Marta Żuchowska, Karol Juchniewicz

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REMARKS ON WATER SUPPLY IN PALMYRA RESULTS OF A SURVEY IN 2010

Karol Juchniewicz,[1] Marta Żuchowska[2]
[1] PCMA affiliate, [2] Institute of Archaeology, University of Warsaw

Abstract: The article provides an overview of the results of a limited field survey of water supply installations in Palmyra and its environs, conducted in 2010. The catalogue of known structures was updated, the main objective being to verify the dating of Palmyra's water system. The known wells were mapped and the remains of the Northern Aqueduct were documented. The examination of the system of water distribution within the city led to some new observations that resulted in a reinterpretation of certain structures related to water management, such as the *sabil* niche which was earlier considered to be a water tower.

Keywords: Palmyra, survey, water supply, water management, well, aqueduct, *sabil*

A brief survey by the authors, conducted in October 2010 under the supervision of Prof. Michał Gawlikowski and within the framework of PCMA excavations in Palmyra, was aimed at documenting any evidence of the water supply system within the territory of the ancient city of Palmyra. The main objective was to verify the available data concerning water management in the oasis town. The catalogue of structures observable on the ground was updated and the mutual relationship and chronology of the installations was determined as much as was possible without additional clearing or archaeological testing.

The only previous publication dealing with relevant data from the city was an article by D. Crouch (1975), whereas the hydrology of the region was described by the French geologist G. Carle (1923). The Polish mission working in the Camp of Diocletian had researched the nature and chronology of the Western Aqueduct and established a typology of water pipes (Meyza 1985; Barański 1997). In 2002, a test trench in the Great Colonnade contributed new data about the chronology of the water conduits under the main street of Palmyra (Żuchowska 2003).

The present survey covered all of the city as well as the northern aqueduct. Based on available accounts (Tourtechot [1735] in Chabot 1897; Carle 1923) and newly recorded structures (Juchniewicz *et alii* 2010), the team examined a possible branch of the northern aqueduct and its connection with the city. The collected data allowed for a new chronological approach, covering the period from Hellenistic to Early Islamic times.

WELLS AND CISTERNS

All well structures identified within the confines of the city walls were catalogued [*Fig. 1*]. The results reflect the limitations resulting from a substantial part of the city remains being still unexcavated. While the presence of wells in these areas is unquestionable, it is impossible to estimate how many actually existed. The number of documented structures and their distribution shows, however, that wells were an important water supply source throughout the city's existence, from the Hellenistic age until early Islamic times.

Of the wells that were documented most were obviously intended for private use or as a source of water for buildings like temples or churches. A few wells, however — located in public spaces, e.g., close to the portico of the Great Colonnade [*Fig. 2*, bottom] or in the vicinity of the gate to the Camp of Diocletian [*Fig. 2*, top] — evidently served a public function. They appear to have constituted a water reserve for the populace and were an alternative to the aqueduct supply. The localization of the wells and certain data obtained during

