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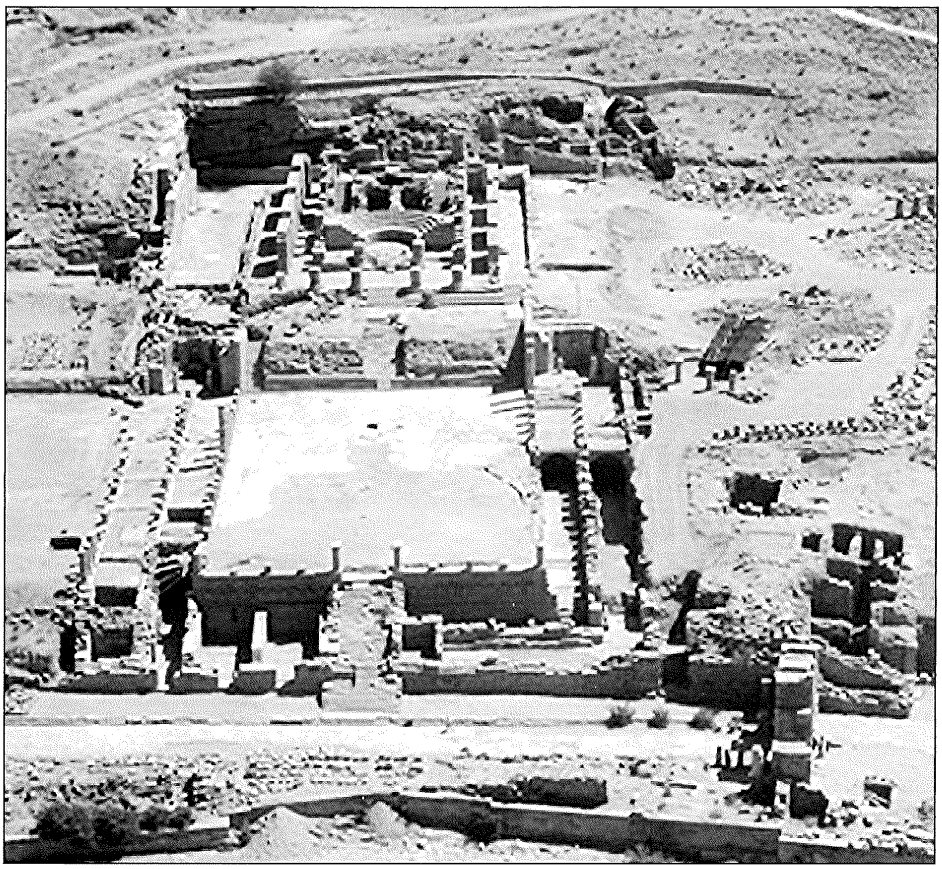
The Petra Great Temple's Water Strategy

Abstract

For over a decade Brown University archaeologists have excavated the spectacular Great Temple in Petra with an amazingly complex system of water strategy. Clear evidence, both stratigraphic and artifactual, shows that Nabataean water systems were built to serve this precinct. Were they put in place by Hellenistic trends and traditions? This submission looks at the evidence to reconstruct and interpret these unique water systems and to reconstruct how they might have been used during the Nabataean and Nabataean-Roman periods. Appearing to represent a number of more common construction techniques — cisterns, subterranean canalizations and open channels — they are in an excellent state of preservation. We will examine the Great Temple water systems as a focal point for serving the Nabataean city center.

Introduction to the Petra Great Temple

The Great Temple represents one of the major archaeological and architectural components of metropolitan Petra. As can be seen in FIG. 1, it is the largest freestanding building yet excavated in the city. Located to the south of the Colonnaded Street and southeast of the Temenos Gate, this 7560m^2



1. Aerial overview to the south of the Petra Great Temple at the close of the 2004 excavations (A. W. Joukowsky).

precinct is comprised of a Propylaeum (a monumental entryway, where there is a shrine of Nabataean double aniconic betyls), a Lower Temenos, and monumental east and west Stairways which in turn lead to the Upper Temenos — the sacred enclosure for the Temple proper.

