides are still visible and they measure at 2m x 1.30m and their estimated depth is 1m. Two walls about 0.30m wide intersect in right angle and divide the building in four equal compartments. The interpretation of the building is currently problematic. In modern times the access to the compartments closed with metal structures. On the outer south side a square opening, 0,25m x 0,25m, is preserved.

Conclusion

The surrounding area of Krinides and the archaeological area of Philippi is famous for the rich water sources since the antiquity. However, the decision to construct an 8km water conduit from Kefalari to the ancient city of Philippi should be attributed both to the increasing needs of the population and the water quality. The entire path of the conduit has not been recorded yet. Different phases and construction techniques can be identified near the springs and close to the archaeological site. Probably more clues will be revealed after further archaeological research.

According to the testimony of the French naturalist and traveler P. Belon, who travelled through the city of Kavala during the time the project was in progress, the aqueduct of Kavala was constructed by Imbrahim Paşa, Great Vizier of Sultan Suleiman the Magnificent, whereas according to the Ottoman traveller Evliya Çelebi it was constructed by the Sultan himself. What is certain is that the aqueduct of Kavala is part of the building program to restructure the city implemented by Suleiman the Magnificent (1520 - 1530) through Imbrahim Paşa.

Bakalakis was the first to accept that there must have a Byzantine aqueduct which was succeded by the Ottoman phase. This view is based on the different form of the arches and the reused building material which can be observed in some places. As the arid peninsula of Panaghia could not meet the city's water need, it is logical to assume that the water supply problem must have preoccupied the founders of the city since its inception. In its largest part this imposing technical project appears as a single work, executed under a well-studied plan that required expertise. From all the periods of prosperity of the city, the Roman period seems to concentrate the best chances for a projct of this scale, although the silence of the sourceson the subject is rather problematic.

Either way a work of this magnitude is logical to be used for a long period of time and to receive interventions and additions. Similar repairs and local interventions occur all the way from the original spring to the city and also in Kamares.

These two works, which carried water from a long distance to provide the cities in question, do not belong in the category of monumental Roman aqueducts. Even though they belong to the same period they demonstrate a central administration concern for both the quantity and the quality of water.

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