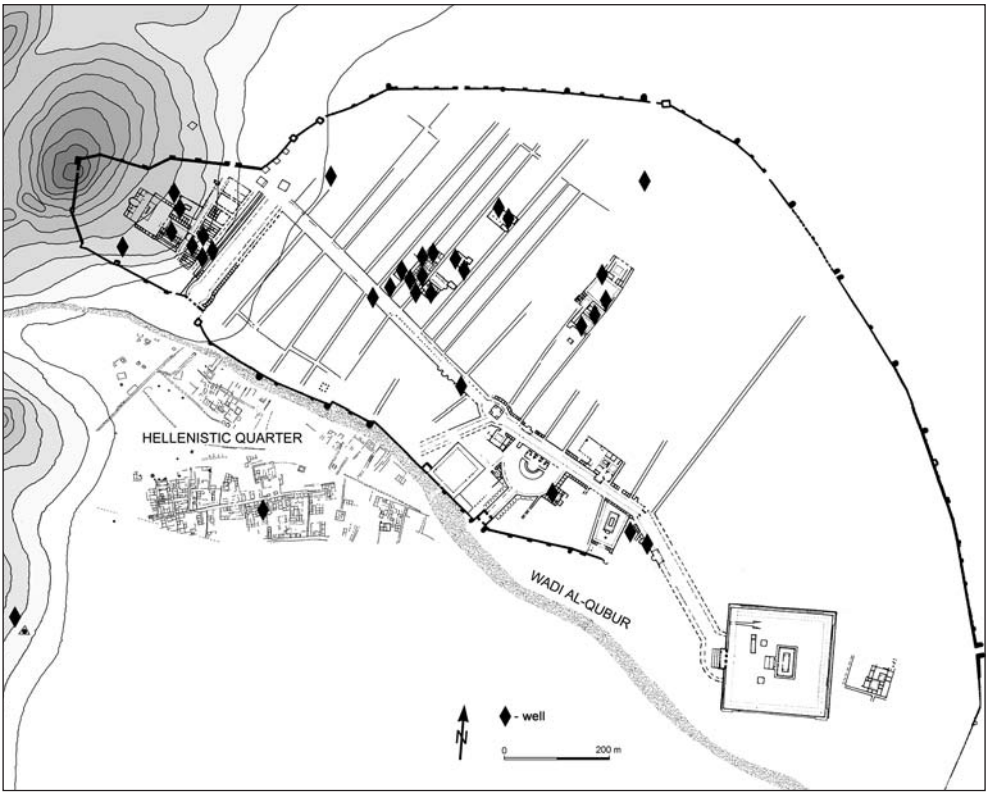

Fig. 1. Ancient wells documented in the territory of Palmyra (Drawing M. Żuchowska)

earlier excavations suggest that some wells had been abandoned at a relatively early date and were replaced by others, while some remained in use for a longer time. The reason for such practices must have lain in architectural or urbanistic needs rather than hydrological problems. The use of some of the wells in the early Islamic period suggests that the water table was high enough to supply them until at least that time.

It is quite possible that well water was sulphuric and derived from the same source that supplied the Efqa Spring. In terms of geological structure, the top layers in Palmyra comprise porous calcareous rock, which enables free flow of underground water beneath the city. This may have permitted many wells to be dug in antiquity when the Efqa was abundant. A well on the southeastern slope of Gebel Muntar also tapped the Efqa source, indicating that sulphurous water was used not only for cultic and ablution purposes, but also for daily activities.

