Water After Antiquity: The Afterlives of Roman Water Infrastructure in the Eastern Mediterranean (300-800 Ce)

Jordan Thomas Pickett
University of Pennsylvania, pickett.jordan@gmail.com

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Water After Antiquity: The Afterlives of Roman Water Infrastructure in the Eastern Mediterranean (300-800 CE)

Abstract
The aim of this dissertation is to assess factors that contributed to the survival or failure of Roman water management infrastructure and practices in the eastern Mediterranean, between Roman antiquity and the early medieval period (c. 0 - 800 CE). Why did some Roman water systems survive for centuries, even until today, while others collapsed after only a few decades of functionality? Individual components of Roman water infrastructure are well described by engineers as technological artifacts. Less understood are the factors that contributed to the resilience or fragility of Roman water systems in late antiquity. These include physical or natural factors, such as climate and geology, but also politico-administrative priorities, and socio-cultural factors, such as the perceived value of monumental architecture or preferences for drinking water sources. After a review of scientific climate proxies for the Levant, which was more climatically susceptible to water scarcity than other areas of the empire, Jarash is introduced as a case study that identifies infrastructural responses to climatically induced water stress in Northern Jordan after the fifth century CE. However, because similar adaptations are visible in areas of the empire with very different climate trajectories, it is posited that socio-cultural and administrative shifts were more important for the evolution of water systems in late antiquity. Procopius is adduced as a lens, understudied until now, through which we can view shifts in late antique urbanism and the trajectory of the state’s interest in water infrastructure, as they are presented in a conservative text of the sixth century. The last chapters offer a detailed analysis of the literary, epigraphic, and archaeological remains of urban water systems in the late antique Eastern Mediterranean in order to demonstrate the surprising diversity, longevity, range, and impact of Roman water systems in cities after antiquity, beyond the traditional seventh-century boundary for the survival of Roman cities in Byzantium.

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WATER AFTER ANTIQUITY:
THE AFTERLIVES OF ROMAN WATER INFRASTRUCTURE IN THE EASTERN MEDITERRANEAN (300-800 CE)

Jordan Pickett
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in
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in
Partial Fulfillment of the Requirements for the
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Supervisor of Dissertation

___________________________
Robert Ousterhout
Professor of Art History

Graduate Group Chairperson

___________________________
Tom Tartaron
Professor of Classics

Committee Members:
Renata Holod (Professor of Art History, University of Pennsylvania)

John Haldon (Professor of European History, Princeton University)
WATER AFTER ANTIQUITY:
THE AFTERLIVES OF ROMAN WATER INFRASTRUCTURE IN THE EASTERN
MEDITERRANEAN (300-800 CE)

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Jordan Thomas Pickett
This is dedicated to JEP and KRP.
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ABSTRACT

WATER AFTER ANTIQUITY: THE AFTERLIVES OF ROMAN WATER INFRASTRUCTURE IN THE EASTERN MEDITERRANEAN (300-800 CE)

Jordan Pickett

Robert Ousterhout

The aim of this dissertation is to assess factors that contributed to the survival or failure of Roman water management infrastructure and practices in the eastern Mediterranean, between Roman antiquity and the early medieval period (c. 0 – 800 CE). Why did some Roman water systems survive for centuries, even until today, while others collapsed after only a few decades of functionality? Individual components of Roman water infrastructure are well described by engineers as technological artifacts. Less understood are the factors that contributed to the resilience or fragility of Roman water systems in late antiquity. These include physical or natural factors, such as climate and geology, but also politico-administrative priorities, and socio-cultural factors, such as the perceived value of monumental architecture or preferences for drinking water sources. After a review of scientific climate proxies for the Levant, which was more climatically susceptible to water scarcity than other areas of the empire, Jarash is introduced as a case study that identifies infrastructural responses to climatically induced water stress in Northern Jordan after the fifth century CE. However, because similar adaptations are visible in areas of the empire with very different climate trajectories, it is posited that socio-cultural and administrative shifts were more important for the evolution of water systems in late antiquity. Procopius is adduced as a lens, understudied until now, through which we can view shifts in late antique urbanism and the trajectory of the state’s interest in water infrastructure, as they are presented in a conservative text of the sixth century. The last chapters offer a detailed analysis of the literary, epigraphic, and archaeological remains of urban water systems in the late antique Eastern Mediterranean in order to demonstrate the surprising diversity, longevity, range, and impact of Roman water systems in cities after antiquity, beyond the traditional seventh-century boundary for the survival of Roman cities in Byzantium.
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PREFACE

I would like to offer two brief points for explanation in the space of the preface. First and most important, I should draw attention to the fact that the emboldened toponyms which appear throughout the text indicate the presence of a fuller treatment of that place’s water history and infrastructure in the long site catalogue included as Appendix F.

Second, in the following work I initially intended to cover Greece, Turkey, and the Levant (including Israel, Jordan, Lebanon, and Syria), but I have privileged sites that I have personally visited. I have nevertheless made reference to studies for the metropolitan cities of these regions, even when I have not visited them, for Palmyra and Tyr or Antioch. Further, settlements lacking status as poleis are excluded. This means that the Dead Cities of the Limestone Massif and the Negev, and so many islands in the Aegean or sites in Lebanon and Syria – so fascinating for their well preserved hydraulic architecture – are not included in this work.

Jordan Pickett
Philadelphia
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INTRODUCTION

The aim of this dissertation is to assess factors that contributed to the survival or failure of Roman water management infrastructure and practices in the eastern Mediterranean, between Roman antiquity and the early medieval period (c. 0 – 800 CE). Modern nation-states are confronted by a range of water-related crises – like chronic water shortage, flooding and river management issues, pollution and problems with drinking water – that were also experienced by the Roman Empire and her successor states in the eastern Mediterranean. Why did some Roman water systems survive for centuries, even until today, while others collapsed after only a few decades of functionality? Individual components of Roman water infrastructure are well described by engineers as technological artifacts. Less understood are the factors that contributed to the resilience or fragility of Roman water systems in late antiquity. These include physical or natural factors like climate and geology, but also technological factors like the complexity or fragility of water delivery and supply systems, politico-administrative contingencies, and socio-cultural factors like the perceived value of monumental architecture or preferences for drinking water sources. When modern water crisis management today is arguably overinvested in technological solutions, and unsure how to change water consumption and conservation behaviors at a socio-cultural level, the post-Roman shift in water management provides an important if understudied example of precisely such a process. How
did this shift happen, and what did it look like from different contemporary perspectives?

Current scholarship remains largely descriptive and tends to define elements of water infrastructure as timeless specimens of architecture or engineering, rather than interpret them as integrated components in larger urban systems that changed throughout time.¹

An overemphasis on the engineering of late ancient water systems has unfortunately precluded discussion of how aqueducts and urban systems were perceived, changed and adapted to new intentions. Or, how cultural evolutions gave ground over the longue durée to a new palette of water-management options that developed over the course of several centuries, leading up to the roundly well agreed upon seventh century horizon for the survival of many east Roman cities.²

Our most comprehensive assessments of urban change in Late Antiquity, like Wickham’s important book, Framing the Early Middle Ages, have left

¹ Ortloff 2009 or the volumes of the Cura Aquarum, pace those few archaeologically-oriented contributions. My thanks to Charles Ortloff and Gilbert Wiplinger for their remarkable insights during our trip together in Lycia-Pamphylia with Gilbert Wiplinger et alii Nov. 2014, who taught me that the contributions of engineers remain to be better integrated with the perspectives of history. I hope to do them justice in what follows, even if this can only be a beginning.

² See for instance Haldon 1985, 75-112, esp. 86-7 for the basic point [expanded in Haldon 1997] that “cities were no longer centres of self-governing administrative regions responsible for providing both their own and imperial revenues...By the seventh century, cities were becoming merely the seats of administrative establishments which regulated the surrounding regions...City buildings important to the state were now maintained by the latter, with defences being frequently first on the list.”
environmental concerns like water supply by the wayside: water infrastructure appears throughout *Framing the Early Middle Ages* merely as a marker of continuities and collapses in Late Antique cities, a *terminus post or ante quem* with which to deliberate urban survival.\(^3\) Liebeschuetz’s *Decline and Fall* similarly invokes archaeological accounts of water infrastructure in the service of continuist or catastrophist dialectics, with which to explain the decline of the Roman state.\(^4\) Yet evidence for the evolution of ideologies and material practices of water management, surviving in texts and archaeological remains, are not so simple: rather, water appears as an important vista from which we can observe a range of changes and shifts in cultural and administrative priorities that together define the transition from imperial to Late Antiquity.

Instead of framing water management in Late Antique cities in terms of a broad seventh century collapse, we might look more closely and aspire to consider Late Roman water culture as it changed, *why* it changed, and on what terms, as Romans themselves might have experienced or understood it. Where scholars have given us dates and descriptions of individual structures, we should integrate their work into broader considerations of water system resilience or fragility, situated in historicized local contexts. A range of factors that circumscribe water system survival have been acknowledged, but a comparative understanding of their configurations and trajectories in many cities and regions is still lacking.

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\(^3\) Wickham 2005.
\(^4\) Liebeschuetz 2001.
Several factors have been suggested: we can quickly outline them here, though it should be stressed that the first three enumerated below are addressed throughout the work as a whole (technological decline, political instability, and administrative reprioritization), while the fourth (climate) provides an easy segue into the subject of the first chapter and the chapters that follow, which are concerned with attitudes to water in the sixth century through the lens of Procopius, and with Late Antique changes and attitudes that concern particular types of water infrastructure (namely aqueducts, baths, wells and cisterns).

**Technological decline:** Technological decline is both a modern conceit, heavy with ideological charges inherited from the ancient past, and a hypothetical explanation for the collapse of Roman water systems after antiquity. Kaika has explained how aqueducts are techno-marvels that redefine man’s relationship to nature, and which fetishize water as a commodity. Aqueducts join cities to water, but separate rural water sources from urban consumption, and hide water’s physicality and its cost with pipes and fountains. Rebuilt Roman aqueducts today still carry water to cities like Vienna, while Ottoman aqueducts in Anatolia were quite commonly placed on Roman footings, and American cities today build Roman-style temples at the sources of their urban aqueducts. A modern techno-marvel like the arched Hoover Dam – which supports the water behind it with the strength of an arch rather than the brutish gravity of an especially heavy, straight

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5 Kaika 2005 and Marx 1867, Bk. I.i.4.
retaining wall – finds its oldest ancestor in sixth century Syria. These facts underscore the point that modern water management still relies on Hellenistic and Roman attitudes and technologies. This inheritance carries a certain ideological weight which, since Gibbon, has leached into modern scholarship – namely, a belief in the power of technological solutions for water crises, and a disbelief that the large-scale systems that supported Roman (or modern) urbanism could collapse and become disfunctional, or be profitably replaced by systems that were in fact less technologically sophisticated, if ultimately more resilient.

Theories of technological decline between Rome’s Empire and Europe’s Middle Ages still hold wide ideological currency, despite recent scholarship’s conclusion that technological innovation continued after antiquity. The continuist/catastrophist lines of this inquiry miss the point, however, that technological change after antiquity represented a renegotiation of Roman attitudes toward the human-nature relationship, mediated by water infrastructure. In Byzantium, this occurred as a de-monumentalization, which viewed the old imperial-scale water systems as increasingly suspect, a source of potential weakness instead of strength. Sophisticated delivery systems – such as the triple inverted siphon at Aspendos – were innovative but fragile, and barely survived a few decades. But ground- and rainwater-capture systems revived after antiquity

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in new institutional and organizational contexts at large scales, without Hellenistic or Roman precedents. Settlements with perennial surface- or ground-water sources that lacked city status in the imperial Roman hierarchy were elevated under Constantinople, a trend which becomes visible in the *Synekdemos* of Hierocles, and the signatory lists of church councils. Simpler open-channel, gravity-flow aqueduct systems were more readily maintained, while sophisticated urban systems with bridges and siphons were still built and maintained for sites of especial military, state or religious significance during Late Antiquity. Hydraulic engineers were still highly sought-after, as prizes in diplomacy or the slave market, inside and outside Byzantium. Yet abandoning or opting out of fragile, aged Roman aqueduct systems in pursuit of alternative water resources became an increasingly viable option for urban resilience after antiquity, well before aqueduct systems began to fail.

**Political Instability:** Political instability is created by disorder and war; such conflicts have frequently played out against water architecture as its backdrop. In Byzantium, cities infringed on one another’s territory to impound water resources; aqueducts were occasionally disassembled piece-by-piece and rebuilt for other cities. Public baths were settings for assassinations and riots.

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7 For water technology export in war and diplomacy: to Sassanians see Pseudo-Joshua the Stylite, sec. 75; to North Africa in Procopius *De Aedificiis* VI.iv.11, to the court of Attila in Priscus, *Excerpta De Legationibus* 3; to Baghdad in ninth century see Pseudo-Jahiz, “Rare Merchandise, Products, Slaves, Stones, etc. Imported from Abroad,” trans. by Pellat 1954, here at 159.

8 Nau and Bousquet 1907.

9 Alexandre 2013.
fomented against state authorities.\textsuperscript{10} Even seemingly innocuous cisterns and reservoirs became spaces for conflict.\textsuperscript{11} As curial governance broke down in Late Antiquity, secular and ecclesial elites used water storage to establish power within cities and neighborhoods, creating networks of local dependency on the water supplies they provided. Just as the ability to supply of water could create power, creating scarcity could take it away. Cutting access to water carried over aqueducks was a common tactic in both foreign warfare and internal disputes.\textsuperscript{12} Supplies were also progressively affected by diversion, lack of maintenance and administrative inaction.\textsuperscript{13} Insecurity of water supplies by aqueduct encouraged some Late Antique consumers to opt out of Roman-style systems entirely.\textsuperscript{14} This raises the question, how did political instability contribute to the evolution of a broader palette of water management options after antiquity in the eastern Roman empire?

\textbf{Administrative re-prioritization:} Should politico-administrative shifts in water management be pinned on the decay of older Roman water infrastructure, or on a more fundamental re-orientation to the value of water resources in different contexts? The establishment of Constantinople as capital in 324, with the concurrent re-organization of the annona system of grain supplies from Egypt,

\textsuperscript{10} Libanius, \textit{Orationes} 22.6 or Malalas 16.6, Jeffreys and Scott trans., 222-3.
\textsuperscript{11} In Constantinople, the earliest reservoirs were embellished with portrait statues of their patrons, patrons who are also associated with rebellions against the state. \textit{Patria} sec. 2.70 and \textit{ODB} 1:31, s.v. Aetius.
\textsuperscript{12} Evagrius Scholasticus, sec. 130.
\textsuperscript{13} Procopius, \textit{Secret History} 26.
\textsuperscript{14} From the \textit{Vita Hypatii}, see Festugiere 1961, 2: 34, sec. 19.
necessitated the creation of new port cities along the south Anatolian coast, several of which were equipped with new water systems at this time; what happened to western systems once supplying the old Roman annona is less clear, though this question is outside the range of the present study. Justinianic reorganization of the eastern Mediterranean in the sixth century coincided with the formalization of legal recognition for local church or elite responsibility over aging water systems; new socio-cultural attitudes towards acceptable water-sources; and new large-scale ground- and rain-water capture systems built with state patronage. But Justinian only formalized developments that had been occurring locally as early as the third or fourth century. During the period of a more military system of state organization during the seventh- or -eighth century CE, on the other hand, it becomes quite clear in Anatolia that 1) a large number of military capitals never had aqueducts to begin with, 2) perennially-sourced river and lake sites predominated, and 3) coastal military capitals not situated on rivers were in a position to take water supplies from simple, pre-Roman open channel systems, instead of more fragile long-distance siphon systems. An eventual post-Roman break from the tyranny of the aqueduct is clear; less obvious is how and why this evolution occurred.

**CLIMATE:** The first chapter addresses the problematic of climate change and its relation to the transformation of Roman water systems in the Late Antique Mediterranean. Increasingly available scientific and historical proxies for ancient
climate change\textsuperscript{15} have encouraged the dissemination of sensationalist claims that climate change “caused the collapse” of civilizations.\textsuperscript{16} A more measured approach is to carefully assess the inter-compatibility of regional sets of different types of climate proxies,\textsuperscript{17} and to compare these proxies with evidence from the archaeological record for social response and water infrastructure adaptation. For instance, speleothem and lake level analyses from modern Israel suggest aridification and more frequent, prolonged droughts in the Levant beginning sometime 300 – 400 CE, and continuing more or less until the ninth or tenth century, with some uncertainty for the timing of these shifts and their intensity, as the available evidence increases in resolution.\textsuperscript{18} This chapter introduces a detailed study of water in Northern Jordan resulting from reconnaissance fieldwork and cooperation in 2010 with the Danish – Jordanian mission at Jarash / Gerasa, from which it is argued that the archaeological evidence at Jarash speaks for a very clear adaptation of Roman water systems during this period, rather than failure or collapse. Levantine cities during Late Antiquity adapted Roman water systems to new uses, or reverted to pre-Roman systems, instituting new social organizations for water-sharing. \textit{But crucially}, because we can observe very similar infrastructural adaptations in the Levant or western Asia Minor – areas that experienced very different climate change trajectories

\textsuperscript{15} McCormick et alii 2012 or Haldon et alii 2014.
\textsuperscript{16} E.g. Ellenblum 2013 entirely ignores scientific proxies in preference for historical sources.
\textsuperscript{17} Finné et alii 2011.
\textsuperscript{18} Orland et alii 2009, 27–35 and Bookman et alii 2004.
(aridification or humidification) during the period in question\textsuperscript{19} – we hypothesize that climate change may have been an aggravating factor in some areas prone to climatically-induced water shortage, but it was not a root cause for the evolution of water management ideologies and practices throughout the empire as a whole. Social and cultural factors were more important.

Such social and cultural factors are explored in the second chapter through an iconic text, the \textit{Buildings} of Procopius, a rich but remarkably understudied source for water management in Late Antiquity. To date, most assessments of the \textit{Buildings} have been predicated upon its credibility as a guide to archaeological remains. The value of the \textit{Buildings} is not, however, dependent upon the unreliability of individual sections, but rather upon its character and goals as part of a larger work that witnessed a period of decisive change in the way that Romans perceived the proper management of water.

This chapter introduces a range of classical and imperial sources that represented water infrastructure, in order to better compare Procopius’s text with his literary models, to understand where and why he diverges from precedent. The author’s representations of water infrastructure and management remain superficially conservative insofar as they adopt Roman hydraulic paradigms into a sixth-century panegyric. But upon closer inspection, this adoption appears

\textsuperscript{19} For the Sofular cave record from province Bithynia, on the South Black Sea coast of Anatolia, compared with other regional proxies, see Göktürk et alii 2011 and most recently Haldon et alii 2014.
inconsistent. No longer generic, the aqueducts and baths so important to imperial rhetorical representations are described at length with incongruous details and water supply from wells or rain-water-fed cisterns – which had never previously appeared in accounts of imperial patronage outside of military or war-time contexts. Procopius’s text thus reveals itself to be an index of evolving water management behaviors and attitudes in the sixth century, long in motion, which were not begun but merely formalized during the reign of Justinian.

The third and fourth chapters assess the state of the major genres of water infrastructure in Late Antiquity: aqueducts, cisterns, and baths. Fountains are mostly excluded here, owing to the recent and exemplary monograph by Richard on this topic, as are domestic complexes which are, on the whole, conservative in their employment of water installations – in addition to being so numerous as to unduly complicate the work of the present study.

The third chapter is concerned with aqueducts and large scale supply systems to Late Antique cities, including cisterns. Aqueducts are typically approached by scholars either as markers for urban continuity/collapse (with collapse generally attributed to invasions and earthquakes), or as timeless technological systems – functioning on the principles of geology and hydraulic engineering – rather than as evolving components of the built environment. Crouch vocally advocated for the “chronology-free validity” of insights from hydraulic engineering because

20 Richard 2012.
“water behaved in antiquity as it always has.”\textsuperscript{21} Certainly the contributions of hydraulic engineering are valuable, but they are not the end of the story – a functionalist overemphasis on hydraulics risks misunderstanding the especial ideological significance and structural flexibility of Roman aqueducts, which proliferated outside of Italy after the first century CE and long remained as visible, fungible parts of the landscape, even after Roman display-oriented consumption practices began to be supplanted by more utilitarian and industrial applications after the fourth century. An analysis of the technological origins and long-term fragility / resilience of gravity-flow and inverted siphon aqueducts is presented in this chapter not as the end of the story but as its beginning, emphasizing the ideological function and origins of aqueducts – and especially inverted siphons – in palatial and religious contexts at the beginning of the Roman imperial period.