In the Propylaeum and Lower Temenos are triple colonnades on the east and west with a total of 120 columns surmounted by phenomenal Asian Elephant Headed Capitals. The temple itself is tetrastyle in antis with four widely spaced columns at the entrance. Beyond these originally stood anta walls decorated with reliefs. Approximately 15m in height, the porch columns plus the triangular pediment and the entablature hypothetically place its height at a minimum of 19m.

Overall the Great Temple proper measures 35m east west, and is some 42.5m in length. The 1993-1997 excavation results have been published and annual reports can also be found in the *Annual of the Department of Antiquities of Jordan* and in the *American Journal of Archaeology*. The final report of these excavations is now underway. The water systems are the focus of this paper; we will begin at the rear of the precinct with the Upper Temenos and the East Plaza Great Cistern, followed by those in the temple and ending with the features of the Lower Temenos and Propylaeum.

History of Excavations and Research

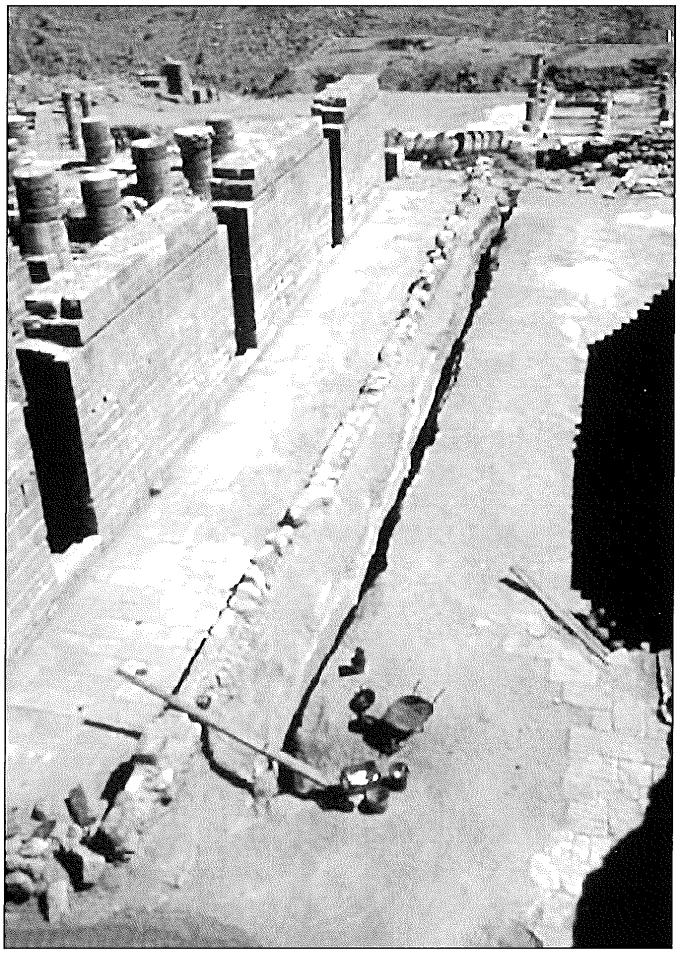
Excavation of the Great Temple began in 1993, and the following season the subterranean canalization system became apparent to archaeologists. Ground Penetrating Radar was utilized in 1995, under the supervision of Brown professor of Geological Science, Terry Tullis, confirming the presence of various stretches of subterranean canalization and detecting the locations of many presumed subterranean hydrological features. For our 1998 publication, *The Petra Great Temple: 1993-1997, Volume* I, Elizabeth E. Payne and Terry Tullis produced a comprehensive study of features discovered to date, although many more would be uncovered in the years to come. Christian Cloke's latest assessment of the water systems is currently in press.

The Purpose of the Great Temple's Water

Spring water for the temple's supply came from the 'Ayn Brāq and other natural springs to the south of the temple, and surface drains like the one shown in FIG. 2, located along the perimeter of the Lower Temenos and at the edges of the temple Forecourt or Pronaos collected rainfall. Once it made its way into the system, water was directed through a number of large channels toward various storage areas, primarily the East Plaza Great Cistern, a large subterranean bedrock cistern to the east of the temple proper, while overflow was transported farther north to the front of the precinct.