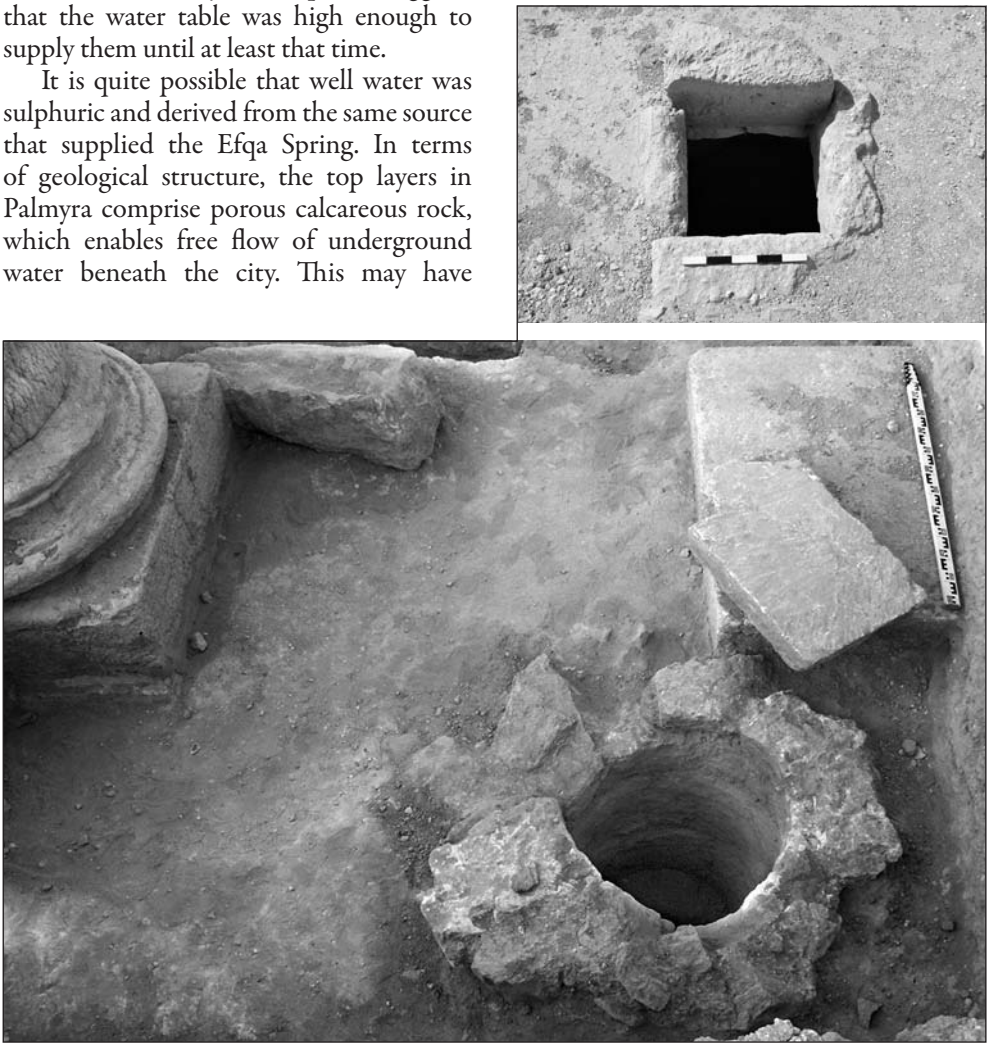

Fig. 2. Wells in public spaces: in Diocletian's Camp (top) and in the western section of the southern portico of the Great Colonnade, western section (All photos by the authors)

WESTERN AQUEDUCT

The survey of the course of the Western Aqueduct bringing water from a source located about 7 km west confirmed most of the findings described by Marek Barański (1997). Additional observations were made at the site of Abu Fawares, a small settlement, possibly a farm, abandoned in the past century, located approximately 3 km west of Palmyra, on the line of the aqueduct. In this area the construction of the water conduit changed, probably due to a change in ground level. Starting from Abu Fawares, the aqueduct emerged from underground and became a stone-lined conduit that ran aboveground to the area of Diocletian's Camp. According to Barański, water in this section of the aqueduct had been carried in ceramic pipes, but the survey could not find any confirmation of this idea. The change in the aqueduct's construction could have been connected with the presence of some additional water installations. Traces of a big water tank, associated with the last phase of occupation, can still be seen in this locality, to the south of the aqueduct [*Fig. 3*]. Local tradition speaks of this water channel still being used in the first half of the 20th century.

Fig. 3. Traces of a water tank in Abu Fawares

NORTHERN AQUEDUCT

The line of the Northern Aqueduct is not visible on the ground except at Umm el-Biyara. Traditionally, this is the point where the *caput aquae* was located. According to David Crouch, there is a vaulted underground channel with Palmyrene graffiti (Crouch 1975: 166), but a Syrian military installation on the spot precluded examination at this time. It could have been part of a Roman aqueduct, although not necessarily its beginning. Traces of a *qanat*, probably the one reported by G. Carle (1923: 156), were identified on the presumed course of the aqueduct, but there is no evidence to associate it with the ancient water channel.