I offer an assessment of aqueducts in representation from Roman and Late Antique literature and inscriptions, from an evidentiary base of approximately 100 inscriptions for aqueduct construction and repair in the eastern Mediterranean, gathered together from various corpora for the first time in scholarship. The bulk of the chapter, however, is given over to a study of the afterlives of aqueducts – their repair, legal and illegal diversions made from aqueducts inside and outside cities, with an especial focus on the diversion of water from temples and for industrial applications. With reference to the extensive Appendix F which

\textsuperscript{21} Crouch 1993, 3.
contains water-infrastructure histories for nearly 200 settlements in the eastern Mediterranean – including an analysis of Late Antique water systems in the 59 sixth-century cities with metropolitan status, and 33 cities with the status of military capitals – a range of alternatives for the afterlives of imperial Roman aqueducts are offered. I suggest that some cities, by the fourth century, had in fact become overly dependent on Roman aqueducts – marked archaeologically by the infilling of older cisterns and wells at the time aqueducts were first introduced – and that this may have presented especial challenges in affected locations. The slow, progressive nature of this change is stressed, with Roman disinvestment from spring-sources at the top of hierarchies for potable water resources occurring alongside a marked improvement of cultural attitudes towards, and applications of, rain- and ground- water sources.

Six models are offered for the afterlives of aqueducts: (1) catastrophe and sudden abandonment, (2) neglect and gradual abandonment, (3) disaggregation of cities to proximal water resources, (4) nucleation of cities towards locations naturally blessed with abundant resources, (5) outright continuity in select locations of especial value, (6) rejection of aqueducts as supplies for cities of status as metropolitan or military capitals. In this variegated light, the continuity of aqueducts outside the eighth-ninth century Byzantine empire is re-considered. Aqueducts proliferated in competing court cultures just as the technologies and skilled labor required for their construction were introverted onto the Byzantine capital, marked by the importation of thousands of skilled laborers for the
reconstruction of Valens’ aqueduct by Constantine V in 765. Thereafter, relatively few locations with especial ideological and strategic importance maintained aqueducts, without exception technologically simple (lacking inverted siphons) and relatively short of distance in length.

The fourth chapter concerns baths after antiquity: it is argued here that moralizing concerns expressed by churchmen were mirrored by conservative Romans like Seneca and Cato, and that – given the potential for the Byzantine state to maintain aqueducts in select locations – the primary cause for the obsolescence of the urban Roman bath was in fact social, insofar as the bath had become a vulnerable *locus politicus* for public assembly and elite self-representation, the frequent setting of urban stasis and riots which are examined here in detail. Further, it is argued that while urban baths disappeared after the seventh century, the behavior of bathing was already largely displaced to locations with natural hot springs, which were elaborately embellished and became increasingly important strategically, frequently appearing as places of opportunity in intrigue, rebellion, and border-wars.
1.1 Water scarcity and climate in the contemporary Levant

Water scarcity is a recurring problem in the Levant historically and today, where water management and its infrastructure are important loci for modern social and geopolitical conflicts. Water scarcity is – like famine – both a social and a natural phenomenon. The two are frequently at odds: the social mechanisms for water sharing in arid environments are more fragile and liable to cause conflict than similar mechanisms in water-rich environments. Among hundreds of possible examples, just two news stories from 2014 can serve to introduce the point that the naturally arid climates of Syria and Palestine can intersect with and magnify socio-cultural conflicts in unexpected ways.

1) After a period of détente between Turkey and the fledgling, so-called Islamic State that formed in north Syria and Iraq in 2014, water infrastructure became one of the first points of open conflict between the two states. The IS accused Turkey of deliberately withholding ever-increasing amounts of water from the Euphrates by means of the Ataturk Dam, at Şanlıurfa, in order to weaken the IS capital at Raqqa. This is just the latest in a long series of Syrian complaints about the effects of Turkish dam-construction along the Euphrates and Tigris as

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22 See the Vice News Video “The Islamic State” accessed 9/1/14 at https://news.vice.com/video/the-islamic-state-full-length in which IS press officer Abu Mosa is quoted saying, “We will liberate Turkey, and open the Ataturk dam from Istanbul…yes this is a clear threat.”
part of the GAP project, which has destroyed important heritage sites like Zeugma, and reshaped whole landscapes in the pursuit of hydroelectricity and water for irrigation or consumption. Ever since the Ataturk dam was completed in 1990, alleged water-hoarding by Turkey has been a sore-point in Turkish diplomacy with Iraq and Syria. However, Turkey claims that they have always provided the promised 500 m$^3$/second, and that the dam in fact helps Syria and Iraq by protecting against seasonal droughts and floods. The detrimental effects of this construction have also been noted in the water supply systems of sites along the traditional Hajj route from Damascus to Mecca and Medina.

2) A second example comes from further South: among many accusations of water hoarding by the West Bank and Gaza against Israel, a newly developed town in the West Bank has been built but remains unoccupied, because the Israeli government refuses to connect its water mains to the larger supply system of the region. While Palestinian towns lack water supplies, a common cause of conflict in ongoing Palestinian-Israeli negotiations is the preferential Israeli settlement of well-watered West Bank lands, leaving cast-off Palestinian areas high and dry. Many areas still rely on traditional methods of water supply and sharing, including meso- and micro-scale qanats and groundwater systems.

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23 For the history of the GAP project, see for instance, Kliot 1994, 100-172 (‘The Geopolitics of Inequality: The Tigris-Euphrates Drainage Basin’).


25 See Kershner 2014.
developed in the ancient and early medieval period. Even these off-the-grid systems are increasingly threatened by lowered water tables in many areas, a result of the over-development of dams preventing ground-water infiltration and deep aquifer-tapping wells that have proven unsustainable, these developments have led to a general attenuation of water scarcity throughout the region. Water-sharing conflicts also characterize relationships between nations along the Jordan river valley, in which Syria and Lebanon take precedence over Israel and Israel over Jordan, though Israel is by far the most efficient collector of water resources along the network as a whole.\(^{26}\)

1.2 Water scarcity and climate change in the Late Antique Levant

Water-scarcity and climate in the Levant during Late Antiquity are no less politicized in scholarship. Huntington advanced a proposal in 1911 that there had been significantly higher averages of annual precipitation in the Late Antique Levant.\(^ {27}\) This proposition was adopted by the British Foreign Office during the Mandate Period as a justification for limiting Jewish migration to arid and semi-arid Palestine, conditions which were perceived as barriers to civilization and repopulation.\(^ {28}\) In response, “proponents of Zionism at the time claimed that desertification in Palestine had less to do with climate and more to do with poor administration and lack of technology.”\(^ {29}\) More recent scholarship, similarly holding management to be the key factor in arid-zone settlement failure or

\(^{26}\) Kliot 1994, 176.
\(^{27}\) Huntingdon 1911.
\(^{28}\) On the point of Zionist attitudes to this problem, see Rosen 2007, 22.
success, have vacillated between notions of Late Antique climate in the Levant as fundamentally similar to today’s conditions, or advocating for slightly more favorable climatic conditions. On the other hand, a hypothetically aridifying climate in the Levant during Late Antiquity has been identified as a cause for the westward movement of nomadic groups, from Central Eurasia to Europe c. 400 and from Arabia to the Levant after c. 500, coincident with the rise of the Ghassanids and the eventual Arab conquests of the 630s. Such theories remain popular in press, but current scientific evidence does not decisively support hypotheses for widespread long-term climate amelioration or degradation at this time. To some degree the formation of these hypotheses can be attributed to the resolution of scientific sources of climate proxy data, which until the mid-2000s worked only at scales of centuries or millennia, rather than decades or sub-decades. These latter are the most important for situating climate change in relation to socio-historical responses in the short or medium-length time scales that affect human lives over the course of a few generations.

The importance of even small climate variations cannot be stressed enough in any consideration of settlement patterns and larger issues of water supply or management in cities, or for irrigation. Critically, and alone among the provinces of the Byzantine world, the Levant included areas like the Hauran and Negev where precipitation regularly averaged under 200mm or 250mm per annum.

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30 Evenari / Shanan / Tadmor 1982.
31 For this position see e.g. Hirschfeld 2004.
These are the minimum thresholds for no-irrigation or so-called dry-agriculture for barley and wheat, respectively, that predominated in the Byzantine world. Rosen and others have drawn attention to the fact that annual precipitation averages are, however, unreliable measures for assessing agricultural potential. More important is the predictability of seasonal precipitation, which constrained the abilities of agriculturalists and city managers to plan for water scarcity with an array of water collection and storage techniques, as well as forms of social organization for these activities, that had been developing as tools for the expansion of settlement into arid and semiarid zones since the Bronze Age. A succession of bad years could overwhelm the buffer strategies of small-scale subsistence farmers, large-scale elite cash-croppers, or city planners responsible for urban water supply, and lead to widespread social dislocation. Pseudo-Joshua the Stylite describes a related scenario (502-506 CE), in which drought led to famine, then plague, then social upheaval.\textsuperscript{33}

Despite the natural constraints of hydrogeology and climate, Late Antiquity in the Levant was marked by widespread urban and rural settlement expansion into arid and semi-arid zones. In urban settlements, the encroachment of industrial and domestic areas onto formerly monumental public space can be a sign of depopulation and ruralization, or an increase in population that required new housing.\textsuperscript{34} In urban and rural areas, settlement expansion in the Late Antique

\textsuperscript{33} Cited by Lucke 2012, 183-4.
\textsuperscript{34} See Foss 1995 and Walmsley 2007.
Levant came as a result of renewed peace and political stability in the eastern empire after the fifth century, the increased stature of Jerusalem and the Holy Land in the cultural imagination coincident with Christianization, as well as longer-term administrative priorities like the expansion of tax revenues, and support for military outposts on the frontiers, maintenance for mining operations in the desert, or the control of preexisting trade routes. Climate change should be understood as an additional, independent variable that affected these better-studied features of Late Antique settlement in the Levant.

What did climate change in the Late Antique Levant look like, if it was not a long period of markedly more arid or humid conditions? A more careful assessment of the varieties of paleoclimatological evidence might underline the counterindications given by differently sourced or scaled scientific proxies, and also emphasize the importance of high-intensity but short-term fluctuations which are only beginning to be visible in the scientific record, despite their importance for our understanding of the period.

Sources for climate proxy data may be defined as paleoecological like pollen, fauna, and foraminifer (diatom) records; geological like lake sedimentation and stream formation profiles; speleothems (growth-sections cut from stalactites); and cultural like archaeological evidence, or historical (nonscientific)

35 Following here Rosen 2007, 154.
36 See the most recent reviews e.g. by Haldon et alii 2014, McCormick et alii 2012, Finné et alii 2011.
records of climate from papyri, inscriptions, visual representations of landscape features, and so forth. Pollen diagrams, for instance, can indicate changes in precipitation regime through the relationship of arboreal to scrub land-cover. Increasing tree cover can be related in a general way to moister conditions higher levels of precipitation; conversely, increased levels of dry-steppic shrubs like Chenopodiaceae and Artemisia are indicative of drier climates. Methods for isotopic analysis are applied to both paleoecological and geological samples. Besides isotope analyses commonly used in Carbon$^{14}$ (C14) or Uranium / Thorium (UTh) series dating for organic and geological remains, respectively, the study of $\delta^{13}$O and $\delta^{18}$O isotopic ratios has also been used as a climate proxy for precipitation, temperature, and ocean salinity in speleothems and cores of marine sediments. Because $\delta^{13}$O has fewer neutrons and is lighter than $\delta^{18}$O, it evaporates more readily; lower levels of $\delta^{13}$O with higher amounts of $\delta^{18}$O are therefore associated with more arid conditions, whereas higher levels of $\delta^{13}$O and lower levels of $\delta^{18}$O are associated with rain water input and higher levels of precipitation. However, the variable conditions of stalactite formation in cave environments have given rise to a number of potential problems and extraneous variables, like temperature and water storage composition in surrounding karst, that must also be considered, and which can complicate interpretations of paleoclimate and historical precipitation. The relationship of $\delta^{12}$C and $\delta^{13}$C isotopes – traditionally from snail shells found in lake or marine sediment cores,

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37 Less factors of human intervention.
38 For this simple overview of sources for proxy data and the varieties of their interpretation, see Rosen 2007, 17-31; for a more thorough-going technical account see Bradley 1999.
but following recent developments also from the travertine or sinter deposits in the channels of aqueducts\(^{39}\) – can also function as a proxy indicator for paleoclimatic change.

In the Late Antique Levant, these categories of evidence present several contradictions and counter-indications, and can be enumerated and summarized as follows, with key-statements concerned with the conclusions of these studies for Late Antiquity reproduced for convenience in the footnotes:

Table 1.1: A Comparison of Scientific Climate Proxies from the Levant

<table>
<thead>
<tr>
<th>Location</th>
<th>Sampling</th>
<th>Proxy + Dating Technique</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional</td>
<td>Marine sediments</td>
<td>Alkenone ratios and planktonic (\delta^{18}O) + AMS(^{40}) C14</td>
<td>Emeis et al. 2000(^{41})</td>
</tr>
<tr>
<td>Regional</td>
<td>Cultural / archaeological</td>
<td>n/a</td>
<td>Hirschfeld 2004(^{42})</td>
</tr>
<tr>
<td>Regional</td>
<td>Tree rings / isotopes</td>
<td>Dendrochronology</td>
<td>Lev-Yadun et al. 1987(^{43})</td>
</tr>
<tr>
<td>Regional [ISR coast]</td>
<td>Well profiles</td>
<td>Lithostratigraphy / archaeology</td>
<td>Nir and Eldar 1987(^{44})</td>
</tr>
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\(^{40}\) AMS refers to Accelerator mass spectrometry, which separates isotopes (in this case Carbon 14) from the surrounding mass.

\(^{41}\) Emeis, Struck, Schulz et alii 2000, 271-272: Research indicated decreasing delta 18O values [2.5-2.0kya], then increase [2-2.5kya] in the Alboran Sea; broad increase in Ionian Sea and Levantine Basin [c. 1.2-0.5kya]; decreasing salinity [more precipitation] in Ionian Sea, Levantine basin, and Alboran Sea from 2-1kya.

\(^{42}\) Hirschfeld 2004 presents an optimistic assessment of late antique settlement expansion coinciding with climate amelioration and humidification, with greater precipitation aiding urban supply systems and runoff agriculture in areas like the Negev.

\(^{43}\) Lev-Yadun, Lipschitz et alii 1987: From 420-480 CE, there were very narrow widths of tree rings in the large region-wide sample collected, indicating drought.

\(^{44}\) Nir and Eldar 1987. Issar and Makover-Levin 1996, 68 concluded that Nir and Eldar’s research on coastal wells indicated the influence of change in precipitation, which during the Roman-Byz period reached the maximum, and during Islamic period receded.
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<th>Regional</th>
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<sup>45</sup> Schilman, Bar-Matthews, Almogi-Labin, and Luz 2001, 165 reports that “A gradual shift to lower N18O values started at ca. 2.0 ka BP and continued until ca. 1.0 ka BP (Fig. 4), suggesting another relatively short humid phase.”

<sup>46</sup> Dubowski, Erez, and Stiller 2003, 72: “Stage B: 2,550–1,600 B.P.: During this stage, C and north increased...The d13C decreased sharply ... and the carbonate content decreased .... The d18O decreased by almost 1‰. These changes suggest that during this period more humid conditions prevailed... Stage C: 1,250–900 B.P.: In this stage...the high carbonate content (ca. 65%), its high d13C, and its relatively high d18O (22.7‰) suggest low allochthonous input and drier conditions and are in accord with the pollen records, in which the reappearance of the natural forest ... indicates a decrease in agricultural activities.”

<sup>47</sup> Hazan et alii 2005, 71: “New archaeological excavations at the Galei Kinneret site in Tiberias exposed sedimentary alluvium and lacustrine sediments, which bury the lower parts of the site, suggesting a rapid rise of lake level during the Early Arabic period .... The rise is constrained by the archaeological findings to between the late seventh and eighth century. The sudden high stand, accompanied by increased high-energy boulder-bearing sediment flux, can explain the abandonment and subsequent deterioration of over a dozen Roman and Byzantine piers and jetties around the lake.” Note also Marco et alii 2003, 665-668.

<sup>48</sup> Issar et alii 1992; note the similar scenario presented by Greenbaum et alii 2000, and the alternatives provided for the Dead Sea lake level curves, e.g. Frumkin 2001 or Migowski et alii 2006, Neumann et al 2007a.

<sup>49</sup> Neumann, Schölzel, Litt, Hense, and Stein 2007, 339-340: “In the early Byzantine period agriculture reaches its climax. In the upper part of [the sample, LPAT 5] a rise in Sarcopoterium spinosum together with slightly higher percentages of Quercus calliprinos and Pistacia may be a signal of the initial development of a Quercus calliprinos maquis. At the end of the Byzantine period the Olea curve suggests a sudden collapse of olive cultivation while the evergreen oak Quercus calliprinos immediately expands. Juglans, Vitis and other anthropogenic indicators also become less important.”

<sup>50</sup> Schwab, Neumann, Litt, Negendank, and Stein 2004, 1730: “At the end of the Byzantine period the Olea curve indicates a sudden collapse of olive cultivation while the evergreen oak Quercus calliprinos immediately increases.”
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\(^{51}\) Lucke, Schmidt, al-Saad, Bens and Huttl 2005, 71-2: “no traces of intensive mismanagement forcing the abandonment of [Abila] could be detected.”

\(^{52}\) Lucke, Schmidt et alii 2006, 82 “These findings do not support the proposal that erosion played a significant role in the abandonment of ancient sites... The huge amount of archaeological material from the Roman and Byzantine period does not point to sudden catastrophic erosion due to land use, because it should have removed the archaeological material too.”

\(^{53}\) Lucke 2008, and see the review by D. Kennedy 2009.

\(^{54}\) Lucke 2012, 112-114: The author’s investigation of sediment profiles at the Wadi Queilbeh, which carries the Abila aqueduct, indicated that “the groundwater table was significantly higher during the Roman-Byzantine period, probably connected with springs which ran dry and were buried by sediments during a substantial hydrological change sometime during or after the Late Byzantine period.” AMS C14 dates of sediments in a 7m fill section under a Roman bridge in the Wadi Queilbeh indicated that the largest part of these sediments, the lower 5m, were deposited before 591 CE. Thus, “the character of the wadi changed only during the Late Byzantine period when the perennial stream was buried by huge amounts of angular debris, probably connected with strong flash floods and earthquakes.” These flood layers were followed by mixed dry soil sediments dating LBzy and later. The author also provides an update on geoarchaeological investigation of the theater at Capitolias/Beit Ras, which was reused as a cistern and for domestic occupation before filling with debris and sediments. The authors indicate, ibid. 115, that the sediments in the theatre of Beit Ras could roughly be dated as Late Roman and Byzantine-Umayyad … Four ash bands occurred throughout the fill. [116] They looked like fly-ash and could be dated by 14C, indicating that the major part of the sediments was deposited approximately between cal 521 and 667 CE.”

\(^{55}\) Bar-Matthews, Ayalon, Kaufman 1997, 155-168. This earliest of the Soreq cave speleothem studies by Bar-Matthews and Orland is illustrative of advances made since in the resolution of proxy-sampling. Here, the scale is millennial – citing from 161 and 166, “The isotopic composition of the youngest speleothems from 7000 to 1000 yr B.P. was similar to that of present-day calcites, with most samples having d18O around -6 to -5%o and d13 C from -12 to -10%o. from 6000 to 5000 yr BP a notable spike of d18O = -4.5%o is observed and smaller spikes of both d18O and d13C occurred at 3000 yr BP,” thus “about 7000 years ago the general climatic conditions became similar to the present day, with less rainfall and warmer temperatures thereafter.”