Progression of Water through the Upper Temenos and Temple

To the rear southwest of the Great Temple water entered the system through an aboveground settling tank, which likely modulated flow into a series of rock-cut channels and ceramic piping flowing east across the South Passageway (FIG. 3). Upon reaching the East Plaza these channels turned north and delivered the majority of this water to the East Plaza Great Cistern below, while the excess supply proceeded north through the large east artery beneath the East Plaza. Inside the temple proper a parallel central artery was set beneath the floors of the



2. Bedrock channel in the Upper Temenos East Plaza connecting to the Great Cistern (Christian F. Cloke).

3. Channels cut along the south perimeter wall leading to the Great Cistern (Christian F. Cloke).

Central Arch and the East Vaulted Chamber, leading north toward the temple forecourt. A map of the Great Temple Water Systems is shown in FIG. 4.

The East Plaza Great Cistern

The East Plaza Great Cistern was hewn out of the natural sandstone bedrock underlying the PGT (typical of Nabataean cisterns) with entrance and exit shafts to the southeast and southwest respectively. The Cistern's storage area measures 327.64 cubic meters. A cistern of this size could have held around 86,562.488 gallons or 327,640 liters of water, an astounding figure, making this the largest cistern yet documented in downtown Petra. A section of the Petra Great Temple east plaza cistern with its bedrock support column is shown in FIG. 5.

On the east side of the room a pillar of bedrock was left to support the ceiling, while a smaller masonry pillar was constructed on the west for the same purpose. To the south of these elements an arched wall was built spanning the entire width of the structure. The arches allowed water to fill the area behind the wall without compromising structural integrity. Farther north, a smaller cistern or reservoir, built into the East Perimeter Wall, was available for storage of additional water, and behind the East Exedra, the East 'Cistern' (in its original bedrock-cut incarnation) constituted an earlier water storage area. The interior of the East Plaza Great Cistern can be seen in FIG. 6.

The Lower Temenos

In the Lower Temenos, circular surface drains with hexagonal bronze fittings (to match the hexagonal paving stones, Joukowsky 1998: Figs. 5.6, 5.7) collected rainwater during the winter months, depositing it into the underlying canalization FIG. 7. Side channels extending from the east and west drain delivered water to the larger central and east arteries. The west drain toward the central artery can be seen in FIG. 8. The majority of water then traveled north through the continuation of the east artery or through the continued central artery shown in FIG. 9 down the middle of the Lower Temenos. Square shafts, or manholes, opened into the central artery to facilitate cleaning of the channel. The ultimate destination of water to the north is unknown, but it is likely that another cistern or storage area existed to the north of the Propylaeum.