The use of the northern aqueduct was confirmed by the discovery of its *castellum*, which lies near tower Ts13, on the outside of the city wall and attached to it (Juchniewicz *et alii* 2010: 56) [***Fig. 4***]. It was exposed during Syrian consolidation works. The *castellum* was rectangular in plan, approximately 8.80 m long and 5.40 m wide. The recorded structure consists of two main parts: a big chamber, most probably barrel-vaulted, where the water from the channel was collected and a set of five small chambers. The inlet of the aqueduct was on the northern side, close to the northeastern corner of the *castellum*. The entire structure of the *castellum* was made of reused elements, originally from tombs. The system probably served the purposes of filtering water and controlling water pressure.

Fig. 4. Castellum of the Northern Aqueduct, top view from the south and view from the north

The only known parallels come from Pompeii and Nimes (Hauk, Novak 1988; Hodge 1992: 281–282). Vitruvius (*De architectura* 8.6.1–2) described a *castellum* similar to the one at Pompeii and explained how the chamber system functioned (Callebat. It is thus tempting to see the Palmyrene *castellum* as an example of a design described by Vitruvius. We must, however, remember that the Pompeian installation was not typical of the entire Roman world. A comparison of the *castella* from Pompeii, Nimes and Palmyra shows regional variations of design. However, without excavation, our notion of the nature of the Palmyrene structure will have to remain vague.

WATER DISTRIBUTION SYSTEM IN THE GREAT COLONNADE

Water distribution installations in the Great Colonnade constitute the only excavated part of the supply system inside the city. Archaeological research conducted over recent decades indicates that the Western Aqueduct was the main source of water for the city from the 1st century AD up to the Abbasid period, while the Northern Aqueduct was used mainly during Byzantine times (Barański 1997; Żuchowska 2000; 2003).

The visible structures connected with these systems in the western and central sections of the Great Colonnade provided data for a reconstruction of the most characteristic features of the Palmyrene water supply system. The system was quite sophisticated using "secondary *castella*" to lift water under pressure probably to small reservoirs placed atop small water towers, thus facilitating delivery to distant areas of the city [***Fig. 5***]. Similar structures are attested in Pompeii, which also had to deal with problems with its water supply (Hodge 1996: 271). In Palmyra, the system had two phases. The first was Roman, while the second seems to have been contemporaneous with Islamic water conduits.

SABIL

The survey reinterpreted the function of some structures unearthed during Syrian restoration works undertaken in the 1950s. One of these lay in the southern portico of the Great Colonnade, near the north-eastern corner of the Theater [***Fig. 6***]. This rectangular structure, measuring about 3.70 m x 4.70 m and 1.50 m high, was made of reused blocks, originally the architraves of the Colonnade. The floor was made of bricks set in waterproof mortar [***Fig. 6***, bottom left]. This structure was evidently a water tank. It was located close to a secondary *castellum*, but not connected with it. If there was an inlet, it was located at a higher level and is no longer extant. The middle of the west wall preserved a small hole with the remnants of a clay pipe inside, probably part of a tap [***Fig. 6***, bottom right].

This structure, which has not been published, is commonly believed to be a water tower, which was used to create pressure in the pipelines. However, the lack of any connection with the nearest secondary *castellum* seems to contradict this interpretation. The use of archi-