Soreq/Peqiin Caves | Speleothem | $\delta^{13}$O and $\delta^{18}$O + U/Th series dating | Bar-Matthews et al. 2003a\(^{57}\)
Ma’ale Efrayim | Speleothem | $\delta^{13}$O and $\delta^{18}$O + U/Th series dating | Bar-Matthews et al. 2003b\(^{58}\)
Soreq | Speleothem | $\delta^{13}$O and $\delta^{18}$O + U/Th series dating | Bar-Matthews and Orland et al. 2009\(^{59}\)
Soreq | Speleothem | $\delta^{13}$O and $\delta^{18}$O + U/Th series dating | Orland and Bar Matthews et al. 2012\(^{60}\)
Jerusalem | Speleothem | $\delta^{13}$O and $\delta^{18}$O + AMS C14 | Frumkin 1999\(^{61}\)

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\(^{57}\) Bar-Matthews, Ayalon, Gilmour, Matthews, and Hawkesworth, 2003a. The authors here lay out their assumptions for the reconstruction of a mm precipitation total, later presented in Bar-Matthews and Orland et alii 2009, here at 3194 “The calculated $\delta^{18}$O rainfall values for the Soreq Cave area can be converted to estimates of paleorainfall amounts, if it is assumed that the relationship between the annual rainfall amount and its $\delta^{18}$O values in the Soreq site was similar to the modern relationship (Fig. 4). This assumption is partially justified by the fact that we are considering rainfall estimates in interglacial time intervals in which climatic conditions (e.g. temperature) were much closer to the present day than they were in the glacial intervals.”

\(^{58}\)Bar-Matthews et alii 2003b.

\(^{59}\)Orland, Bar-Matthews, Kita, Ayalon, Matthews, and Valley 2009, 33 “$\delta^{18}$O dark–light is a measure of “seasonality” and is obtained by analyzing the light and dark extremities of each resolvable band. Prolonged wet periods are recorded by low $\delta^{18}$O values, as seen ca. 2.0 ka in Figure 6A, and correlate with larger values of $\Delta^{18}$Odark–light in Figure 6B. Conversely, relatively dry periods, marked by higher $\delta^{18}$Ovalues after 1.9 ka, are characterized by decreasing maximum $\Delta^{18}$Odark–light values. Hence, the climatic transition that is inferred from the shift in $\delta^{18}$O values is reflected in our measure of seasonality as the maximum value of $\Delta^{18}$Odark–light dropped from $\sim2.1\%$ to $1.0\%$ between $\sim2.0$ and 1.3 ka...[34] The discussion above presents new data that suggests decreasing rainfall and thus climate deterioration from CE 100–700 in the Levant region.”

\(^{60}\)Orland, Bar-Matthews, et alii 2012. Just as Litt et al 2012, Kolodny et al 2005, and Frumkin 1999 criticized the Soreq speleothem studies by pointing to a range of factors that can affect $\delta^{13}$O and $\delta^{18}$O values in speleothems besides seasonal precipitation, here Orland et al point back to difficulties with reading past regional rainfall from Dead Sea shoreline records, owing to interpretive problems with precipitation and evaporation processes in those records. They note [ibid. 241] that the Dead Sea records point to an absolute high-stand during the last ice age, when Soreq speleothems would indicate a drier EM climate; here we should emphasize that a similar difficulty exists for late antiquity, when the fragmentary Dead sea record between 300 and 500 seems to point to a high-amplitude, short-frequency lake level high-stand followed by declining levels, over a period when the Soreq speleothems more plainly indicate increasing aridity after the Roman Warm Period (200BCE - 200CE).

\(^{61}\)Frumkin 1999, 317-327 draws attention to environmental causes for $\delta^{18}$O shifts unrelated to annual precipitation, as assumed in Soreq cave analyses, like seasonality of precipitation, synoptic air circulation patterns, salinity and composition of existing water in storage zones before addition of input from precipitation...concludes that, ibid. 325, “one must determine long-term isotopic variations of precipitation for each region independently, rather than rely on global-scale relationships.” The Jerusalem speleothem record under consideration includes the Roman and late antique period, but due to the record’s unusual length, it has unfortunately not yet been published at more than millennium-scale resolution.
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<sup>62</sup> Kadan 1997, *non vidi.*
<sup>63</sup> Frumkin, Kadan, Enzel, and Eyal 2001.
<sup>64</sup> Enzel and Bookman (Ken Tor) et alii 2003, 268: “The second lake level fall occurred between the late fifth and late eighth century CE”
<sup>65</sup> Bookman, Enzel, Agnon, and Stein 2004, 566: After Dead Sea highstands during the second and first centuries BCE, Bookman et alii’s study recorded a highstand between 340-470 CE, and a drop in lake level during the fifth century. The authors point to narrow salt cave passages in the Sedom diapir, archaeological evidence, and historical testimony which “all indicate that at least since the sixth century CE the lake level was relatively low, and the rising trend started only after the ninth century” (idem).
<sup>66</sup> Migowski et alii 2006, 427 points to “several short term periods of wetter climate, as recorded in the high amplitude, short-term lake level fluctuations” after 3.5kyr BP, including as per the author’s fig. 3, a short-frequency high-amplitude lake level rise and drop during the fourth/fifth century CE.
<sup>67</sup> Neumann, Kagan, Schwab, and Stein 2007, 1491 in which the authors indicate that “a drop in lake level around 300 CE…can be connected to the decrease of anthropogenic indicators in the pollen diagram of Ze’elim. In contrast, percentages of anthropogenic indicators in Ein Feshkha remain high from the Hellenistic until the Byzantine Period. During the Byzantine Period Olea, Vitis, and Phoenix expand again in the Ze’elim record, indicating a return to more humid conditions… Between the Byzantine and the Early Arab Period primary anthropogenic indicators (Olea, Juglans, Vitis, Ceratonia, Phoenix) are decreasing in both pollen records.” The authors’ 1494 indicates the lake level drop at 250 CE.
<sup>68</sup> See Frumkin 2009 for severe drop in Dead Sea levels during Intermediate Bronze Age, as part of 100 yr drought.
<sup>69</sup> Litt et alii 2012, 103 cautions on the use of speleothems for precipitation reconstructions, to quote: “Comparison between the Holocene Dead Sea level curve as a paleo-rain monitor in the watershed and other regional paleoclimate recorders such as the Judea caves speleothems (e.g.
The highest resolution data available at present is derived from the third-generation publication and analysis of speleotherms found in the Soreq caves (Fig. 1.1), analysis of which indicated steep drops in precipitation after the first century CE, before which time annual precipitation averaged between 1000-1200mm. This increasing aridity after the first century was, with some periods of instability, maintained until a reversal around the year 1000CE. Components of

the Soreq cave record) should be taken with caution. Several studies suggested that the oxygen isotope ratios in the speleothems reflect primarily the east Mediterranean source-water composition, and thus, cannot be used as a simple palaeo-rainfall indicator. Periods of speleothem growth are more likely to offer a clearer index of past hydrology.”

70 Amiran 1997, 97: “One can, therefore, consider the Madaba map to be evidence for an extraordinary dry period in Israel in the 560s.”

71 Frumkin et alii 1998. The author offers comparative study of two catchments in the Negev, the very large Nahal Zin, related to runoff farm assemblages associated with Mampsis and Oboda/Avdat; and the Nahal Misqafaim on hyper-arid Mt Sedom. Both records, quoting here from 106, “suggest flood cluster episodes with more frequent and larger floods c. 2000 and 1000 yrs BP.”

72 Greenbaum, Schick and Baker 2000, 966: “Our study yields just two palaeofloods during the period 1730-1380 yr BP. … The present study yields 12 high magnitude palaeofloods during the period from 1380 to 880 yr BP, with a significant change in the sediments to a much coarser texture, probably indicating higher flood magnitudes.”

73 Hunt, Giberston, El-Rishi 2007, 1329 the authors press for a wetter estimate of the Roman-Byzantine period, as compared to present conditions “when the sedimentological and algal microfossil evidence (Table 10, Figs. 14 and 18) indicates that the environment was wet enough to sustain perennial standing water behind the barrage for many years. Given the geography of the site it is difficult to attribute other than a climatic reason -- greater precipitation -- for this. …In the Iron Age to Byzantine charcoal… the Faynan landscape should have been significantly less desertic than is implied by the available biological evidence.”
dramatic bouts of weather instability, rainfall peaks and lows occur in close sequence at the Soreq Caves around the turns of the fourth-fifth and fifth-sixth centuries. A 20% drop in rainfall here meant that new averages settled between ~700-800mm/annum, with new lows reaching 520-610mm/ann during the course of intense drought episodes in the first half of the third century, the latter fifth to early sixth century, and finally the turn of the 11th century. Isolated maxima close to the pre-first century average mark still occurred, albeit highly irregularly. It should be noted that the new lows of post-third century precipitation at Soreq Cave approach modern inter-annual rainfall averages for the region today (an average of annual rainfalls at Soreq Cave over the last 60 years equaled 519mm/annum), hinting at the basic equivalence of modern and Late Antique climate, after several centuries of considerably wetter weather during the classical and medieval periods. Especial caution is warranted for this data, however, as Frumkin draws attention to problems in method related to Bar Matthews et alii’s postulation of a global-scale relationship between long-term isotopic variations related to precipitation, rather than local or regional relationships that are influenced by seasonality, salinity of precipitation, and the composition of existing water in storage zones where speleothems form. There may also be issues with the dating calibration method employed for the Soreq speleothems, throwing the chronology of the postulated shifts into question.

74 Bar-Matthews, Ayalon, Gilmour, Matthews, and Hawkesworth, 2003a and Bar-Matthews and Orland et alii 2009, here at 3194.
75 Frumkin 1999.
However, the Soreq Cave speleothem’s evidence for aridification, especially in the later fifth or sixth century, seems to be corroborated by tree-rings from the region indicating drought 420-480 CE,\textsuperscript{76} analysis of fragmentary lacustrine deposits in the Dead Sea that seem to point declining levels after a mid-fifth century high-stand\textsuperscript{77} and into the sixth century (as reinforced by salt cave passages in the Sedom diapir).\textsuperscript{78} Droughts and lack of rain are also frequent complaints of historians during this period, as indicated by recent surveys of the documentary sources.\textsuperscript{79}

Counterindications provided by other climate proxy sources should not be overlooked, however: these include the Lake Kinneret cores showing rapid lake level rise in the Late Byzantine / early Umayyad period,\textsuperscript{80} sediments from wells in Caesarea indicating maximum precipitation during the Byzantine period followed by Umayyad recession,\textsuperscript{81} and evidence for a higher water table at Abila during the Roman-Byzantine period followed by Umayyad drops in the water table that were related to spring disfunction.\textsuperscript{82}

The most recent review of the available evidence has suggested that “in the southern Levant, the climate may have become more humid after c. 400 C.E.

\textsuperscript{76} Lev Yadun and Lipschitz 1987.
\textsuperscript{77} Dubowski, Erez, and Stiller 2003, 73 and Enzel and Bookman (Ken Tor) et alii 2003, 268.
\textsuperscript{78} Bookman, Enzel, Agnon, and Stein 2004, 566.
\textsuperscript{79} See the numerous late fifth and sixth century references provided by Telelis 2008.
\textsuperscript{80} Hazan et alii 2005, 71.
\textsuperscript{81} Nir and Eldar 1987; Issar and Makover-Levin 1996.
\textsuperscript{82} Lucke 2012, 112-114.
until sometime in the sixth century, when drier weather prevailed," with the caution – as is clear from the above survey – that “the chronology of such changes remains insecure.”

1.3 Introducing Jarash and the archaeology of cities: evidence for Late Antique climate change or adaptation?

Can changes in the hydraulic infrastructure of Late Antique cities in the Levant help us evaluate or assay the counterindications provided by the scientific climate proxy evidence, by providing localized and historically-contextualized evidence for adaptation to water scarcity?

In this chapter, Jarash (Fig. 1.2) functions as a detailed test-case by which we might examine the relation of water scarcity to the evolution of urban infrastructure. Only by very carefully comparing climatic, geological, and archaeological evidence can we determine the relative adaptability of infrastructural change to water scarcity in cities like Jarash during Late Antiquity. Today, the inter-annual average of rainfall at Jarash varies between 400-590mm/year, falling primarily between September and April, with peaks in January averaging 75mm, though lows below 20mm and highs above 200mm during winter months are not unknown.

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83 Quote from Haldon et alii 2014, 122.
1.4 The hydrogeology of Jarash

Many of the Late Antique buildings in Jarash, especially churches, appear to be carefully positioned within their surrounding geology and catchment areas so as to effectively harvest rainwater or groundwater as it ran down or across sloping terrain, sometimes with the assistance of man-made channels cut into the bedrock.\(^{85}\) Except for the area southwest of the city, which is characterized by the Kurnub aquifer’s sandstones and marl, the area of the ancient city rests on the Ajlun series, “an alternation of limestones, marls, and marly limestones” whose formation contacts contain the deep Na‘ur aquifer layers that are currently being depleted by local deep drilling and water consumption – six springs and seven wells issue from it.\(^ {86}\)

No deep wells tapping these aquifers during the classical or post-classical periods are, at the time of writing, known at Jarash.\(^ {87}\) Roman and Byzantine water works (spring catchments, groundwater and runoff collection) interacted with only the top two layers of this geological series: a 20-30m layer of “marl with intercalations of thin banks of limestone and dolomite, sometimes sandy” on top of a 40-55m thick layer of “limestone, hard, dense and marly-nodular with thin

\(^{85}\) For the most recent assessment of structural and hydro-geology around Jarash, see the report by D. Boyer in Kennedy et alii 2011, 75-83.

\(^{86}\) Hammouri and El-Naqa 2008, 87.

\(^{87}\) Though wells are not uncommon in the Negev and Southern Jordan – see for instance the Nahal Zin well near Avdat that is cut through 70m of dry rock, discussed in Evenari, Shanan and Tadmor 1982, 156.
intercalations of marls.\textsuperscript{88} The undulating beds within these formations are mirrored in the uneven floors of rock-cut cisterns in the area, which follow the contours of the rock formations. The Temple of Artemis platform (Fig. 1.2, #26) and the churches around it sit on the upper layer, of marly conglomerate limestones, which is sometimes called the Abu Suwan formation. These geological qualities are important from a hydrological perspective because the horizontal layering of the bedrock gives rise to numerous suspended water tables between each strata. The Abu Suwan conglomerates are soft, intercalated vertically and laterally with marl and clastic chert and limestone cobbles, and prone to solution holes that naturally cut water channels and form pools in the soft rock. These were frequently enhanced by human action so as to facilitate the action of natural runoff collection.

It is notable, then, that this particular geological formation is also home to the densest cluster of church complexes in the city – St Genesios (Fig. 1.2, #16), the triple church (Fig. 1.2, #17), the Cathedral (Fig. 1.2, #21) and St Theodore’s (Fig. 1.2, #19) – at which can be found baths, cisterns, fountains, water-powered saw-mills, all symptoms of sophisticated water management by ecclesial patrons in a geological zone that facilitated their efforts at water collection.

\textbf{1.5 From macro to micro: the architecture of water management at Jarash in its urban context}

\textsuperscript{88} Wolfart 1961, 190.
At the macro level of municipal water planning, the largest water feature in town is the supply line and sewer that runs the length of the Cardo from the North Tetrapiyon (Fig. 1.2, #33) to the Oval Piazza (Fig. 1.2, #8). So long as the salvage excavations conducted by the Jordanian army in the 1960s remain unpublished – this work cleared the streets and sewers and re-erected the colonnades - some of its history will be obscure. Hugh Barnes important work surveying the city’s streets stone-by-stone will undoubtedly add to our knowledge of what the most walked-on and subsequently overlooked monument in the city (Fig. 1.2, #11). Besides the ongoing Danish work near the south Tetrapiyon, the only area of the streets to have been excavated and published are the sections of the North Decumanus near the north Theater (Fig. 1.2, #30-31), published by Alan Ball.

These excavations revealed the basic picture of water distribution in the city streets after they were laid in the mid-second century: “The street surface is regularly paved from curb to curb with hard limestone slabs laid diagonally in lines approx 50cm apart. Longer slabs along the center cover a longitudinal drain pierced at approx 14m intervals by stone manhole covers each about 60cm in diameter, with remains of iron lifting rings cemented into centers…Below the surface and alongside the stylobate on the north sidewalk is a drain made up of sectioned stones. Alongside this is a ceramic pipe, presumably to feed water to

89 Most recently, see the remarks of L. Blanke, H. Barnes et alii 2006, 310-312, and Seigne 2008.
the tetrapylon fountains.”

Ball concluded that shops along the south side of the north Decumanus (well to the north of the Artemision) were blocked up and abandoned after the early fifth century, but this was not the encroachment trajectory followed by shops further south in the city, which were occupied for centuries thereafter. Because the Late Antique maintenance of sub-sidewalk channels depended on access to the pipes in areas occupied by shops, building projects affecting the sidewalk are important considerations. More detailed notes on these matters will be offered in the conclusions below, after the individual treatment of the fountains, seeing as the history of the Cardo and its pipes run all together.

Baths are also important components at the macro-level of city water organization. Besides the Danish work at the Late Roman bath near the south Tetrakionia, directed and published by Louise Blanke, the large East and West baths in the city have been partially cleared but remain mostly unexcavated, though they were the subject of a review article by Lepaon that surveyed past architectural studies and offered phasings and schemes of circulation (Fig. 1.2, #32 and 37). Unpublished excavations outside of the West Baths appear to have been looking for a continuation of the Decumanus’s street surface to the

90 W. Ball in F. Zayadine 1986, 390-1.
91 Notable however, is the later, un-datable addition of a cistern along the north Decumanus sidewalk, see ibid, 391.
92 On related questions see Simpson 2008.
93 See the Danish-Jordanian Islamic Jarash Project website, with reports and bibliography, at http://miri.ku.dk/projekts/djiip/.
east of the north tetrapiylon outside the baths, though they were unable to find it. They did however uncover evidence for the creation of shops/dwellings in partitions and subdivisions between the intercolumniations of the bath’s external portico, which suggests that the exterior of the bath-buildings were in use under modified circumstances, possibly for industrial applications.

On the other hand, water supplies associated with the Placcus Baths, within the St Theodore / Cathedral complex, were quite visibly linked to industrial activity.

The baths of Placcus, located on the north side of the St Theodore ecclesial complex, are dated by one inscription for their foundation in 454/5, and another for its restoration in 584. The Yale excavations concluded that this restoration probably also coincided with a contraction of the overall size of the bath complex, even as the hot rooms were enlarged. Also important, though too-little noted in larger synthetic discussions, are the Late Antique baths excavated recently by the French on the other side of town, about ~100m northwest of the East Baths (Fig. 1.2, #41), as well as a small, secondary bathing installation in the northeast exedra of the church of Sts Cosmas and Damian (the northernmost part of the so-called Triple Church).

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95 For the Placcus Baths, see Welles 1938, 475-6 #296-297 and Fisher 1938.
96 For Cosmas and Damian, see Crowfoot 1938, 247. For the small late antique baths northwest of the larger imperial East Baths, see Lepaon 2008, 65-67.
The chronologies and typologies of these buildings are well understood, even if the baths of Jarash are still poorly known as elements of the larger municipal system of water supply and consumption – a perspective which depends not so much on architectural layout or ground-plan, as on the capacities of bath basins and piscina, and subsequently on larger schemes of supply availability and aqueduct discharge.