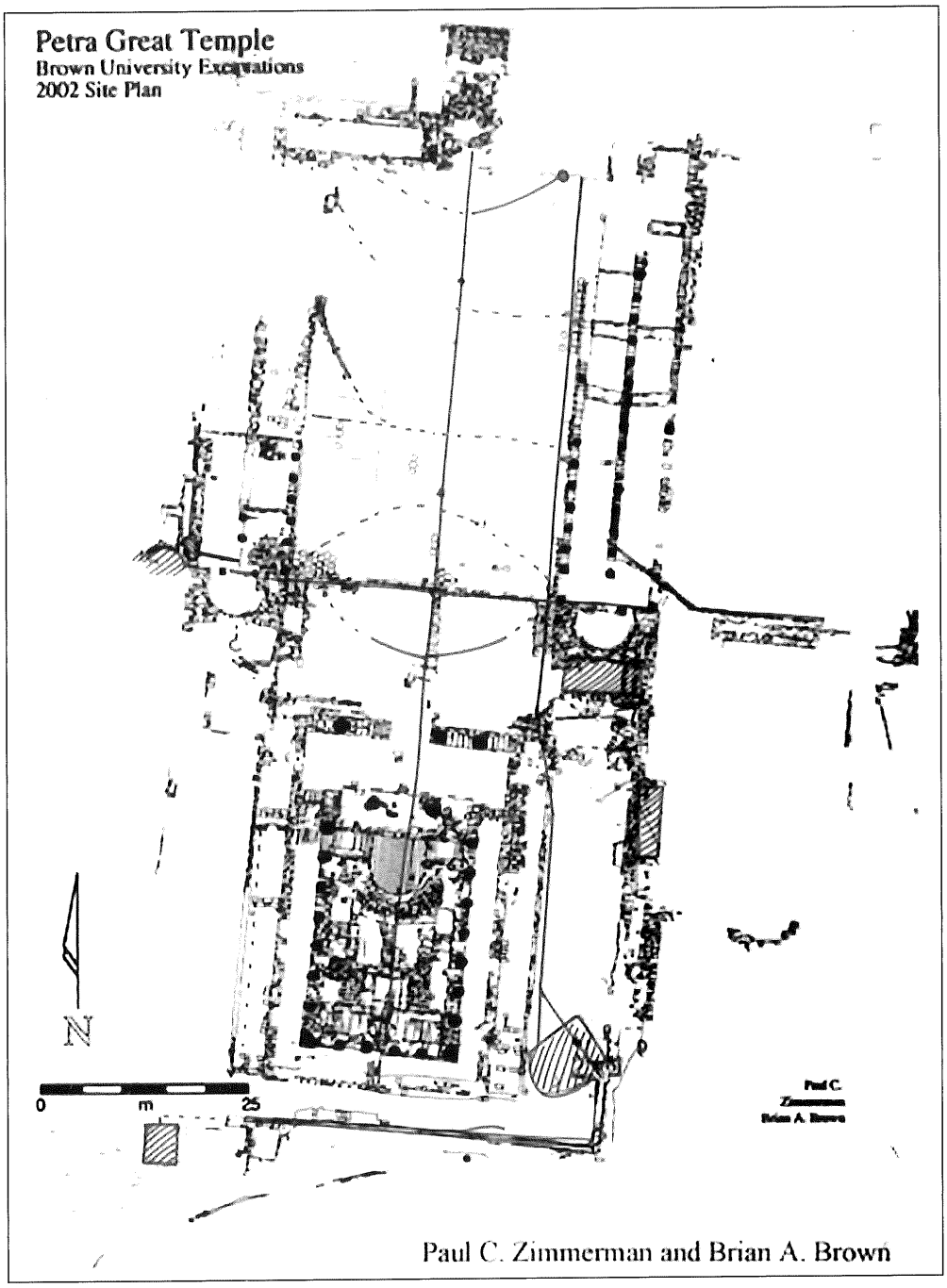
Ensuring Water Quality

Numerous features within the PGT water systems indicate a clear concern for the cleanliness of the water supply. A sill across the central artery at the north of the Lower Temenos was designed to catch silt and debris while water flowed over FIG. 10.

A basin in the northeast Lower Temenos, FIG. 11, also cleared the water of debris, which settled to the bottom while the cleaned water rose and flowed out toward the central artery. Additionally, all subterranean channels were capped with large stone slabs and lined with hydraulic mortar. Above the capstones were layers of packed, clay-like soil to seal the channels entirely, preventing intrusion of dust and debris from the surface. Ultimately, the concern for cleanliness of the water supply is seen in parts of the system dealing both with spring water and rainwater, indicating that both types of water were valued and intended to be potable.

Later Features

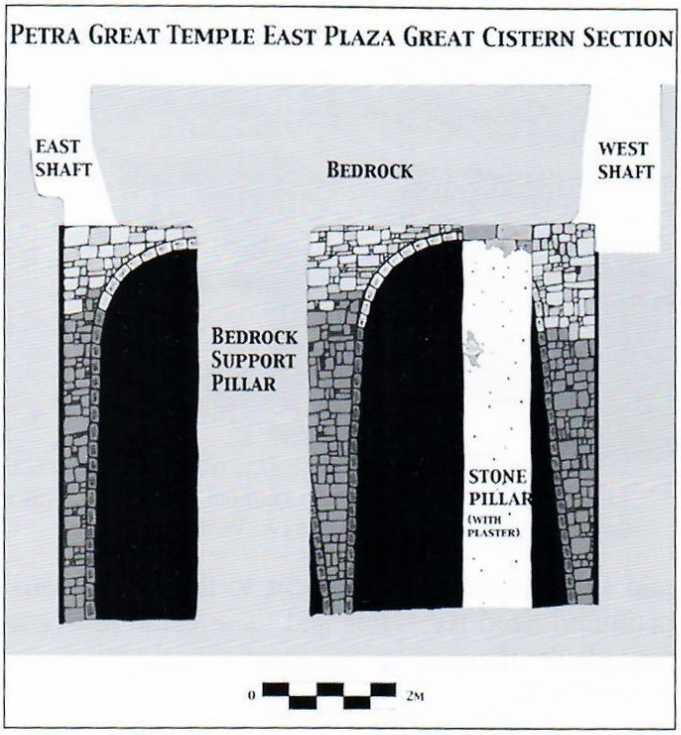
All water systems discussed to this point were