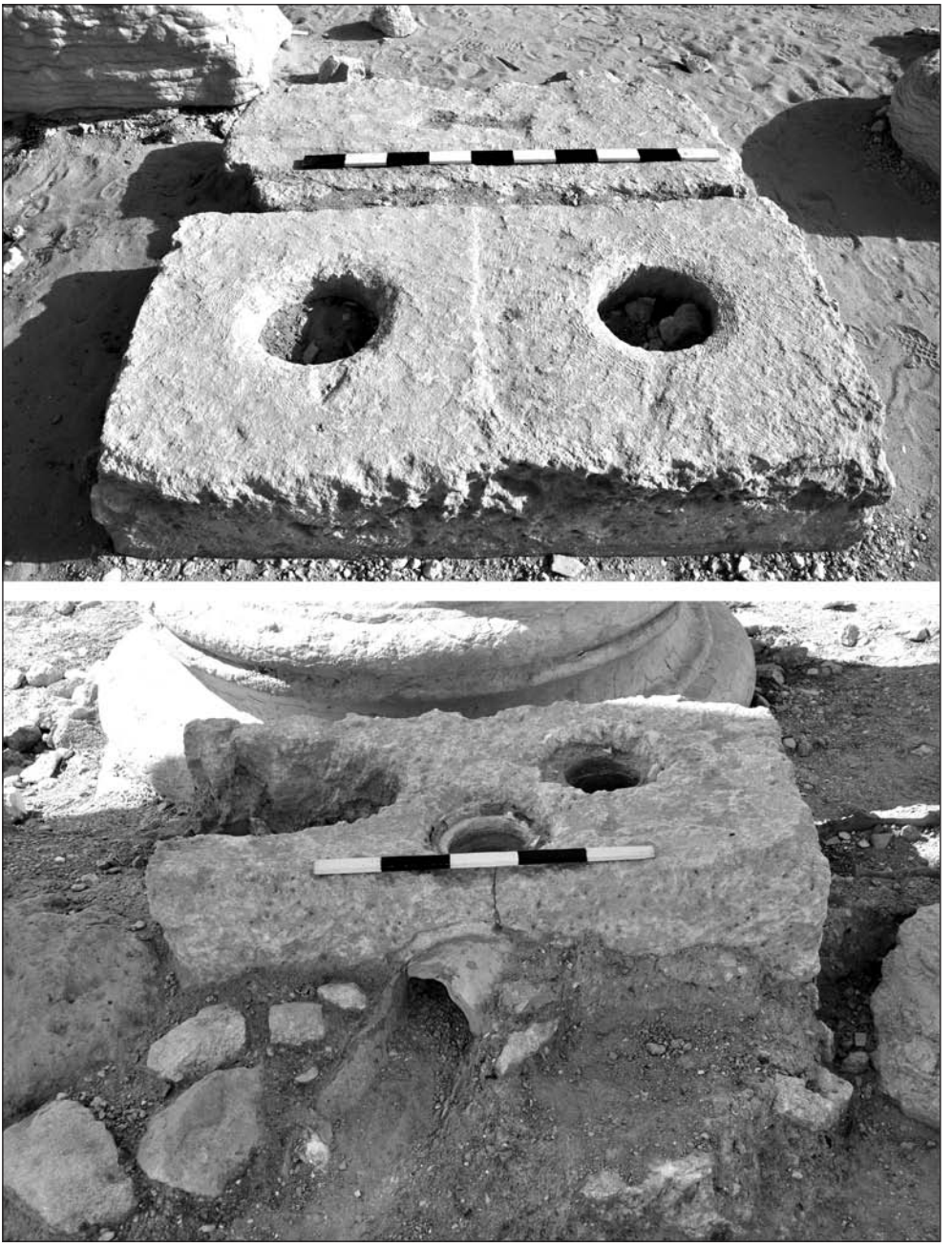

Fig. 5. Stone bases of water towers in the northern portico of the Great Colonnade, central section (top) and near the Theatre

traves of the Great Colonnade suggests a later date of construction, most probably after the final collapse of the pipeline water system, which explains the lack of a connection with it. The structure, which was definitely used for water storage, must have been filled by hand. In the opinion of the authors, it is very likely that this feature was a *sabil*, that is, a water-house providing free drinking water to the public. Its location in the centre of the city, close to the main mosque (Genequand 2008) also