The aqueducts of Jarash (Fig. 1.3) have almost completely disappeared, except for fragments of water channels and supply pipe-lines discovered in and outside of the city. Waters from the known springs at Birketein (590m ASL), Ain Karawan (566/570m ASL), or El Shawahid/Souf (656m ASL), or El Kharj (795m ASL) are assumed to have been potential sources for aqueduct feeds in the Roman period, though shifts in the locations of springs related to seismic activity should not be underestimated. Excavation in the late 1970s revealed pipe sections laid in the sidewalk of the north Decumanus. Numerous cuts for pipes can be observed all up and down the length of the Cardo, sometimes in association with known fountains. Extensive survey directed by David Kennedy has uncovered numerous sections of rock carved or ashlar channels and reservoirs associated with the municipal water supply to the city’s north and west, while recent investigation of the city walls led by Ina Kehrberg has discovered a 20cm

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97 See the Jarash Hinterland Survey reports, e.g. Kennedy 2011, electronic copies of which were consulted at ACOR in Amman, where CD versions are on file.
diameter terra cotta pipe entering the city from the west gate that led in the direction of the south Decumanus.\textsuperscript{98}

1.6 The fountains of Jarash during Late Antiquity

At the suggestion of Hugh Barnes, the fountains on the city’s cardo were all extensively cleaned, leveled, and photographed in May/June 2012 so as to better understand their history and the relationships between the elevations of the city’s springs and the line of pipes and fountains running north-south down the cardo. Together, these features constitute one of the largest closed water systems in the Roman world. A recent article by Jacque Seigne\textsuperscript{99} reviewed the epigraphic evidence for the fountain’s original dates of construction - which he related mostly to the second and third centuries CE - in order to fix a mid-second century terminus ante quem for the creation of the municipal water system’s skeleton.\textsuperscript{100}

He also determined that Ain Karawan (566/570m ASL), situated intra muros on the eastern side of the Chrysorhoas, could not have served as the primary source for the city’s many fountains and baths, whose supply pipes at their highest elevation were recorded in June 2012 at 581.2m ASL just north of the Propylaea on the Cardo. Seigne’s work is important for its establishment of a mid-second century date for the installation of the Cardo water system as a whole. In the course of that work, Seigne recognized that several of the city’s fountains were modified in Late Antiquity, but he did not clarify the nature or

\textsuperscript{98} Kehrberg and Manley 2003, here at 84-5.
\textsuperscript{99} Seigne 2008b.
\textsuperscript{100} Also considered in Seigne 2004.
extent of these changes, signs of which are especially recognizable at four fountains on the Cardo. Such changes are the subject of the following section. Following Seigne’s system of numbering (Fig. 1.4), these fountains are:

**Fountain 5b**

Fountain 5b is located on the east side of the Cardo, just southwest of the Propylaea Church (Figs. 1.5-6). A set of matching inscribed architraves found near the entrance to the Propylaeum refer to fountains in the vicinity. Dating to the mid-second century, these inscriptions indicate that two fountains were dedicated by Attidius Cornelius, *consul designatus* in 150 CE.\(^{101}\) Parapetti related these dedications to the remains of two fountain basins on the Cardo flanking the entrance to the Propylaeum, tucked into the southwest and northwest exterior corners of the trapezoidal atrium that was built against the north bridge over the Chrysorhoas. At the northwest, traces of hydraulic mortar were noted in earlier publications though they could not be located in June 2012. Seigne expressed doubts about the southwest fountain’s relationship to the second-century inscription due to the late appearance of its construction.\(^{102}\)

The southwest fountain is well preserved. Its basin floor of *tegulae* (580.5m ASL) rests on a coarse mortar lining that forms the north surround of the basin walls. This initial lining was subsequently covered with at least three distinct layers of

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\(^{101}\) Welles in Kraeling 1938, 404 #63; see also Seigne 2008b, 38.
\(^{102}\) Brizzi, Mastrogiacomo, and Sepio 2001, 447.
coccia pesto, or finer lime mortar with a high proportion of crushed coarse-ware ceramics. (Some of these were collected in order to examine their fabrics, for which see below in Appendix A.) Several circular indentations in the floor of the basin record the long-term impression of falling water and possibly the provision of some shade from the sun. The front of the basin was cut for the attachment of a closure panel. At present, measuring 0.9m wide x 1.2 long x 0.5m deep, the basin's present volume is 0.54m\(^3\), though there are indications that this represents a contraction from the original phase, at which time the basin was rather larger. The south wall of the fountain basin is not lined with mortar, as at north, but instead is simply a massive limestone block placed directly on the basin's tile floor that has been fit to size, and given a mortar cuff on its south side to make it reasonably water tight. The hydraulic mortar at the back of the basin continues south past this block for an unknown distance – at least 25cm – unfortunately a half-buried and rather large and immoveable Corinthian capital in this location made clarification on this point impossible. If the basin's original volume originally extended out this additional 25cm, beyond the block, then its volume in a secondary phase was contracted by at least 22%, from ≥0.69m\(^3\) to its present 0.54m\(^3\).

There are no indications of the terra cotta or lead pipe that must have supplied this fountain, though it is perhaps notable that two sets of water marks are visible on the basin floor – both in the middle, but at different distances out from the back wall of the basin. This indicates that the horizontal position of the water
spout was kept the same in consecutive phases of use, even if the spout’s vertical position or elevation was changed.

Seigne concluded that “les traces de mortier ‘au tuileau’…révèlent que des basins avaient été construits…à une époque tardive (IIIᵉ siècle ou époque byzantine?).” Further, he suggested that the inscriptions may not have referred to the present location of Fountain 5b, but point instead to two fountains placed in the small semicircular niches at the north and south sides of the Propylaea.  

However, no trace of an inlet pipe, a basin closure at front, or a mortar lining could be seen in these semicircular niches in May 2012. It is perhaps more likely that Fountain 5b, which shows signs of long-term use in the careful repair of its mortar linings and the less-refined contraction of its basin volume with reused masonry, was used both in the Roman and later Byzantine periods, at which time (terminus post quem from nummia of Phocas, 602-610) the Propylaea Church’s trapezoidal atrium was repaved and fitted with new water pipes to supply a terminal fountain on the atrium’s south side. These pipes were estimated by the Italian excavators to have been a part of the larger Cardo network.

**Fountain 7**

Fountain 7 is located on the west side of the Cardo, between the twentieth and twenty-first columns on the west side of the colonnaded street north of the south colonnade.

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103 See Seigne 2008b, 38.
104 Brizzi, Sepio, and Baldoni 2010.
Tetrakionia, several meters south of the Cathedral complex (Figs. 1.7-12). The fountain’s basin is constructed of finely cut, closely jointed ashlar blocks placed directly on top of the original sidewalk surface, similar to Fountains 8 and 10. The fountain comprises three courses of reused blocks: the lowest belonging to the sidewalk steps, upon which are set 60cm tall closure slabs. The top surface of the closure slabs is unworn, suggesting that it is not representative of the original height of the basin. At the southwest corner, partially obscured by accumulated earth, is one piece of a 30cm tall reused moulded cornice. This tripartite composition closely recalls Fountain 8 and the Fountain Court’s basin, to the west of the Cathedral. To the south, between Fountain 7 and Fountain 8 by the Tetrakonia, the sidewalk has been raised with steps of reused architectural pieces (visible at lower left of the basin in the photos). The fountain apparatus itself has also been reset at some point, as it rises ~8cm above the slabs neighboring it in the stylobate of the Cardo’s colonnade. The fountain’s setting and apparatus, through which water flowed up and out of sculpted lion head mouths, was partially restored during the Jordanian army’s mid-20th century clearance and anastylosis of the street and its colonnade. The fountain apparatus’s top block, bearing dual carved lion’s head spouts and an inscription, is damaged on the right side. The inscription above the moldings is partially legible, and was transcribed by Seigne, who dated it to the beginning of the third century on the basis of similar vocabulary in a more securely dated inscription.
The basin itself is mostly intact. As in Fountain 5b, the basin of Fountain 7 consists of mortared tegulae tiles placed on top of the first sidewalk step within an area delimited by closure slabs to form a watertight tank. These tiles are visible at the southwest on the level of the first sidewalk step. Sometime later, this surface – and the volume of the basin along with it - was reduced by bringing the original back surface of the basin forwards by nearly 50cm: a 3cm layer of earth had accumulated or was packed onto the tiles, then covered by a line of small roughly cut ashlars set on fluted box tiles in a heavy lime mortar. This surface was then covered with re-used ashlars and lined with coccia pesto. Another indication of this change is the curvature of the coccia pesto lining at the northwest and southwest corners, where the lining follows the now smaller basin’s outline. Cumulatively, these changes contracted the volume of the basin by 43%, from 2.76m$^3$ to 1.59m$^3$.

Further, there is evidence for a change in the water supply to the fountain. Originally, the fountain was clearly intended to discharge water through the sculpted lions head mouths, at 581.04m ASL. Pressure appears to have been no problem at this stage, because the pipe inlet at the back of the fountain head immediately widens out into a small reservoir tank at top, reducing the water pressure, a normal feature in fountains where the intended effect was that of a rippling brook, rather than a jet. 1.67m below the lion’s head outlets (581.04m ASL), set into the base of the third sidewalk step, is a rectangular cut for a pipe 18cm in diameter or less (579.37m ASL). This cut was not made contemporary
with the laying of the sidewalk, but must have occurred coincident with its relaying at some point - the stylobate/third sidewalk step under the fountain setting is ~6cm above its immediate neighbors, on which sit bases for the columns of the colonnade. Because of these relationships, the addition of a second line may have occurred in association with the contraction of the basin and/or the raising of the sidewalk immediately south of here.

**Fountain 8**

Fountain 8 is located on the west side of the Cardo, at the northwest corner of the south Tetrakionia (Fig. 1.13-15). Jacque Seigne has noted that the construction and disposition of this fountain is very similar to the preceding Fountain 7, probably its mate in a paired set of fountains on either side of a presently-unexcavated public building in this section of the Cardo.\(^{105}\) Three courses of stone form the basin (1.6m\(^3\)) – the first sidewalk step, again reused as the floor of the basin, large limestone closure blocks cut to form the basin into the sidewalk steps, and a balustrade of reused cornice pieces. The top pieces are heavily worn from use with rounded indentations and rope marks; in addition there is a post hole in front of the fountain, indicative of a sun-shade set to cover the basin. The fountain apparatus itself is set above and forward from the second step of the colonnade by 30cm, indicating that unlike the Macellum Fountains (#9-10), planning and construction here was subsequent to the initial establishment of the sidewalk. Examination of the stairs at the north end reveals

\(^{105}\) See Seigne 2008b, 40.
that cornice blocks reused in the stairs a line of stones worn by the action of water falling from above. Thus the elevation of the sidewalk did not coincide with the construction of the fountain, but took place somewhat later.

Like Fountain 5, and not noted by Seigne, there are indications that a second water source was added as a supplement or replacement. A 20cm pipe cut was added 1.17m below the lion head spouts (579.54m ASL), between the first column base and the fountain setting at the southwest corner (578.37m ASL). This channel respects the column bases and fountain setting, then cuts deeply into the blocks of the indented splash plate, and so appears to post-date the original configuration of the fountain. This channel was covered in a mortar which matches that observed in the latest phase of the basin lining.

**Fountain 10d**

Fountain 10D is located on the west side of the Cardo, south of the Macellum. Adding to the astute published observations of Seigne, it should be noted that there is evidence here for the construction of the sidewalk running from the Oval Piazza to the Macellum all at once, with careful forethought made for the placement of a fountain here and at 10c, on the north side of the Macellum: the ashlar blocks are arranged so as to make as little joint surface in the basin as possible, with surrounds carefully cut to fit the placement of the west basin wall behind. Sometime posterior to the initial construction, damage to the basin was sustained, with the effect that the sidewalk pavers at the floor of the basin were
dramatically tilted towards the south. The angle and form of this damage leads to the conclusion that damage was sustained from a column fallen out of place from the colonnade on the opposite side of the street. The basin, no longer surviving at the north, was contracted to the south (though it is unclear by precisely how much) and repaired on top of the subsided pavers (leaving the basin dramatically slanted). These pavers were then covered with a new hydraulic lining in their subsided positions. Some of this mortar remains in situ.

**Fountains: Conclusions**

The present state of the city’s fountains along the Cardo is the result of several episodes of Late Antique repair and reconstruction. Fountain 10 was demonstrably repaired after a major earthquake felled columns of the colonnade onto the basin. In other cases - Fountain 5b, 7, and 10d - the remodeling of fountain basins coincided with a contraction of their volumes so as to retain less water, while Fountains 7 and 8 were equipped with a secondary water supply at a level lower than the original lion’s head spouts. Evidence for tampering with the sidewalk surface (and possibly the pipes beneath) is present in all of the fountains. Together, these features point either to a deficiency of water from the original spring or a pressure problem that was resolved by lowering the intake channel (thereby increasing the elevation difference between the fountain and the spring head, and increasing pressure), or by introducing a separate and secondary supply line from a different spring. It may be no coincidence that these changes occur during a period of declining precipitation, as indicated by the
scientific climate proxies introduced above. Infrastructure adaptations in Jarash fountains also coincide with other efforts to economize water usage and expand supply in the Late Antique city via groundwater and runoff sources that are discussed below.

All of the springs excepting Ain Karawan are possible candidates for the supply of the Cardo fountain system, including the closest at Birketein. If the published elevation of the Birketein spring (590m ASL) is correct, at 4km distance from the site the aqueduct’s gradient would have been close to 2.4m/km, comfortably within the upper range of “usual” gradients for Roman aqueducts elsewhere in the empire. With sufficient rainfall and aquifer recharge, the Birketein spring should have been more than capable of supplying the city’s fountains on the Cardo. On the other hand, if rainfall declined to the detriment of the spring’s supply, or more diversions were added upstream from the fountains, then secondary and more distant sources may well have proved necessary. Pipes coming into the city from the north have been found by the Jarash Hinterland survey that may be associated with the Shawhid spring (4km), or at slightly greater distance from El Kharj in Dayr Al Liyat near Ajloun (~7km away), for which see the map above.

106 “The usual gradient is somewhere around 1.5m to 3.0m per kilometer,” as per Hodge 2002, 218.
Back inside the city, it is difficult to date changes made to the fountains. On the one hand, their latest phases are demonstrably Late Antique, as indicated by ceramic wares of the sixth to eighth centuries crushed up in the latest mortar-linings of the basins (see Appendix A below). But in the absence of stratigraphic excavation or carbon dating of mortar, the evidence at hand is predominantly architectural or epigraphic, and necessarily concerns the history of changes made to water-lines along the length of the Cardo, as they link supply and drainage features throughout the city’s real estate.

The later-second century establishment of the city’s water system was roughly coincident with the construction of the city wall and gates, the beginning of work on the Artemis temple complex, the widening of the Cardo and the paving of the N/S Decumani, the establishment of their sidewalks, and the imposition of the Corinthian order on their colonnades. 107 Also dated to this period are the two fountains near the Propylaeum, identified by inscription. 108 The Severan Nymphaeum was added to the Cardo around 190 CE, around which time was also dedicated fountain 10c near the Macellum, by inscription.

The Late Antique maintenance of at least portions of the original mid-second century Cardo water line may be inferred from other datable additions to the system, both supply-diversions and drainage line-convergences.

108 Welles in Kraeling 1938, 404 #63.
Dated episodes begin with the remodeling of the South Tetrakionia and South Decumanus that was recently placed in the very early fourth century. After sometime in the early fifth century, the Cathedral and its dependencies (including the Baths of Placcus and the Fountain Court) were supplied by waters descending from the Artemis temple platform (more on that below), but drained into the Cardo.

Mid-fifth century inscriptions found in the ruins of the city’s south gate and wall record repairs to the gate and/or walls, as well as the construction of a στοά – which likely included the water supply pipes that ran under the sidewalks.

The later sixth to early seventh century saw the addition or restoration of fountains at the Propylaea Church. Italian excavators there concluded that a piped-in water channel supplying fountains in the atrium and facing the street took advantage of a pre-existing supply from the Cardo, though it may also be the case that a rise in the Cardo’s level in front of the Propylaea indicates that the sewer in this sector was not working when the pipes were relaid.

A date in the latter sixth or early seventh century may also be entertained for the elevation of the Cardo’s paving between the Propylaea and the south Tetrakionia

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110 Brenk 1996.
111 Welles in Kraeling 1938, 467-9 #273 and 275.
(between Fountains 7-8), and by the Macellum’s frontage on the Cardo (Fountains 9-10) if two building inscriptions, found on architraves and a column nearby, are brought to bear. These inscriptions record the dedication of ἐμβόλοι by the μεγαλορεπέστατος and περιβλέπτος ἄρχων Flavius Elias sometime after the reign of Justinian, before which time this particular combination of titles does not occur.\textsuperscript{112} Indications of EQ damage repaired in the sidewalks south of the south tetrakionia were noted above for Fountain 10. Olavarri-Goicoechea suggested that the creation or restoration of an ἕμβολος near the Macellum may have coincided with the refurbishment of Fountains 9-10, and with broader changes made to the water supply of that building at the time of its transformation from a market to an industrial center that included a water-intensive tincturer’s or dyer’s workshop with numerous basins.\textsuperscript{113} North of the tetrakionia between Fountains 7 and 8, the sidewalk’s stylobate was removed, an embankment inserted to raise the sidewalk’s elevation with spoliated entablature pieces, and the stylobate was then replaced, presumably with new pipes to supply the two fountains that book end a large and as yet unexcavated building in this sector. On the south side of the city, Hugh Barnes has suggested that the insertion of a western-supply line into the Oval Piazza\textsuperscript{114} was coincident with the raising of the Cardo south of the Tetrakionia, which if related to the above

\textsuperscript{112} The Macellum and Cardo ἐμβόλοι inscriptions may be found in ibid., 471-2 #280-281.
\textsuperscript{113} Olavarri Goicoechea 1986, 82. Further excavation and investigation by Uscatescu and Martin-Bueno 1997 also placed these changes, on the basis of stratified ceramics and other materials, to the late sixth century.
\textsuperscript{114} On this see also the Jordanian excavations of 1975-6 in the western part of the South Decumanus and the western half of the Oval Piazza, results from which were somewhat cursorily published by Barghouti 1997, 219-225.
inscriptions might be placed anytime between the early fifth and latter sixth century. That date stands to be refined as a result of the continuing Danish shop excavations directed by Ian Simpson.

If the Umayyad Mosque drained into the Cardo, that could push at least partial functionality of the south cardo sewer into the eighth century, which also marks a solid terminus post quem for the functionality of the city’s aqueducts.115

A seventh-eighth century date for modifications to the system are indicated by the discovery of grey-ware terra cotta (typically dated to the seventh or eighth centuries) used in an L shaped water joint pipe discovered in the Oval Piazza, and preserved today in the Jarash Museum on site. Grey-ware ceramics were also found by the author in the latest linings for basins in Fountain 8 (at the Tetrakionia, Cardo Fountain B) and the Placcus Bath Cistern (see Appendix A below).116

Together, we might conclude that in spite of modifications made to the fountains that they might consume less water from a lower source, the infrastructure supplying spring-water to the Cardo fountains and the St Theodore complex was maintained in the area between the Propylaea Church and the Oval Forum from

115 Blanke, Barnes et alii 2006, 312. A sizeable cistern and possible ablution fountain near the Mosque were encountered in excavation by the Danes in the summer of 2012 – they appear to be unrelated to the Cardo system, though was not confirmed at the time of writing.
116 See Harding 1949, 15 for the pipe from the Oval Piazza; and see Appendix A for information on the so-called Umayyad grey wares, generally dated to the seventh or eighth centuries.
the mid-second to at least the early seventh century, if not also into the mid-eighth century.\textsuperscript{117}

1.7 Temples, churches and cisterns at Jarash

Among all the churches in the city, the Propylaea church alone was fitted with a supply from the city’s main closed-supply line that ran down the length of the Cardo. To quote from the Italian excavation report, a southern portico built in the atrium there during the latter sixth or early seventh century preceded the insertion of “a terracotta water pipe … into a ditch running alongside the [new portico’s] stylobate. The pipe was made using tubuli 40cm long preserved by the western wall of the atrium. A column drum was reused as a spout holder to the central columns, where an L shaped pipe element and a cut in the stylobate suggest the presence of a second terminal fountain…which was probably supplied by the same aqueduct used for the roman fountains on the colonnaded street and was still working in the post-Roman period as documented by basins built in close proximity – a semicircular monolithic malakia limestone basin found in the atrium in the 1920s is identical to the one still in situ in the Cathedral courtyard, and could have belonged to this fountain. Construction of the porticoes involved renovation of the atrium paving: found in its bedding were “12 nummia dated to the reign of Phocas, 602-610.” Later in the seventh to mid-eighth

\textsuperscript{117} Again see Appendix A for detailed information on ceramics used in the mortar linings of basins, for evidence pertaining to the maintenance of these fountains.
century, the southern part of the church and chapel was converted to domestic use.\textsuperscript{118}

Like churches in the Negev or the Hauran, or in many other places across the Byzantine world, church construction at Jarash coincided with the installation of rainwater collection schemes that fed large cisterns, especially in their atria. Such atria cisterns were – to judge from their architectural contexts and volumes – public, and not strictly restricted for purification or the consumption of clergymen or liturgical activities, as is frequently assumed. At the Theodore Church, separate water cisterns were maintained in the Clergy House (7 m\textsuperscript{3}), near the Baptistery (1.5 m\textsuperscript{3}), \textit{and} in the atrium (70 m\textsuperscript{3}). This represents a clear demarcation of consumer-types: churchmen, the \textit{alousia}, and likely the residents of dense housing and workshops contemporary to and surrounding St Theodore.