4. Top Plan of the Petra Great Temple with water features (Paul C. Zimmerman, Brian A. Brown and water features by Christian F. Cloke).

devised initially in the Nabataean phases of the temple's construction and use, dating to the late first century BC. This early system, however, was expanded upon and modified during Roman and Byzantine times as well. Spanning the east west width of the Lower Temenos south a lead pipeline was laid to traverse the precinct, delivering water from the direction of the Garden and Pool Complex on the east to the west side of the temple precinct, where water may have been needed, perhaps for a small bath near the West Exedra, which is of a much later date.

Other components throughout the precinct show numerous modifications to the water systems, resulting from various damage, changes in purpose and varying degrees of technological expertise and engineering capability. Artifacts within the East Plaza Great Cistern and channels to the south of the temple proper show that these systems were installed at the end of the first century BC, and used well into the Byzantine period at Petra, and even contained Islamic period ceramics. Ultimately, it is clear that these systems served many people for hundreds of years. Although modified somewhat,



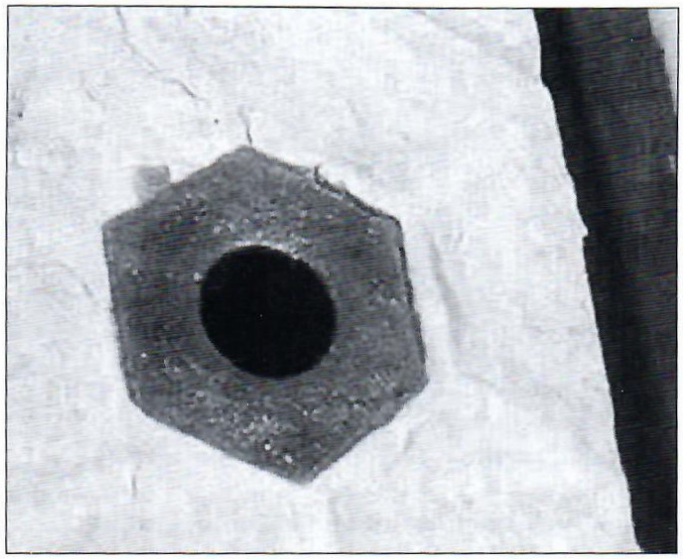
5. Cross section of the east Plaza Great Cistern showing masonry and bedrock features, wall with arches, entry and exit shafts (drawing by Emily Catherine Egan).

6. View to the southwest of the Great Cistern. To the left, is the west arch and to the right, the plastered face of the masonry pillar (Christian F. Cloke).

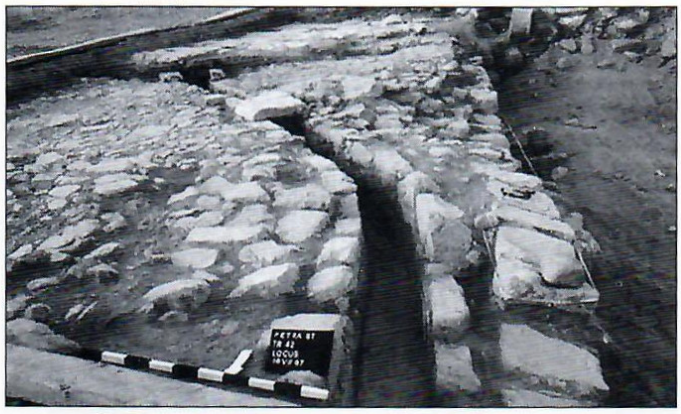
they retained their original character while Petra itself underwent far more drastic transformations.