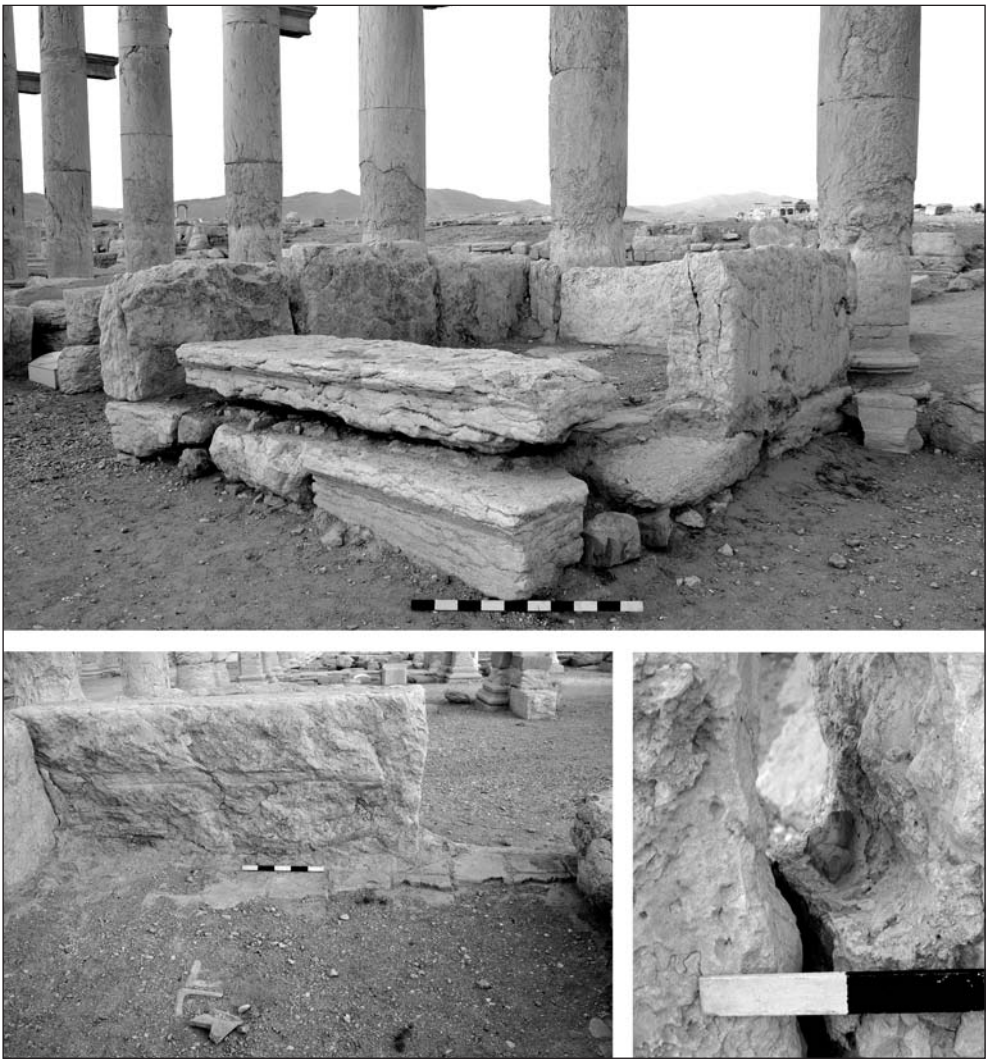

Fig. 6. Water tank near the Theatre , probable sabil: top, view of the structure from the southeast; bottom left, remains of the floor inside the tank against the east wall; right, clay pipe running through the west wall (seen from outside), probably part of a tap

supports this idea. However, the appearance of such a feature in Islamic cities does not seem to be earlier than the 12th century (Bosworth 1995). The chronology of the Palmyrene *sabil* remains unclear and awaits further study.

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Dr. Karol Juchniewicz
karol.juchniewicz@gmail.com

Dr. Marta Żuchowska
Institute of Archaeology, University of Warsaw
00-927 Warsaw, Poland, ul. Krakowskie Przedmieście 26/28
marta.zuchowska@gmail.com

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