At Jarash, several groupings of cisterns resolve in terms of types of access, topography and building-histories: at the Zeus temple, on the Artemis temple platform and the vast St Theodore-Cathedral complex to its south, and the Genesios and so-called Triple Church to the Artemis temple’s southwest. The independence and small scale of these predominantly ecclesial Late Antique water management schemes is striking, as is their tendency to seize upon available sources or catchments in obsolescent public buildings. Water storage features in these locations must have been considerable supplements to urban

\textsuperscript{118} See Brizzi, Sepio, and Baldoni 2010.
water supplies by aqueduct. Such water storage features are also typically found in proximity to industrial installations: water for churches was not merely a spiritual benefit, but also conferred material advantages.

The Temple of Artemis and the Cathedral-St Theodore complex and its dependencies, discussed in more detail below, were significant points of water storage and distribution in the city. At the Artemis temple there is evidence for both aqueduct-fed and rainwater collection systems which, in a later phase, were modified for the benefit of the ecclesial constructions and numerous industrial and residential installations to the south.

The now destroyed intra-muros Church of Prophets, Apostles, and Martyrs on the east side of the wadi may have functioned in a similar distributive capacity. This church, an unusual and very early cruciform building dated to 464-5 by mosaic inscription, was built about 100m from the spring of Ain Karawan that supplied the fourth-century baths further south. These were perhaps a smaller-scale replacement for the larger imperial East Baths, immediately to the southeast, whose structural history and use-phasing is little known.

The lower platform of the Zeus temple was also outfitted with a cistern (~16m³) excavated by Seigne in the 1984-5, fed by two channels. One was a simple open

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119 Most recently for the Placcus baths see Lepaon 2008, 65-67. For the Prophets Apostles and Martyrs church see Crowfoot 1938.
cut in the pavement (8-10cm diameter and 5-6cm deep) beginning at the steps of the temple, the other was built and covered with reused limestone masonry. Seigne concluded that this cistern was built as a receptacle for rainwater sometime between the second and sixth centuries and suggested that, more specifically, its construction may have coincided with the installation of a Christian (Monophysite?) community dated to the end of the fifth century by mosaics. After the destruction of the church in the sixth century, the terrace was newly occupied by small scale agriculture and potters' kilns, and the cistern became a cesspit and began to fill up with broken pottery.  

1.7A The Artemis temple complex

Besides the Cardo network, the largest-scale water feature encountered on site was the multi-phase complex of masonry/rock-cut reservoirs, settling tanks, drainage, and runoff channels installed inside the precinct of the Artemis temple (Fig. 1.18). A number of these features connect to other structures to the temple’s south (the saw-mill, the Cathedral/St Theodore complex and its dependencies) and east (the one-aisled church on the intermediate terrace, the Severan Nymphaeum).

Inside the temple temenos and near the podium, several water installations may quickly be enumerated and described (Fig. 1.19). These are two north-south running open channels, rock-cut and partially covered with re-used limestone

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120 Rasson and Seigne 1989, 119 and 150.
masonry, which converge at the northeast corner of the Artemis temple podium. From here ran a covered channel south along the temple podium’s first step, obviously posterior to the temple but apparently anterior to the Byzantine/Umayyad kilns established in front of the podium in the sixth century.\textsuperscript{121} This channel terminates at the southeast corner of the temple podium in a re-used Roman ossuary serving as a \textit{dividiculum} (~.4m\textsuperscript{3}), which divides the channels flow in three directions: west via a long rock-cut channel to a 1) long basin and 2) series of rock-cut reservoirs along the temple’s southern side, 3) south via a channel cut and covered with reused masonry, and 4) east through an outlet in the dividiculum (Fig. 1.20-21).\textsuperscript{122}

1) The long basin (~7.5m x 2m x .6m= ~9m\textsuperscript{3} or 9,000 liters) was cut into the bedrock and fitted with a molded cornice surround that raised its lip slightly above the paving that once covered the temple platform – this prevented rainwater runoff from entering the basin. The basin’s cornice matches other pieces on the temple platform and should be dated to the second century. Only part of the cornice survives; the paving was later removed to build the walls of nearby churches. Originally, the basin could have been a \textit{lakkos} associated with the Artemis cult; this is a common imperial-period donation to Artemis sanctuaries that is attested in Jarash and elsewhere by inscription. Whatever its original role

\textsuperscript{121} Compare with the remains on the Zeus temple terrace. 
\textsuperscript{122} Pierobon 1983-4, here at 87.
on the platform, it is clear that it was later converted for use as a terminal water
storage point, just one of at least three fed by the dividiculum’s western channel.

2) The rock-cut reservoir was fed by the western branch from the dividiculum,
and abuts the south corridor of the temple podium. The reservoir was cut into the
soft marly conglomerate after the platform’s paving was removed. At the NW, the
bedrock was vaulted to form a sunshade: this may be all that survives of a longer
vault that stretched further W. The reservoir is accessible via carefully carved
steps leading down from the east. Its volume may be conservatively estimated at
15m$^3$.

3) Another masonry-built channel runs outside the long basin’s eastern side
towards the south portal, and was noted by the Italian excavations. It should
hypothetically be connected to conduit cuts found by Fisher that cross the south
temple portal’s stylobate, and to the other pipes and water-consuming structures
on the St Theodore street, discussed below. 123

4) The eastern branch from the dividiculum did not survive in its entirely, though it
should be noted that another carved conduit with spolia covers was found on the

123 The complex west of St Theodore’s is no longer accessible, having been used by Fisher’s
team as a dump for 20,000 cubic meters of overburden taken off of the Artemis temple platform.
Thorough excavation reports were published in the late 1920s and 1930s by J. W. Crowfoot and
Clarence Fisher, formerly of the University Museum in Philadelphia – upcoming work in the Yale
University Gallery of Art’s Gerasa Archives (see http://www.artstor.org/what-is-artstor/w-html/col-
yale-dura.shtml) will hopefully clarify a number of questions that remain. Photographs from the
archives and some tentative suggestions concerning this area are offered below.
southeast corner of the temple platform by the Yale excavations, above the sawmill and its reservoir (Fig. 1.22).

The podium conceals an additional series of interconnected, vaulted substructures that have been interpreted as water-storage features (Fig. 1.23-24). No connection was noted between the system of late channels/dividiculum and these adjacent temple substructures which are on roughly the same level. To quote from Clarence Fisher’s 1938 report on the temple excavations:

“…Between these various foundation walls[belonging to the temple podium] ran a series of long passageways and chambers. The longest of the passageways is that running around three sides of the building between the foundations of the cella and those of the peristyle. It was entered from the northeast corner of the cella by a flight of steps descending in the core of the eastern wall. At the south a doorway provided communication with the chambers under cella and portico. Set into the foundations to support cella and portico floors, the walls and barrel vaults of these chambers were built of a softer local limestone. The chambers were arranged in two groups of three each, arched doorways connecting the individual members of the groups and each group with the other….All the chambers were connected with each other by vertical slots 30cm wide let into the walls dividing them….The entire arrangement of passages and chambers seems to have served as a place for the storage of water.”

Reference to plans of the Artemis Temple made by Fisher and more recently, by Parapetti, facilitates the calculation of volumes for these presumed reservoirs, which may be conservatively estimated from below the vault springs at 68 m³, or 68,000 liters. Originally, these substructures were accessible from stairs at the

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124 Fisher 1938, 135.
125 See the published plans in Guillini 1983-1984; reference was also made to the unpublished drawings made by Fisher, available by the Yale University Gallery Archives (online through ArtStor), as well as at Dumbarton Oaks.
cella’s southwest corner. The creation of a drawhole near the center of the
temple’s pronaos may have been an original feature related to the cult of
Artemis. Because of its slightly off-center location and rather haphazard
construction -- cut through the podium’s pavers -- it appears to be posterior to the
original construction, possibly related to the obstruction of the original entrance to
the substructures when the temple’s cella was blocked off (Fig. 1.25).

The technical detail that the substructures were interconnected by 30cm vertical
slots is critical: this connects these chambers with masonry water reservoirs built
elsewhere in the Roman world, and particularly in North Africa, as described by
Wilson. There are also numerous comparanda – even if they are little
discussed, synthetically - for other types of water storage in Roman-period
temple complexes: for instance at the Temple of Claudius in Rome or the Temple
of Apollo at Claros, on the Jewish Temple Mount and the later Haram al Sharif,
or in the birkets of the Hauran.

1.7B Supplying the Artemis temple complex

On the Artemis temple platform at Jarash, there is evidence for water supply via
both spring-fed aqueducts and rainwater runoff diversion. It is tempting to
associate the conduits just north of the temple with either of the two groups of
rock-cut and masonry channels discovered to the city’s north and northwest of

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126 For a good summary of A. Wilson’s voluminous work on the topic with references and
republished drawings of these types of installations by the 19th century French excavators, see
Birketein by the Jarash Hinterland Survey, fed by springs at elevations sufficient to ascend the temple’s steep platform (601m ASL).^{127} On the other hand, the channels on the platform have relatively narrow sections (20-30cm) and do not have covers north of the temple proper and the area of the kilns: these elements may indicate that the channels functioned to divert runoff rather than carry a pipe.

Though it is without comment in the existing literature, the remains of a western aqueduct can also be observed intra-muros, on the hill to the west-southwest of the Artemis temple temenos. There, cut into the hillside, is a sizeable and regular depression that appears to be a large open-air reservoir, connected to the temple via portions of a long masonry built channel which snakes east along the hill (see photos below). The reservoir is in poor condition. It is rock cut with sheer, smoothed walls occasionally reinforced by rubble masonry. No mortar lining is visible. Measurement via Google Earth puts its dimensions at roughly 35 x 8m, with a variable 1-2m in depth exposed – we can conservatively estimate its minimum volume at 280m$^3$. The presumed reservoir slopes down towards the east, where it opens into a (natural but enhanced?) cave. The reservoir was probably originally dug out as a quarry, that was later adapted for water storage. A long, neatly built opus incertum channel roughly 70cm wide runs east and away from this reservoir down the hill and back towards the Artemis temple, though the final 10m or so west of the temenos could not be traced. The

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^{127} See Kennedy 2011, 47f and 80-82.
channel’s long snaking profile at variable elevations precludes its identification as a building foundation; more likely it housed a conduit (Fig. 1.26).

On the other hand, rain-water falling on the temple platform (~15,000 m²) could have been a significant resource, if it was harvested effectively. In its original incarnation, the paving of the temple’s platform provided a surface with a very high runoff coefficient, meaning that the surface drained water very effectively with minimal losses to infiltration. Because climate proxy evidence discussed above indicates a very rough correspondence between precipitation patterns in Late Antiquity and today, we might consider that a typically heavy winter rain event [9.5mm] falling today on the upper terrace’s paved limestone surface would have produced [15,000m² * .0095m * 0.85=] ~121m³ or 121,000 liters of water. This includes an estimated runoff coefficient of 0.85 for jointed limestone pavers. Average annual rainfall [420mm] at the same runoff coefficient would have produced [15,000m²*.42m*.85=] 5355m³ or 5.355 million liters of runoff.

The removal of the temple platform’s paving began in perhaps the early fifth century, when occupational deposits and water-management installations began to appear on the temple platform, and when some of the temple’s architectural sculpture began to reappear as spolia in nearby churches. One result of the platform’s despoliation was that thereafter water ran off of the coarser marly conglomerate bedrock, which possesses a significantly lower runoff-coefficient.

128 A piece from the architrave of the temenos peristyle can still be seen in the early fifth century cathedral, albeit in modified form. See Parapetti 2002, 33-35.
Numbers generated in the Negev by Evenari et alii and recently adopted in Oleson’s recent study of Humayma estimate runoff-coefficients anywhere between ~0.02-.15. A simple set of calculations as above indicates that a heavy rain event (HRE) of 9.5mm would produce ~2.9-21.4 m$^3$ of runoff on this surface, with annual runoff approximating 126-945m$^3$. On the other hand, a runoff coefficient of 0.65 was noted for marly conglomerates in arid southeast Spain by Cantón for arid southeast Spain – this would equate to 92m$^3$ in an HRE or 4095 m$^3$ annually. Whichever coefficient is used to calculate run-off potential for the temple platform, the quantities involved are substantial.

The question thus becomes whether or not this runoff was harvested, and if so, how effectively and for whom.

At the time the temple was built in the mid second century, water was designed to run off the platform, collecting from drains on or graded surfaces on the pavement into sewers at the south and east. Under the south portal, Fisher’s excavations revealed a large masonry drain of well cut ashlars, with an unlined but smooth floor. It led away to the south where it presumably joined the west-east sewer known in the south Decumanus (Fig. 1.27).

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129 0.02 to 0.15 are used as coefficients by Oleson 2010, 368-9 for Humayma. On the other hand, a runoff coefficient of 0.65 was noted for marls by Cantón 2011, 3 see his fig. 1. Ashlar-masonry paved surface coefficients are harder to determine, as they are functionally dependent on the characteristics of the parent geological formation, as well as the size and frequency of gaps between the pavers. The figure used here is based on the advice of modern construction manuals, though it remains a provisional figure.
Seigne noted, as regards hydraulic installations on the Roman Zeus Temple platform at the south end of town, that throughout the entire Roman period, effort focused on the complete evacuation of rainwater with paving, crowned surfaces leading to drains. Water was inconvenient and unnecessary, to be cast off. The attitude at Jarash, during the Byzantine period, was entirely different, with a marked shift to the collection rather than the drainage of pluvial water. The same shift is visible at the Artemis temple, where the removal of paving in the early fifth century left the marly conglomerate subsurface exposed and liable to modification for runoff collection. A dividiculum distributed waters into pipes and open channels for storage and consumption. Older drainage channels on the platform were repurposed to divert water from sewers into storage, while natural runoff channels were enhanced and new conduits were constructed with reused masonry for the same purpose. Relatively narrow sections (20-30cm) and lack of covers probably indicates their use for rainwater collection, at least in a late phase.

1.7C South of the Artemis temple: the Cathedral – St. Theodore complex and dependencies

Fisher’s excavations along the Artemis temple’s south side revealed numerous water conduits, crossing both under and over the stylobate of the temenos peristyle, all along its length, in channels open and closed (see map above and

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130 Rasson and Seigne 1989, 150.
photos below), which directed water from the temple platform towards the Cathedral-St Theodore complex and related structures.

Water emanating from the Artemis temple platform was consumed in the complex of buildings surrounding St Theodore and the Cathedral, namely: 1) a water-powered sawmill built after the early fifth century,\(^{131}\) 2) the Fountain Court attached to the Cathedral of the early fifth century, 3) a large cistern supplying the Placcus Baths built in 454/5 and restored 584 CE, and 4) the multiphase area west of St Theodore’s with the large Cistern 1 (c. 300 CE) and several houses and industrial complexes (post-fifth century). The supply of a 5) cistern in the atrium of St Theodore’s is unclear: it may have come from any of several pipes known to its west and north (now inaccessible) or from runoff directed from the rooftops in the St Theodore complex.

1.7D The sawmill and the fountain-court

Evidence for water directed from the southwest corner of the temple platform may be observed in two masonry built east-west channels that feed into a large reservoir (\(>88.5 \text{ m}^3\)) on the intermediate terrace (Fig. 1.28). An overflow channel

\(^{131}\) Seigne 2002, 212 dates the mill to the reign of Justinian “and his immediate successors [because this was] a period of relative prosperity in Jarash when more than twenty churches and chapels as well as bath houses were built, all great consumers of stone slabs for floors and walls.” The mid-sixth century did witness renewed construction in the city, but there is nothing archaeologically that indicates Justinian’s patronage, that insures a sixth century date or prevents a fifth century one, when construction on the Cathedral began below. Much of the construction materials were taken from the Artemis temenos. See the most recent dating of the Cathedral and Fountain courtyard to after 404-435, deduced from coin finds, in Brenk et al 1998, 427-9. Further, this would sit well with the date of very similar water conduits on the Zeus temple platform, according to Seigne’s own interpretation of remains there. See n. 120 above.
in this reservoir, in turn, supplied an overshot watermill powering a stone saw (see photo below right). Interestingly, the overflow channel here is 60cm above the floor of the basin, indicating that it would have had to be quite full in order for the saw to function, and therefore that the mill was not its primarily recipient. (It may have connected to structures at the east: Italian excavations there on the east intermediate terrace discovered a one aisled church with re-used stone built conduits on its north and south. The former continued east of the church, while the latter gathered in some sort of tank inside an apse at the church’s west, whose occupation was dated by coins and pottery from the fifth/sixth to seventh centuries.)\textsuperscript{132} The watermill was installed sometime after the early fifth century in order to power a stone-cutting saw that was recently studied and expertly restored by a team under the direction of Seigne.\textsuperscript{133}

Though previously unnoted in publication, the large stone discharge channel running west from the sawmill bent hard to the south, crossing under the paved street, and down the hill along stairs by the Placcus bath’s south side (the Serapion passage). Crowfoot had earlier concluded that the water channel under the west side of the Serapion passage supplied the Fountain Court, though he could not have known that the sawmill’s discharge channel ran in the same direction.\textsuperscript{134} This channel disappears under the Serapion passage on a chord with the large exit channel installed in the base of the Fountain Court’s northwest stairway landing (Fig. 1.29).

\textsuperscript{132} See Piazza in Guillini 1983-4, 119.
\textsuperscript{133} Seigne 2002.
\textsuperscript{134} Crowfoot 1931, 150.
This channel probably contained a pipe or some other supply for the Fountain Court – though this is impossible to confirm due to collapse within the channel. Conceivably, a pipe in the channel entered a settling tank behind the exit channel in order to be fed, under pressure, into the lead pipe that was discovered in 1929 running southeast from the exit channel to the Fountain, under the Fountain Court’s pavers. The spolia-built exit channel at the Fountain Court’s northwest corner is large enough for maintenance at nearly a meter tall and half a meter wide, and is also sufficiently large and well-positioned to have housed a drain for the Placcus bath complex immediately to its N. An alternative source for the Fountain Court might be sought I none of the pipes found crossing under and over the temple platform stylobates at its south (discussed below).

The Fountain Court itself was carefully planned for the drainage of runoff. Overflow from the fountain or rainwater alike fell into the long drainage channels that are cut along the interior length of the three-sided portico’s stylobates at its north, south, and east. These converged and drained together at the northeast corner. A cistern near here was discovered by the Yale Excavations, though it is unclear how it was supplied and if it was accessible after c. 400, when the Glass Court lost its function as part of a bath complex and was integrated into the Fountain Court. At the northeast corner, the line then traveled under the north external corridor of the Cathedral and sloped downhill to the east towards the Cardo, where it joined the city’s main sewer via another late exit structure and
pipe channel built adjacent to the south side of the Nymphaeum (see photo below). The construction of this channel housing is similar to exit housing in the Fountain Courtyard. An associated pipe-cut in the stylobate may be followed all the way down to the Cardo – though it is unclear whether it actually joined the Cardo sewer underground or simply let out onto the street surface (Fig. 1.30).