Conclusions

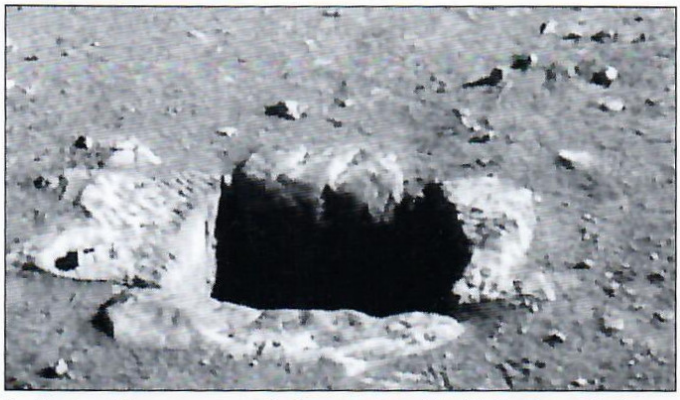
Our excavations at the Petra Great Temple have yielded much information about the fascinating water systems of the Petra Great Temple through use of traditional methods, Ground Penetrating Radar and computer applications such as virtual reality reconstruction of trenches and architecture. Parallels to the Petra Great Temple systems can be seen at other ancient sites within the Nabataean world and beyond. Particularly useful comparisons can be made to the cisterns, reservoirs, aqueducts and channels at the nearby site of al-Ḥumayma, near Wādī Ramm, excavated extensively by Oleson, Eadie, and others in recent years. Despite its clear



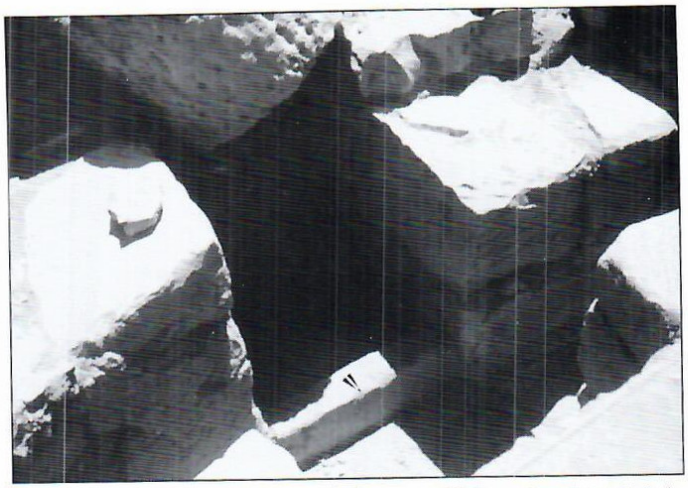
7. Bronze Drain Fitting for a Lower Temenos Hexagonal Pavement. (A. W. Joukowsky).



8. Lower Temenos canalization in the northwest (A. W. Joukowsky).

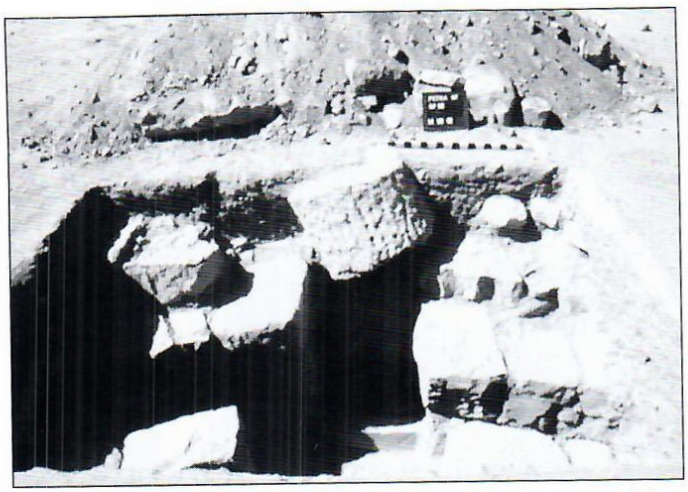


9. Lower Temenos manhole opening (A. W. Joukowsky).



10. In the center is a stone ledge or sill for cleaning debris from water in the central artery (Christian F. Cloke).

11. Lower Temenos channel leading away from settling basin towards the central artery (Christian F. Cloke).



12. Lower Temenos subterranean channel and artery with a collapsed column drum on top (A. W. Joukowsky).

place within the wider Nabataean corpus of hydrology, the Petra Great Temple is unique in some respects, and its ingenuity, efficiency and utilization of many techniques for water collection, direction and storage provide testament to the Nabataeans' profound need for water and their great ability to provide for themselves and their remarkable desert cities like Petra.

Acknowledgements

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