1.7E The Placcus baths

The Placcus Baths are dated by one inscription for their foundation in 454/5, and another for its restoration in 584 CE (Figs. 1.31-33). The Yale excavations concluded that this restoration probably also coincided with a contraction of the overall size of the bath complex, even as the hot rooms were enlarged. The cistern feeding the Placcus Baths (112 m³) is on a chord with a series of three water channels excavated by Fisher that cross over the Artemis temple’s temenos stylobate at its south-eastern side. These head directly towards, but do not obviously connect with, the large cistern labeled B47 and B43 at the northwest corner of the bath in Fisher’s plans. No pictures of these channels have been located thus far, though they are identified in plan, and their build-materials and exact relation to the stylobate are unclear. Space B47/43 was identified as a swimming pool/frigidarium by Fisher, though as Lepaon noted it has neither an obvious entrance nor stairs for descent into the pool, while frigidaria are generally absent in Late Antique baths anyways, in which the focus

135 For the Placcus Baths, see Welles in Kraeling 1938, 475-6 #296-297 and Fisher in Kraeling 1938.
is on the hot rooms. At a later date (584?) this chamber was subdivided at the west, contracting or repurposing the reservoir - this partition wall does not survive. No obvious intake channels are visible; these may have been above the level of the surviving masonry at N. But there are at least two outlets: an overflow channel 87cm above the floor is present near the cistern’s southeast corner. This open channel flows into Room B44, where a second, much lower channel exits the cistern and directs water into the hot rooms. The last mortar lining in the cistern probably covers the original outlet at this lower level, and so must date to a time when the bath was used only in the winter when water was particularly abundant and could fill the reservoir completely to exit via the overflow, or when the bath was no longer used at all and the cistern became a terminal storage point.

1.7F St Theodore and associated structures to its west

A host of other consumers in the neighborhood west of St Theodore were supplied by water directed from the Artemis temple platform. This area was previously given over to tombs in the earlier Roman period, but later transformed and grew. A solidly built drain channel east ran down from the Artemis temple’s south portal and was contemporary to it; Temple C (second-third centuries) also drained into this sewer. A heavy masonry wall across the street from the portal may have belonged to a cistern fed by some of its runoff; this was absorbed into

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136 Fisher in Kraeling 1938, 268-269 and Lepaon 2008, 57-59, who also identifies the first phase of the Glass Court as a Roman bath, 59-60.
a fifth century house construction and supplemented or replaced by the
construction of the large vaulted Cistern 1 that Fisher dated to c. 300 CE. After
the fifth century, further residential and industrial areas developed in this area
just west of the church of St Theodore. Fisher’s excavations revealed a dense,
confusing tangle of drains and water conduits (a, b, c, d) built of reused materials
running north-south under the street at the church’s west (Figs. 1.34-6).
Immediately south of the east-west street below the Temple, Fisher observed
“heavier walls belonging to a much earlier period,” “almost parallel to the south
wall of the Artemis temenos,” that may have been belonged to a cistern
contemporary to the Artemis temple, before it was absorbed into the Late Antique
House VI/Rooms A40-45.\textsuperscript{137} Fisher concluded that “a drainage channel coming
from the court of the Artemis temple passed under the sill [of the temple’s
southern portal] and terminated in a settling basin under the steps before it. From
the basin drains ran out in a number of different directions. Originally the
drainage probably ran to the cistern under house VI… [that was] built shortly after
the temple itself to catch and store some part, at least, of rain water which the
slope of the court sent southward. It is possible to conjecture that Cistern 1,
father to the south, was built to supplement [or replace?] that first constructed on
the site of house VI.”\textsuperscript{138}

\textsuperscript{137} Fisher and McCown 1931, 284-5.
\textsuperscript{138} Ibid. 286.
Fisher distinguished this channel from several others in the same area, which he ascribed to a later date: “Excavation below the irregular rooms (B72-4) revealed a water drain \( b \) similar in construction to east but of poorer workmanship. This conduit started inside the south colonnade of the Artemis court and was traced as far south as the additions to St Theodore’s atrium, where it disappeared. The drain … was built only after the Artemis temple had ceased to be an inviolable shrine. The reason is that the walls of the drain cut through the stylobate of the colonnade and projected above its floor. [The construction of this drain in photographs is similar to one found in the 1980s by the Italians and discussed above, which runs north-south to the east of the temple court’s long basin.] In the open space between House IV and the additions to St Theodore’s atrium two open water channels were discovered – the uppermost built of roughly trimmed stones \( c-c \) led to an old stone sarcophagus reused as a water trough. The lower \( a \) was constructed of column drums flattened below and chiseled above to provide a narrow channel for the flow of the water. The latter led to cistern 1. The source of the water for both is not evident, but must in all probability be sought in the drain \( b \).”

It should be noted from this account that even if the cistern’s construction was dated (largely by technique) to c. 300 CE, the fashioning of its supply conduit \( d \) from reused column drums evinces a later date, likely after the temple platform began to be quarried for new building projects in the fifth century – similar

\(^{139}\) Fisher in Kraeling 1938, 291.
columns appear in the nave of St Theodore. Conduit \(d\) appears at the southwest corner of the later room A7, and crosses over conduit \(c\).

Conduit \(c\) appears at the northwest corner of A7, and is a narrow rectangular channel cut into long reused blocks, placed end to end in order to fill the re-used sarcophagus visible in photos above. Fisher’s conclusion that the reused sarcophagus was used for terminal storage should probably be questioned: a quick glance at the above photos shows a smaller tank immediately below the sarcophagus with cuttings for additional pipes at its west and south ends – this might mean that the sarcophagus is in fact a settling basin, typical of rainwater fed systems, placed before another *dividiculum*. Closed pipes and another rock-cut channel are indicated on the plan or may be seen immediately below this tank in photos, but whether they lead into or out of the south Theodore atrium is unclear. Conduits \(c\) or \(d\) may have connected to the reused masonry channel \(b\) that originates on the temple platform and disappeared nearby in Room B72. Their location and numerous sections of unconnected pipes and channels suggests some connection with the immediately adjacent Clergy House and Theodore Church.

Fisher further suggested that “by the end of the sixth century or the beginning of the seventh, conditions [on the street] had become unstable – Christians screened the [St. Theodore] street from neighborhood by a wall and changed its character by closing the northern end [off from the Artemis temple completely]
and transforming the section between the atrium and the northern boundary of
the church’s property into a series of rooms (A 6-7 and cistern 2). It was
henceforth only an alley leading to the church. The last vestige of a formal
connection with the Shrine of the Tyche was thus cut off. The life giving waters
from her court dribbled henceforth into a sarcophagus and drained into the
cellars of a roman ruin.”

Despite the negative connotation of ruin evinced by Fisher in the above quote,
the patrons and builders of these late water installations clearly show significant
ingenuity and adaptability in their efforts to channel waters from the obsolescent
Artemis Temple platform toward new uses in the area around St Theodore’s and
the Cathedral over the course of several centuries.

5) One large cistern in the public space of the atrium at St Theodore’s was
observed in May 2012 that is acknowledged but little discussed in the earlier
reports (Fig. 1.37). The cistern is collapsed at the north, but survives in fair
condition at the south, albeit with a sizeable debris cone obscuring the level of its
floor. The cistern was carved directly into the bedrock below the atrium, and used
at least two columns to support the rock roof and pavement above, which
indicates that it was probably contemporary with the atrium’s construction, which
has been dated by inscription to the late fifth century. The atrium cistern (v=

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140 Ibid., 294.
141 Crowfoot 1929, 24.
142 For the inscription, see Welles in Kraeling 1938, 476-7 #299.
>70m$^3$) expanded upon an earlier Roman hypogeum, and could have been fed via runoff directed from the courtyard’s roofs and pavement. But no drains were visible in the atrium, and no intake channels were observed in the cistern’s interior. The northern side of the cistern has, however, partially collapsed – it may well be that the atrium cistern was fed underground by one of the channels that immediately west or NNW of St Theodore, as shown in the map above.

Two other smaller cisterns were also inspected in May 2012 – one immediately behind St Theodore’s baptistery (v=5.2m$^3$), and another inside the Clergy House immediately northwest of the North Chapel (v = 7m$^3$) – this was noted as a cave in the earliest publications, but the presence of a mortar lining confirms that it was used for water collection. Another cistern was observed on the foot of the St Theodore hill, at the back of the Umayyad House on the Western Decumanus; its volume was approximately 3.5 m$^3$.

1.8 The Genesios church

At the Genesios church, a sixth century foundation that was restored in 611, one large, two-phase cistern (as yet unpublished) was fed by rainwater collected as runoff from rooftops or the north hillside into which the church’s foundation is cut. On a line with the triple church (at which another cistern was noted by Crowfoot though it could not be located in May 2012) and the Theodore/Cathedral

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143 For cisterns outside that city that also reused pre-existing Roman rock-cut tombs, see for instance Sites 212 and 251 in the 2008 Report of the Jarash Hinterland Survey Project.
complex, the geology of the hillside here is the same porous marly limestone which comprises the Temple of Artemis platform. The cistern at the Genesios church is cut into this top layer of marly limestone. Located at the northwest corner of the church’s interior, its volume approaches 110 m$^3$. Its walls are covered with hydraulic mortar to within 30cm of the roof, on which sits the paving of the esonarthex. The cistern is accessible via two separate drawholes, both set into one-piece ashlar wellheads; one outside the church in the atrium, the other in a raised and finely decorated area of the narthex (Figs. 1.38-39).

**Cistern A/Draw-hole #1** – At the north-east corner of the atrium, and immediately to the north of the central west entrance to the Genesios church may be observed a 66x82x22cm rectangular limestone block, cut in its center with a 32 cm diameter draw-hole that gives access to a cistern beneath the atrium and church (Fig. 1.39-40). It must be noted that the west wall of the church is built over this well head, whose construction thus preceded the latest (seventh century) phase of the church – some stones of the church’s western wall run over the well and are bonded into the pier immediately to the north, constituting the northwest entrance of the church. From the interior of the well, it is clearly discernible that originally this was a rectangular shaft well, about 0.95m x 0.75m x ~4.2m deep, that was expanded into a cubical bell cistern 3.8m long and 1.6m wide. The draw-hole block is set on top of a 4cm tall, slightly wider base which rests on the paving of the atrium – therefore in this position it could not have been fed by pavement runoff. Diverted roof run off is one option, though
numerous concavities on the drawhole’s opening, (2cm in diameter) created by the repetitive action of sliding a bucket and rope down into the well in order to draw water, indicate that this was a well-used source rather than an intake point, and probably precludes its function as a collection point for gutter pipes.

In fact, there is no sign of an intake channel anywhere near the cistern, but several features might indicate that the cistern was filled by well-planned groundwater diversion. First, the Genesios Church’s location at the sloping foot of the hill that rises behind the Artemis Temple, composed of the soft Abu Silwan type conglomerate, means that it was easily carved and manipulated for such a purpose. The church’s foundation is cut into the hillside at north. By nature, the church’s wall effectively acted as a terrace wall, pooling water at its northern edge. A similar arrangement is conceivable for the supply of the bath installed in the north exedra of the church of SS Cosmas and Damian, to the immediate east of Genesios in the same rock formation. Crowfoot recorded there that “this exedra was originally approached through an arch at the west end. Its north side was cut out of the rock to a height of 2m. Above this the masonry wall is set back a little to give space for a gutter cut in the rock and now leading to a bath which was constructed at a later date in the northeast corner.”\textsuperscript{144} At the Genesios Church, it is also possible that the harder mortar lining of the rock-cut cistern interior acted as a lip, being less porous than the rock around it, and that the

\textsuperscript{144} Crowfoot in Kraeling 1938, 247.
cistern was at least partially filled with seepage and drip from precipitation. Even in late June 2012, the walls were somewhat damp.

**Cistern A/Draw-hole #2** – Sharing the same cistern as Well head #1, Well head #2 is set on a platform of bedrock in the narthex’s northern section, 0.35m above nave and aisle level. The draw hole is set in a one piece square wellhead approximately 1m x 0.6m that today rests out of context, just inside the church’s main east door. The bedrock platform is separated from the narthex by one step, from the north nave aisle by two steps. The north nave steps also give access to the bema of a chapel set at the church’s northwest corner, cut into the hillside bedrock like the church’s foundations.

The cistern’s access point was visually and spatially set apart with balustrades and revetment. Limestone and marble revetment covered the floor here as they did in the chancels of the church and chapel - the rest of the narthex was paved with stone tiles set on the diagonal, while the nave was covered in mosaic. A concavity may be observed at the platform’s northeast corner, probably from a colonette, while tracks suitable for panels are cut into the bedrock and run from the northeast concavity back towards the west entrance. This draw-hole’s privileged position, enclosed and sharing a platform with an entrance to the bema of a small chapel at the north, may be related to liturgical use; yet it is curious that what appears to be a “holy water source” shared its supply with the more publicly accessible draw-hole in the atrium.
Two further water features were also noted at the Genesios church.

**Cistern B/Draw-hole #3** - A third draw-hole belonging to the second cistern was observed within one of the auxiliary structures to the west of the Genesios church’s atrium. These have only been partially excavated, apparently by Jordanian teams, and are difficult of interpretation without publication. Preliminary measurement indicated that the well of this structure was much deeper than that of the narthex/atrium, and is at the very least ~5m in depth, though of unknown extent and character.

A very different water feature may be observed outside the extent of the church – an apsed niche composed of three large rectangular blocks of limestone masonry inset with a curved niche and matching semi-conch top, whose middle section was cut in its center to accommodate a water channel (Fig. 1.41). The fountain set is presently in the area to the south-east of the south chapel, clearly out of context, and likely the result of the more recent and unpublished Jordanian excavations. Because the known cisterns at the Genesios complex are well below ground-level, they could not be the source of water for this feature – pipes or an as yet undiscovered cistern, at a higher level behind the church’s north retaining wall, are other possibilities. Pipes for a possibly related feature in the
south chapel were drawn into plan and mentioned by Crowfoot and Fisher in the church’s original publication.¹⁴⁵

1.9 Conclusions: Water stress and infrastructural adaptation

Reconnaissance and review of the monuments and topography of Jarash by the present author has identified and documented significant changes to the city’s water system between the third and eighth centuries.

Of the churches in the city, the Propylaea church is the only definitive recipient of a diversion from the city’s closed supply running down the length of the Cardo. Indications that this church functioned as a treasury for collected Byzantine taxes may be no coincidence. The Temple of Artemis was linked, at least in its earliest phases, with a western aqueduct whose waters were destined first of all for the lakkos, the podium reservoirs, a fountain on the platform, and probably also the Severan nymphaeum on the cardo. Changes came with the obsolescence of the temple and its use as a quarry for church construction after the early fifth century. All around the St Theodore / Cathedral complex, a new system of Late Antique water channels, settling basins, dividicula fed open air reservoirs, and cisterns were installed during Late Antiquity; these benefited a fountain and cistern in the church atria, as well as a nearby water-powered stone mill and glass kilns, church-run baths, and middling residences with food preparation areas. It was suggested above that the north-south channel near the temple steps was

¹⁴⁵ Crowfoot in Kraeling 1938, 251.
connected with a northern aqueduct which supplied water from the El Shawahid spring some kilometers north of the city, as identified by the Jarash Hinterland Survey Project. The fact that some installations associated with this line near the temple were used with open channels and settling basins is, however, suggestive of later conversion for rain-water collection, perhaps independent from the original spring supply. These installations appear as independent, meso- and micro-scale contributors to the city’s older, larger municipal system of water supply, and correspond to broader shifts in the habitus of water in the Late Antique city.

As concerns the functionality of Jarash’s aqueducts during the Umayyad period, ceramic evidence gives a seventh or eighth century terminus ante quem for the maintenance of a fountain fed by the Cardo aqueduct. The systems that originally supplied the Temple of Artemis and later the St Theodore – Cathedral precinct may have gone out of use somewhat earlier, but archaeological evidence to date the conversion of these channels to rainwater use is lacking. Historically, this could have depended on two factors:

1) The availability of funds to clergy for maintenance of these systems. In the Late Roman period, the integration of episcopal systems into larger networks for urban supply and drainage was directed by bishops with or without the use of state/city funds. There is no explicit evidence for the situation at Gerasa – though this review certainly indicates a body of circumstantial evidence that water
management (and tax collection) at Jarash was organized by the church after the fifth century. Umayyad municipal priorities were probably less willing to support or maintain water systems that, by the seventh century, almost exclusively benefited church complexes.

2) A western aqueduct to the Temple of Artemis / St Theodore-Cathedral complex (maximum 602m ASL) could have relied on one of three spring sources: El Kelab at 770m ASL, Fawakhir at 690m ASL, or Shawahid at 656m ASL. At the spring closest to the Artemis Temple, El Kelab, pipes were found in survey just to the SE. If we hypothesize a completed circuit between the spring, these pipes, and the Artemis complex, we find that the line would descend 170m rapidly through high-relief terrain to the temple platform, with water under immense pressure at several points, not least the short-distance siphon that ascended the platform itself at the line’s terminus. High pressure in the lines would have required frequent replacement and repair, for burst pipes and potential sinter build-up, especially in elbows. By contrast, water from the Birketein spring feeding the Cardo system would have dropped less than 10m over 4km under open-channel or low-pressure conditions, meaning it required far less maintenance than the western systems. That the fountains along the Cardo were modified so as to take water from a higher level could reflect the addition of supplies from the Fawakhir or Shawahid springs, located further north along the Wadi Deir. These too, would have been relatively simple, gravity or lower-pressure if also longer-length systems maintained in the seventh or eighth
century. Thus the more complicated west system benefiting the Artemis complex and later the St. Theodore complex could have been given up without endangering the continuity of the fountains along the Cardo, by the Umayyad mosque at the southwest corner of the Tetrakionia.

Water scarcity had a definitive architectural response at Jarash. Urban fountains and bathing facilities were contracted, and cisterns and reservoirs proliferated in the obsolescent public buildings of the city, to expand water storage capacities. Existing Roman infrastructure (which was primarily concerned with drainage) was modified or augmented for the collection of rainwater and aqueduct water-storage. Aqueduct supplies were narrowed, with selective maintenance of simple, proximal supply lines to the exclusion of longer lines relying on complicated siphon systems. Ceramics give a terminus ante quem for seventh or eighth century functionality of the Cardo aqueduct, gravity-fed from the 4km distant Birketein spring. Aqueducts feeding the Temple of Artemis complex and eventually the St Theodore complex and environs, may have gone out of use somewhat earlier before their distribution lines were converted for use with rainwater.

The initial demand for church construction coincided with the fifth and sixth century precipitation troughs indicated by various scientific climate proxies introduced at the beginning of this chapter. It is striking that expansion of demand
may have thus coincided with a diminution of supply.\textsuperscript{146} The virtuoso hydraulic installations around the St Theodore – Cathedral complex speak to the sophistication and prowess with which bishops were able to insert their constructions into the civic fabric, simultaneously adapting to and re-fashioning existing Roman infrastructure for their own needs.

I would argue that the urban and episcopal adaptations at Jarash are best compared with monastic water systems (as found after the fourth century for instance in the Judean Desert), and ultimately in the considerably more ancient rural Nabatean water systems, such as those found around Humeima or in the Negev, or Judaic monastic-type settlements as known so famously at Qumran.\textsuperscript{147} Their appearance at Jarash after the fifth century – with good parallels at Bosra or Abila, and poorer preservation of comparable indices from Gadara, Caesarea Maritima, or Jerusalem – marks the beginning of the importation of such systems into cities across the empire more broadly.\textsuperscript{148} When compared to the display-oriented Roman aqueduct-bath-fountain system, the economizing and industrializing qualities of the Late Antique water systems around the churches of Jarash stand out. Whereas imperial Romans were concerned primarily with display and drainage, Late Antique denizens of the city became concerned with

\textsuperscript{146} This situation compares with the Negev, as discussed by Decker 2009, 174-203.  
\textsuperscript{147} See Hirschfeld 2002 for hydraulics at Qumran.  
\textsuperscript{148} For such systems in monastic contexts, see especially Hirschfeld 1992, 148-161; for Humeima with a survey of related Nabatean water installations see Oleson 2010, 417-492; for the water infrastructure histories of the emboldened cities mentioned, see their entries below, in Appendix F.
utility and storage, building water-powered industrial installations and large-scale public cisterns well before the city’s aqueducts failed.

On the one hand, it has been suggested that certain of the water system changes at Jarash should be chalked up to water stress and their architectural response (particularly the diversification of water sources in new contexts, the shrinkage of fountain basin volumes to conserve water in system flow-through, and the introduction of alternative or secondary water supplies to fountains at lower levels, indicating problems with pressure). On the other hand, it is undeniable that the framework of these changes – a shift in priorities from display and drainage to economizing utility and storage – may also be observed in cities of Anatolia and Greece like Hierapolis and Xanthos, or Thessaloniki,149 where scientific evidence (such as it is at present) suggests very different trajectories of climate change during Late Antiquity. Where the Levant appears to have become drier in the later fifth and sixth centuries, Anatolia and Greece in fact became wetter around the same time.150 The homologous nature of water infrastructure change in areas with different climate trajectories is a strong argument that climate’s value as a variable for explaining the nature of water system change in Late Antiquity is limited. In all the chapters that follow, it is argued that we should instead locate the causes of Late Antique water system evolution not in climate change, but in a reconfiguration of social, cultural, and administrative priorities,

149 Again, see the detailed surveys of water systems in these cities, in extenso, in Appendix F.
150 Haldon et alii 2014, 123.
instead. This hypothesis is borne out by a wide range of evidence, literary and archaeological, examined here together for the first time.
CHAPTER 2
THE DE AEDIFICIIS OF PROCOPIUS: A WATERSHED SOURCE FOR THE HISTORY OF WATER MANAGEMENT IN LATE ANTIQUITY

In the first chapter we examined the popular proposition that climate change was a driving cause of water systems during Late Antiquity, before concluding that – because homologous hydraulic adaptations are visible in cities with very different climate history trajectories and profiles – socio-cultural changes were in fact more important. This chapter introduces a remarkably understudied text, the De Aedificiis or Buildings of Procopius, as a platform from which we can observe larger changes in late Roman society's attitudes to water, and as a prelude to a more thorough-going examination of aqueducts, baths, cisterns and wells in the chapters and appendices that follow.

2.1 Introduction

Scholars have long been preoccupied with the reliability of the Buildings, comparing its passages with the archaeology or epigraphy of single sites, rather than examining the work and its goals as a cohesive text.151 Yet the character of

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151 All quotes and (parenthetical) citations of Procopius come from the Loeb editions; see the list of abbreviations with the bibliography, infra. Citations use the enumeration of sections found in the Dewing translations, which corresponds to those used in J. Haury’s edition, Procopii Caesariensis Opera Omnia, rev. G. Wirth, 4 vols. (Leipzig, 1963–4). I should note at the forefront that my argument has little to do with lingering questions of the date of Procopius’s composition, much of which revolves around the statement that he wrote the Buildings during the construction of the Sangarius Bridge, dated by Theophanes to 559/560 CE; for a review of the arguments and a conclusion in favor of the traditional c. 554 date, see Greatrex 2013. There is also the question of the short and long recensions of Procopius; Montinaro 2011 argues that the 1531 Rhenanus edition of the Buildings is an earlier draft rather than a later redaction, with some important differences of detail and structure between the texts. I look forward to his publication of a collation from the manuscript. My work here is concerned principally with the long recension.
the *Buildings* provides an important window onto the material culture of Late
Antique cities because Procopius was concerned precisely with the emperor’s
relationship to nature and the built environment, mediated by architecture. Even
after antiquity, this relationship sustained uniquely Roman identities with
particular forms of monumental construction and interventions on the
landscape.\(^{152}\) Water was a crucial component in the constellation of behaviors
and monuments enabled by empire: the striding arches of Roman aqueducts
advertised the security and abundance of water inside the empire’s cities, where
travelers and citizens benefited from baths and fountains, all supplied by free,
state-provided water.\(^ {153}\) Aqueducts and baths were critical genres of building in
the architectural ‘tool-kit’ for laudatory representations of Roman urbanism.
Procopius drew from a rich reservoir of precedents that described these
structures, amalgamating influences from diverse sources like imperial
biographies,\(^ {154}\) descriptions of cities that harkened back to Homer and Plato\(^ {155}\)

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\(^{152}\) For Roman attitudes to monumental architecture, see fundamentally Delaine 2002.

\(^{153}\) Aqueducts and baths were especially important to Gibbon’s recollection of the empire, insofar
as they were “conducive to the health, the devotion, and the pleasures of the meanest citizen,”
see Gibbon 1776, sec. 1.2.2; see also Kaika 2005, 100-5 on the cultural paradigm-shift enabled
by the Roman imperial introduction of spring–water into cities, with continuing ramifications for the
habitus of modern cities, such as inspired Athens to attempt a (failed) reconstruction of Hadrian’s
aqueduct between 1833 and 1889.

\(^{154}\) *Res Gestae Divi Augusti* 20, trans. Shipley, 377: “I restored the channels of the aqueducts
which in several places were falling into disrepair through age, and doubled the capacity of the
aqueduct called the Marcia by turning a new spring into its channel”; Suetonius, *Divus Claudius*
20.1, trans. Rolfe, 39: “He brought to the city on stone arches the cool and abundant founts of the
Claudian aqueduct, one of which is called Caeruleus and the other Curtius and Albudignus, and
at the same time the spring of the new Anio, distributing them into many beautifully ornamented
pools.” Also in the Scriptores Historiae Augustae, *Hadrian* 20.5–6, trans. Magie, 63: “[Hadrian]
gave his name to aqueducts without number.” Water infrastructure of any kind is notably absent
in the *Vita Constantini*, though it appears in panegyric and imperial biography for the later
emperors, discussed below.
but were updated by imperial antiquarians,\textsuperscript{156} geographers like Strabo\textsuperscript{157} and Pausanias,\textsuperscript{158} rhetoricians like Menander,\textsuperscript{159} architectural ekphraseis,\textsuperscript{160} technical and tactical manuals,\textsuperscript{161} as well as epideictic speeches as crafted by Libanius\textsuperscript{162} or Himerius.\textsuperscript{163} The influence of Classical and Roman rhetorical models on the Buildings has become plain in studies from the last decade, but the especial value of water’s representation within the Buildings – as a platform or vehicle

\textsuperscript{155} On Homer (\textit{Odyssey} 6, 262–268 for the harbor in the city of the Phaeacians) and Plato (\textit{Critias}, 110–112 on the advantages of the Acropolis, including its spring) see Ma. Whitby 2008, 50.

\textsuperscript{156} Dionysius of Halicarnassus, \textit{Roman Antiquities} 3.67.5, trans. Carey, 241 “Indeed, in my opinion the three most magnificent works of Rome, in which the greatness of her empire is best seen, are the aqueducts, the paved roads and the construction of the sewers.” Note also Pliny’s declaration, following an account of the early emperor’s involvement with aqueduct construction, that “If we take into careful consideration the abundant supplies of water in public buildings, baths, pools, open channels, private houses, gardens and country estates near the city; if we consider the distances traversed by the water before it arrives, the raising of arches, the tunneling of mountains, the building of level routes across deep valleys, we shall readily admit that there has never been anything more remarkable in the whole world.” See Pliny, \textit{Natural History} 36.121–3, trans. Eicholz, 96–99.

\textsuperscript{157} Strabo, \textit{Geography} 5.3.5, trans. Jones, 405 “So much then for the blessing with which nature supplies the city; but the Romans have added still others which are the result of their foresight … Water is brought into the city through the aqueducts in such quantities that veritable rivers flow through the city and the sewers …”

\textsuperscript{158} Birge 1994, 240 notes more than eighty shrines or temples identified by Pausanias in association with springs, fountains, or other water sources nearby. Elsner locates the model for Procopius’s brand of periegesis in Pausanias, which “unites sights … with narratives about them.” See Elsner 2007, here at 42.

\textsuperscript{159} Menander Rhetor, \textit{Treatise II} 386.22–30, trans. Russell and Wilson, 107, in which Menander recommends, in a speech of epibaterion or arrival, that “you must describe the actual form of the city, and talk of its colonnades, temples, harbours, prosperity, wealth, imports by sea, race-courses (if any), festivals, luxurious baths [λουτρῶν ἀπολαύσεις], aqueducts [ὑδάτων ἐπιρροάς], groves in the city itself, the surroundings…”

\textsuperscript{160} See the study of Hippias’s ekphrasis of a bath, by Yegül 1979; the description of problems arising in the course of construction was a commonplace in such architectural ekphraseis, picked up by Procopius, see the note by Mi. Whitby 2008, 60.

\textsuperscript{161} The \textit{De Re Militari} of Vegetius was produced in late fourth or early fifth century Rome, and heavily glossed the \textit{Strategemata} of Frontinus.

\textsuperscript{162} \textit{Antiochixos} / Oration XI.245, trans. Downey, 678, “We surpass the beautiful waters of other cities by the abundance of ours … Each of the public baths pours forth a stream as large as a river.”

\textsuperscript{163} Himerius, Oration 41.5–6, trans. Panella, 61: “Who could find great or beautiful enough words with which to hymn your great size or beauty? This city [Constantinople] begins to be bathed by the waters that are almost halfway across the straits … Its senate house shines forth, its baths are enchanting, its theaters also win people’s favor.”
from which to observe broader changes in Late Antique culture and cities, in a subtle but marked break from these aforementioned classical or imperial Roman precedents – remains undervalued.\textsuperscript{164}

Cameron identified water as one of three themes in Procopius’s \textit{Buildings} ("church building…, fortification and the water supply"), but concluded that in general, “it is less clear whether Procopius had made a conscious decision to concentrate on these topics, or how in practice he meant to arrange his material … but the material [in the \textit{Buildings}] often seems to be strung together in an arbitrary kind of way.”\textsuperscript{165} Cameron omitted any further discussion of water in her chapter devoted to the \textit{Buildings}, which she read as indicative of the author’s “acceptance of the basic assumptions of the Justinianic regime.”\textsuperscript{166} Kaldellis, whose book is the most recent commentary on the literary production of Procopius, similarly refrains from any more than passing mention of water’s role in the \textit{Buildings}. His reading concluded that the \textit{Buildings} was – following on Rousseau’s earlier argument\textsuperscript{167} – “an insincere and possibly coerced work of flattery, full of subversive allusions and grievous factual distortions.”\textsuperscript{168}

\begin{footnotes}\textsuperscript{164} This lack may have been amended by Meier (forthcoming), or the conference “Reinventing Procopius: New Readings on Late Antique Historiography” held at Oxford University, 17–18 January 2014 (proceedings forthcoming?), though neither was available for my consultation at the time of writing.\textsuperscript{165} Cameron 1985, 86.\textsuperscript{166} Ibid., 11.\textsuperscript{167} Rousseau 1998.\textsuperscript{168} Kaldellis 2004, quote from 55.\end{footnotes}
Articles in the 2000 issue of *Antiquité Tardive* dedicated to the *Buildings* were on the whole more positivistic in orientation, their authors including water infrastructure throughout in truth-tests for particular regions or sites, which compared Procopius’s text with archaeological evidence in order to prove or disprove the veracity of his account. Palmer made moves in the direction of a more perceptual, eco-critical history of flooding at Edessa, but nevertheless also

169 The *Buildings* would fascinate even if it were a complete lie, but nevertheless it is important to note that scholars have been widely split on the factual accuracy of the *Buildings*. Rouéché – Carrié – Duval 2008 included a number of articles dedicated to this problem, where authors compared Procopius’s statements book–by–book with epigraphic or archaeological evidence. Klaus Belke, in an analysis of Book V concerning Asia Minor, writes that “much of Procopius’s information is verifiable from other literary sources and/or archaeological investigations,” before concluding that “even where there is no independent confirmation…Justinian is very likely to have been responsible” see Belke 2008, with both quotes here in the abstract, at 115. Denis Feissel demonstrated that Procopius finds wide if occasionally spotty agreement with epigraphic sources, but also that inscriptions for a number of buildings known to have profited from Justinian’s patronage are absent in the *Buildings*; see Feissel 2008. Elsewhere, “assess[ing] Procopius’ reliability,” Florin Curta wrote of the *Buildings’* treatment of the Balkans that, “Procopius’ description may thus be viewed, in its essence, as sound. The archaeological evidence substantiates this conclusion;” see Curta 2007, quoting here from 155, and see 151f for Curta’s discussion of fortifications, which can be tendentious, playing fast and loose with the evidence, but other archaeological discoveries in the region do match up quite well with Procopius. The fortifications at the Hexamilion on the Corinthian Isthmus were proved by Gregory’s excavations to be Justinianic in date (see Gregory 1993), while excavations at Caričin Grad have revealed that Justinian monumentalized the city of his birth in a fashion befitting its status, even if it was only occupied subsequently for a short period of time, and was perhaps never finished; see Bavant 2007.

More negative assessments of the *Buildings’* reliability predominate. A quick walk through Viranşehir in Cappadocia, identified by Berger as Mokisos, can inspire a fundamental mistrust of the *Buildings* (see Berger 1998). Procopius tells us, “[after describing fortifications]…There too [Justinian] built many churches and hospices and public baths and all the other structures that are the mark of a prosperous city. Consequently it rose even to the rank of a metropolis, for thus the Romans call the leading city of a province” (5.4.15–18). Excepting a few scattered churches, the settlement at Viranşehir could be forgivably mistaken as Bronze Age. No hint of baths or an aqueduct, or even city walls apart from a small fortified enclosure, can be recognized at the site in the form suggested by Procopius. There are certainly none of the institutions or “marks of a prosperous city” by the classical Roman conception, which would necessarily include aqueducts and baths. Elsewhere, Croke and Crow found “selective omission and misrepresentation … throughout Book 2,” and warned that the *Buildings* should “only…be used with the utmost caution as a potential repository of factual information…” see Croke and Crow 1983, here at 144 and 159. Cameron, too, acknowledged serious problems in the *Buildings*, citing Crow and Croke’s study of Dara to show that Procopius “reveal[ed] his] deficiencies as a reporter even for places he knew well through his own experience;” see Cameron 1985, 86. And throughout the *Buildings*, Roques noted “déséquilibres, bizarrières ou oubli…[et] absences;” see Roques 1998, 995.
concluded with a judgment on Procopius’s “seriously undermine[d]…credibility.”  

Whitby’s contribution to the 2000 Antiquité Tardive volume was more holistic in approach, concerned less with the text’s credibility or sincerity than with its integrity. Specifically, Whitby concerned herself with the way that Procopius shaped his text in light of older literary models, and assembled a wide-ranging corpus of texts. Thusly armed, Whitby convincingly demonstrated how Procopius updated Classical and Roman *topoi* or rhetorical formulae for architecture in the *Buildings*’ Book I, the better to express the tranquility and security of Christian Constantinople. Imperial power embraced the capital and, secure in the emperor’s piety and closeness to God, defied nature with architecture that changed earth into water, water into earth, and even brought the heavens under a dome, at Hagia Sophia. Similarly, in a 2007 article, Elsner drew attention to the way in which Procopius deftly interwove numerous genres throughout the *Buildings* – drawing local histories into imperial geography, or extending the generic appearance of buildings in imperial biography or Menander’s praise of cities into disarmingly elaborate ekphraseis – to “create a brilliant new kind of panegyric,” a “bravado text that transpose[d] real monuments into textual discourse.” As a whole, Elsner argued that this discourse served to articulate a “three-pronged imperial ideology: the maintenance of defenses, the upholding of

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172 This modified chiasmus is lifted from Delaine 2002, 211.
173 Elsner 2007, here at 50.
an ancient civic and civilized way of life founded upon cities…; and the cultivation of the Christian god.”

The problematic of water can add several more pieces to this puzzle: closer inspection of water’s representation in the Buildings reveals that Procopius was as much an innovator as his imperial subject, an author who combined literary topoi and tropes in a creative fashion to express – as best he could within the limits of his genre and classical education – how the hydraulic worlds he knew had subtly but markedly diverged from their imperial Roman predecessors.

My aim here is to treat the text as an artifact, deliberately shaped by its author, where water appears in a starring but strikingly incongruous role. Let us not “falling into the positivist trap” of comparing the Buildings with archaeological evidence to assess its reliability – that is a first rather than a last step. Nor – like Cameron, Rousseau, and Kaldellis – must we always judge the potential subversion (in/sincerity) of the Buildings, either vis-à-vis its discrepancies with the Secret History and Wars or its deployment of classical allusions. The value of the Buildings lies not in the reliability of individual sections, but in its character

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174 ibid. 46.
175 ibid. 57.
176 Cameron asserted that Procopius “accepted the basic premise that Christian emperors ruled by the grace of God,” but Kaldellis reads the Buildings as wholly subversive, arguing that "Procopius understood the ideological dimension of Justinian’s tyranny, [but he did not accept it].” See Kaldellis 2004, 51. For Kaldellis, flattering elements and classical allusions in the Buildings, like comparisons of the emperor Justinian to tyrants Cyrus or Themistocles, “reflect Procopius’s hostility to the regime;” see ibid. 53. Rousseau similarly explored the possibility that “the Buildings can be read as a judgment on Justinian almost as scathing in its implications as [the Secret History],” see Rousseau 1998, 121.
and goals as part of a larger work that witnessed and reflected Late Antique urban change, and which included in a very fundamental way shifting Roman perceptions of proper state-level investments in water infrastructure.

What can explain the ubiquity of water in the *Buildings*? Howard-Johnston went so far as to speculate that Procopius himself was a hydraulic engineer by training, “very much … concerned with structural stability and with the protection of all manner of man-made structures against damage by water.” But the wide range of water infrastructure’s representation in the *Buildings* arguably has less to do with Procopius’s professional training, or even the inheritance of rhetorical precedents from classical and Roman antiquity, and rather more to do with the state of the Roman world and the challenges it faced during the sixth century, at the time of Procopius’s composition.

Procopius alludes to these challenges, but only very carefully, and nearly always in the context of conservative images for Roman cities, cleverly and creatively deployed, that he derived from the traditional architectural ‘tool-kit’ for Roman urbanism. This ‘tool-kit’ included walls, aqueducts, baths, and fountains, but never cisterns or reservoirs, which appear as the objects of an emperor’s peacetime patronage for the first time in Procopius. Procopius communicates unusual details about baths and aqueducts – which were represented so generically in earlier Roman literature – and this should give us pause. When compared with

Roman literary precedents, the wide-ranging episodes related to water management in the Buildings paint a surprisingly variegated picture of both conservative and innovative approaches to Late Antique water management, which extends throughout the whole of the work (see Appendix D).

We see that problems with water-shortage or -superabundance in the Buildings provide structure and create contrasts or amplification within and between the city set-pieces of Procopius’s periegesis. From this perspective: omissions, distortions and fabrications stand out – especially when we think Procopius might have known better – because they represent very deliberate interventions of the author upon the text and his subject.

Cameron wrote that “the cities themselves were already changing from the classical to the medieval form…[but] of this complex and subtle development there is little sign in the Buildings, with its bland assumption of Late Roman continuity.”\textsuperscript{178} Quite to the contrary, Procopius does not just mimic inherited literary topoi that praise a city for its water resources, aqueducts, fountains, and baths. Rather, Procopius emerges as an innovator who mixes genre characteristics and expectations, who manages to describe changing ideologies and practices of water management with conservative language and concepts, and who expands the range of water management projects with which emperors

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\textsuperscript{178} Cameron 1985, 111; for an overview of urban change in the sixth century as it relates to aqueducts and baths, see also Saradi 2006, 325–352.
\end{flushright}
were traditionally associated. The *Buildings* positively creaks with Procopius’s effort.\(^{179}\)

The strain becomes immediately apparent if we compare section 26 of the *Secret History*, concerned with the disrepair of Constantinople’s aqueducts, against the general tenor of the *Buildings*, including the lengthy description of the capital in Book I. In the *Secret History*, Procopius reports that:

“One of the municipal aqueducts, which furnished not a small share of the city water, collapsed; but the rulers [Justinian and Theodora] disregarded the matter and refused to repair it, though the constant crowds who had to use the wells were fairly stifling, and all the baths were shut down. On the other hand, he threw away great sums of money senselessly on buildings by the seashore and elsewhere, in all the suburbs, as if the palaces in which all the former emperors had been content to dwell were not enough for this pair. So it was not to save money, but to destroy his subjects, that he refused to rebuild the aqueduct; for no one in all history had ever been born among men more eager than Justinian to get hold of money, and then to throw it immediately away again. Through the two things left to them to drink and eat, water and bread, this Emperor injured those who were in the last extremes of poverty; making the one hard to procure at all, and the other too expensive to buy.”\(^{180}\)

Justinian’s mismanagement of water at Constantinople in the *Secret History* contrasts sharply with the ruler’s qualities in the *Buildings*, where Justinian is a fast-responder, judicious, inspired, and more clever than his engineers; an economizer of water resources with indiscriminant taste for water from wells or cisterns. In the *Secret History*, on the other hand, the emperor misused state

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\(^{179}\) Procopius confronts his inadequacy when he famously claims to have only “a lisping and thin voiced tongue” that is incapable of doing justice to his topic, in his first *proemium*, see *Buildings* 1.1.3.

\(^{180}\) *Secret History* 26.
funds to build lavish sea-side mansions for himself, while a collapsed aqueduct was left un repaired, leaving thirsty citizens to crowd around wells. Crow has argued that the aqueduct in question was the long-distance Thracian line, damaged by earthquake; the Hadrianic channel that supplied the Great Palace was apparently unaffected and continued to function.¹⁸¹ That the city was so affected by the dysfunction of the Thracian aqueduct in Justinian’s reign suggests an overreliance on aqueduct supplies, and an insufficient number of backup sources even after two centuries of reservoir and cistern construction, which – in the event of siege – could in fact become a danger to the capital’s security. Procopius’s inclusion of the episode ascribes to the emperor a lack of care (σπουδῇ) and foresight (ἐπιμελίᾳ), both qualities important throughout the

Buildings and in inscriptions from Justinian’s reign.¹⁸²

Here, the Secret History also betrays Procopius’s classical prejudices for a preferential urban water supply focused on aqueduct-carried spring water. Throughout Roman literature, the report of reluctant or forced consumption from wells and cisterns was an important motivating factor that led to the imperial decisions to build aqueducts.¹⁸³ As recently as the reign of Justinian’s near-

¹⁸¹ On this passage and its relevance for the history of Constantinople’s water system during the sixth century, see Crow, Bardill, and Bayliss 2008, 17–19. ¹⁸² See for instance the inscription claiming construction of an aqueduct σπουδῇ καὶ ἐπιμελίᾳ of a bishop with funding from Justinian in Trabzon, below in Appendix F, s.v. Pontus, Trebizond. ³⁴ Compare the report of Philostratus that Herodes Atticus successfully intervened with the Emperor Hadrian for funds to underwrite the aqueduct at Troy, after observing that it was “ill– supplied with baths, and that the inhabitants drew muddy water from their wells, and had to dig cisterns to catch rain water.” See Philostratus, Lives of the Philosophers and Sophists: Herodes Atticus 548, trans. Wright, 142–3. Such clear preferences for spring water are also noted by Pausanias, when that author describes how the inhabitants of rocky Phocaean Stiris descended
predecessor Anastasius (r. 491 – 518), the emperor had been so pained to hear of his citizens drinking well and cistern water at Hierapolis, that he was convinced to undertake construction of an aqueduct there.\textsuperscript{184}

2.2 Water for the Queen of cities: Hydraulic infrastructure in Constantinople, Book 1

Water is almost absent in the first book of the \textit{Buildings}, which is focused on Constantinople and overwhelmingly concerned with church construction. Five incongruous points deserve brief and especial notice however:

1) Constantinople’s aqueducts are not the object of Procopius’s praise, though these were standard elements in the praise of cities.\textsuperscript{185} Rather, the city’s aqueducts are mentioned only insofar as their output (derived from springs in a variable-karst zone) was susceptible to seasonal droughts that created frequent water shortage challenges (1.11.10-11). Nevertheless, Procopius describes the city as surrounded by water (1.5.2).

\begin{flushleft}
\textsuperscript{184} Procopius of Gaza, Chauvot trans., 18–19 for the Greek and 43–44 for the French translation. Which Hierapolis – Cilician, Phrygian, or Palestinian – is unclear, see Jones 2007, 455-467. \\
\textsuperscript{185} For the Roman literary models see above, n. 152-63.
\end{flushleft}
2) Baths, another standard element in the praise of cities, garner little attention in
Procopius’s account of the capital. The Zeuxippus baths and colonnades are
mentioned briefly only in the context of their restoration after the Nika revolt of
532 (1.10.3). More important is the Arcadianae baths at the Propontis harbor,
which Justinian embellished with a column-monument surmounted by a statue of
Theodora, in the bath’s forecourt (1.11.1-9).

3) Justinian offered his patronage to two major church shrines at springs around
the city, at Blachernae and Zoodochos Pege (1.3.1-10). Justinian’s restoration or
elaboration of the Zoodochos Pege church – originally founded by Leo I, but
before he became emperor – was also described in the tenth-century
*Anonymous Miracles of the Pege.* Justinian’s patronage of a church at a
spring-site is, to my knowledge, without Late Roman precedent.

4) The account of the Basilica Cistern’s construction (1.11.12-15) is completely
anomalous in the history of Roman praise for imperially sponsored architecture,
for two reasons. First, and by simple virtue of its inclusion in Book I of the
*Buildings*, Procopius elevates cisterns and water storage to the level of churches
and baths or walls, or other works traditionally befitting an emperor’s patronage,
that created the acknowledged image of an ideal Roman city. Water storage

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187 A ground-water comparison might be sought in Constantine’s foundation of a church at the
Holy Well of Mamre; see the *Life of Constantine*, Cameron and Hall trans., 301.
structures, in the centuries preceding Justinian, had previously been the reserve of elite and episcopal building activities. Second, Procopius identifies the economization rather than abundance of supply as the goal of a major imperial water infrastructure project. We discuss the importance of the genre of cisterns and reservoirs to the Buildings in fine detail, below.

Despite these major hints, absences, and incongruities, it is only at the beginning of Book II that Procopius introduces an unexpected allusion that helps to identify how the theme of water might function in the work that follows.

2.3 Frontinus intrudes on Procopius’s proemium for the Buildings Book 2

Procopius begins the second book of the De Aedificiis with a pivot from Constantinople to the provinces, ostensibly setting out his subject by stating that:

“For it is not the pyramids which we are about the describe, those celebrated monuments of the rulers of Egypt, on which labour was expended for a useless show, but rather all the fortifications, whereby this Emperor preserved the Empire, walling it about and frustrating the attacks of the barbarians on the Romans.”

Fortifications are, indeed, a central theme of Procopius’s work in Books II-VI. But here Procopius also re-directs his Latinate readers to another subject, water infrastructure, with a clever allusion and an implied absence: a cameo from

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188 See the section dedicated to cisterns infra, sec. 2.9.
189 Buildings 2.1.3 = οὐ γὰρ τὰς πυραμίδας ἀφηγησόμεθα, τοῦτο δὲ τῶν ἐν Αἰγύπτῳ βεβασιλευκότων τὸ διαθρυλλούμενον ἐπιτήδευμα, ἐς χάριν ἀποκεκριμένον ἀνόνητον, ἀλλὰ τὰ ὀχυρώματα σύμπαντα , οίς ὁ βασιλεὺς οὗτος τὴν βασιλείαν ἐσώσατο, τειχισάμενός τε αὐτὴν καὶ ἀμήχανον τοῖς βαρβάροις καταστησάμενος τὴν ἐς Ῥωμαίους ἐπιβουλήν; this passage is identical in the short recension of Rhenanus.
section 16 of Frontinus’s *De Aquaeductu*. There, Frontinus described the techno-marvel of Roman aqueduct systems in the age of Trajan:

“With such an array of indispensable structures carrying so many waters, compare, if you will, the idle Pyramids or the useless, though famous, works of the Greeks!”

Procopius’s rephrasing of Frontinus is both obvious and deeply incongruous. Procopius gives the reader an unexpected twist on his source, maintaining Frontinus’s reference to the pyramids as useless, but also conspicuously modifying it, by inserting fortifications into the place of aqueducts. Aqueducts are thus a missing premise in this statement. Despite changing the subject of his allusion, Procopius nevertheless preserves Frontinus’s focus on utility as the criterion by which imperial construction programs are to be judged by history, characterizing the pyramids as celebrated but useless. This is a further inversion of Frontinus – switching the qualifiers for pyramids and *opera Graecorum* used in *De Aquaeductu* – because it would hardly be appropriate to call the *opera*...
Graecorum ‘useless [but] famous’ in a work dedicated to praising the buildings of an emperor in a work of Greek-language panegyric.

Such an allusion is not isolated, but rather is the product of a literary technique found consistently throughout Procopius’s oeuvre, a technique which has been studied at length by Cameron, Rousseau, Kaldellis, and Elsner. Kaldellis highlighted how Procopius “manipulates his readers’ reactions and expectations” with “literary allusions [that] make classical sources complicit in his strategies of meaning, creating relationship between works.”

Generally speaking, the creative use of allusions is a feature of classical literature and art during Late Antiquity as a whole. Kaldellis explains how Procopius makes use of allusions as “an artful strategy of indirect reference that relates contemporary individuals and events to classical paradigms ... Verbal imitations may serve a deeper purpose after all: they alert careful readers to specific passages in classical texts that contain missing premises, suggest unflattering parallels, or supply an entire framework of analysis for the events described. Contrived interplay between narrative and classical models can provide anything from a benign or heuristic comparison to an allusion that actually subverts the claims made on the surface.”

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193 See Roberts 1989.
194 Kaldellis 2004, 34.
In the allusion to Frontinus, Procopius thus explicitly announces his focus as the emperor’s program of defensive building, while implicitly drawing attention to the absence of water infrastructure as works that ‘preserved the Empire’, on the model of Frontinus. Despite the absence of water infrastructure where one might most expect it – in an allusion to Frontinus – aqueducts and water management generally occupy a substantial portion of Book II, and the rest of the work as a whole. Episodes of water scarcity and superabundance or flood help structure the entire text of the Buildings, internally ordering individual set-pieces, or arranging them as groups to create contrast and amplification between set-pieces (see Appendix D). Along with churches and fortifications, the proper management of water was still a bulwark of empire in the sixth century. Procopius subtly acknowledges that the terms of this relationship between nature and imperium were changing, even if he cloaks novelty in conservative language and concepts; a more thorough-going assessment of water at Dara will help make this point, before we consider how Procopius shaped and represented genres of water infrastructure throughout his text.

2.4 Flows into Dara

To understand how Procopius used water as a structuring element in the Buildings, let’s begin with Dara. Dara is the longest set-piece in the entire work after Constantinople, beginning immediately after the allusion to Frontinus in Book II’s introduction. Procopius may have chosen Dara to introduce his survey of the provinces in Books II-VI because of his personal experience there as
Belisarius’s secretary during the Persian campaigns. However, the range of distortions and inaccuracies might also suggest that Procopius chose to begin with Dara because it allowed him to introduce and shape water, in breadth and depth, as a theme that would pervade the rest of his work. The structure of Procopius’s Dara set-piece (2.1-3) can be expressed as follows:

Table 2.1: A Narrative Map to Water in the Dara Set-piece of Procopius’s *Buildings*

<table>
<thead>
<tr>
<th>SECTION #</th>
<th>PASSAGE IN B</th>
<th>PROBLEM</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.1.1-3</td>
<td>Proemium</td>
<td>Allusion to Frontinus 16</td>
</tr>
<tr>
<td>2</td>
<td>2.1.4-27</td>
<td>Fortifications</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2.2.1</td>
<td>Shortage (-)</td>
<td>First mention in <em>Buildings</em> of church with cistern for urban water storage</td>
</tr>
<tr>
<td>4</td>
<td>2.2.2-9</td>
<td>Superabundance (+/-)</td>
<td>Description of Cordes river management, sluice gates for river in north and south circuit walls; river water fills reservoirs and conducted within city, but flow-through to plain makes for easy siege</td>
</tr>
<tr>
<td>5</td>
<td>2.2.10-12</td>
<td>Shortage (-)</td>
<td>Beginning of tale resembling spring-discovery in monastic tales and e.g. <em>Vitae Sabae</em>, diverted to discovery of chasm à la the tale of Michael the Archangel</td>
</tr>
<tr>
<td>6</td>
<td>2.2.13-16</td>
<td>Super abundance (-)</td>
<td>The flood at Dara, “circulated through the market-place and the streets and even through the houses”</td>
</tr>
<tr>
<td>7</td>
<td>2.2.17-18</td>
<td>Superabundance (+)</td>
<td>River has controlled flow through city, “fills reservoirs to overflowing then borne out of city by the exits”</td>
</tr>
<tr>
<td>8</td>
<td>2.2.19-21</td>
<td>Shortage (+)</td>
<td>Strategic diversion of torrent into</td>
</tr>
</tbody>
</table>

195 For the author’s biography, still fundamental is Rubin 1957 in *Paulys Real-Encyclopädie.*
chasm, rather than out onto plain on other side of city, where thirsty besieging Persian armies can drink it.

| 9 | 2.3.1-23 | Superabundance (-) | Chryses of Alexandria and Justinian both dream of plans for construction of arched dam and sluice gates to regulate water flow; commission sent out to Isidore and Anthemius |
| 10 | 2.3.24-5 | Shortage (-) | Problems with water quality or availability directly from river, widespread shortage leads to construction of “great conduit by which Justinian led water to every part of the city…and also constructed two shrines, Great Church and Church of Bartholomew” |

The structure of story elements in the set-piece as a whole is striking. After dealing with fortifications, each story element describes some episode of water shortage or superabundance in positive or negative terms. Water shortage in drought causes serious social disorder, but when a besieging army unexpectedly finds itself without water outside the city walls, water scarcity can also be positive. Floods are a clear danger to the health of the empire when they wipe out cities and kill Romans or their animals. But when carefully controlled for purposes like irrigation, or unleashed strategically, water super-abundance or flood can also take on very positive connotations.

True to his introduction’s stated intention to focus on Justinian’s fortifications, Procopius begins (2.1.4-27) his account of Dara with a lengthy description of the
city’s circuits. Procopius relates how Anastasius elevated a village named Dara to the status of a city, for reason of its strategic position on the Persian-Roman border. In anticipation of siege, Anastasius “carried out the construction of the circuit-wall in great haste, not having made it fit to withstand the enemy” by neglecting to raise them to full height, with dressed and fitting stones, or even mortar, according to Procopius (2.1.8-9). Justinian’s upgrades to these circuits are therefore described as the more important construction activity in the site’s history. But Crow and Croke found no evidence for significant alterations or restorations in the circuits, and concluded that Procopius’s account here is “a calculated misrepresentation,” which uses the Battle of Dara in 530 CE as a pretense for Justinian to claim credit for the work of his predecessors.\(^{196}\) Procopius’s account of this battle in his other work, the \textit{Wars} “has no hint of inadequacy of [pre-existing] fortifications.”\(^{197}\) Justinian’s restorations of the fortifications at Dara – if any – were probably minor.\(^{198}\)

After discussing fortifications in the first section, the remainder of the Dara set piece is devoted to water infrastructure, with a long series of balanced anecdotes that concern the manipulation of water, with both positive and negative affects linked to water management actions or inactions.

In the second episode (2.2.1) the author quickly addresses water shortage.

Procopius describes the construction of tanks for water / reservoirs (ὕδατος) in the city’s fortifications, and separately “close by the church which is dedicated to the Apostle Bartholomew.” Brands has argued that the Bartholomew church should be identified with the large, polygonal apsed cruciform cistern in the substructure of a church in the west part of the city.\(^{199}\) This is the Building’s first acknowledgement of an important aspect of Late Antique urban change: the church’s growing role in urban water management and especially water-storage, with large cisterns in church complexes that were commonly fed independently by rain-water, but could also be integrated into municipal aqueduct systems, as precisely described here. The church of St Bartholomew is identified by Theodore Lector\(^{200}\) as the work of Anastasius, while the long account of Zachariah of Mitylene\(^{201}\) reports that the church and cistern were the work of the bishop and clergy of Amida.\(^{202}\) Justinian’s role is, in any case, likely overstated.

Procopius initially explains that these cisterns in the fortifications near St. Bartholomew were fed by river-water, but later contradicts himself. The reservoir in the fortifications was “between the circuit-wall and the outworks” – this strongly suggests a moat, but the parallelism ὕδατος … εἰργάσατο with the St Bartholomew church-reservoir could indicate that both were intended or

\(^{199}\) Brands 2004, here at 153–4. Sinclair informs us that the church was reused in the Islamic period as the Great Mosque, and reports that “we know from a tenth century source that all channels in the city flowed into the cistern beneath the [mosque],” see Sinclair 1989, vol. 3.221.

\(^{200}\) Theodore Lector 2.57, PG 81.1 col. 211.

\(^{201}\) Zachariah of Mitylene 7.6, trans. Greatrex, 247–251.

\(^{202}\) Croke and Crow 1983, 152.
perceived as suitable sources for drinking water, the former by the reservoirs probably consumed by animals.203 A few lines down, Procopius says that these reservoirs – in the fortifications and at St Bartholomew’s – were filled by river-water from the Cordes directed into the city by a sluice gate (2.2.6), though he later (2.3.23) contradicts himself when explaining why Justinian needed to build an aqueduct for the city. While Crow and Croke argued that cisterns known at Dara are on high ground, and could not have been filled by river-water without sophisticated water-raising devices, Brands suggested that “eine Ableitung von Wasser aus dem Fluss durchaus denkbar [ist],” and considered the possibilities of both rain-water or an aqueduct-fed supply, discussed below.204

The third episode in the set-piece (2.2.2-9) turns to the management of the Cordes / mod. Amudah river near Dara. The river was super-abundant with a negative result: it detracted from the strength of the city walls by making the city easy to besiege. After the river Cordes flowed through the city, filling its reservoirs and “conducted wherever the inhabitants wish” (2.2.6), river water exited the city near the main south gate in the fortifications. “And winding about the plain nearby, it used to make the city easy to besiege; for it was not a difficult matter, thanks to the bountiful supply of water, for the enemy to encamp there.” These sluice gates, in the city’s north and south gates, were identified by

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203 Croke and Crow 1983, 156 in which the authors astutely point to the 540 siege of Beroea / Aleppo in the Wars 2.7.13, during which animals consumed all the water inside the besieged citadel, accelerating their surrender.

204 Croke and Crow 1983, 158 n. 81 and Brands 2004, 150.
Preusser\textsuperscript{205} before they were assessed by Croke and Crow,\textsuperscript{206} and most recently by Garbrecht.\textsuperscript{207} Procopius then indicates that this matter was taken under careful consideration by the Emperor Justinian, who is rendered as divinely-inspired master-builder and mechanikos: “God provided the solution for the impossible problem which confronted him, settling the matter out of hand and saving the city without the least delay” (2.2.9).

The fourth episode (2.2.10-12) is a pendant to the third, concerned ostensibly with water’s shortage. “In consequence of a dream or … of his own accord,” a soldier organized labor to dig a trench within the circuits, “showing them a certain spot where he said that they would find sweet water welling up from the recesses of the earth” (2.2.10-11). Procopius thus introduces an exceedingly familiar trope, of the miraculous discovery of springs, for instance by contemporary monk-saints like Sabas.\textsuperscript{208} But Procopius defies genre expectations. The workers do not discover a spring but a large chasm, which “proved to be the salvation of the city, not indeed by any foresight of these workmen.”\textsuperscript{209} The chasm solved the problem of the river Cordes’ dangerous abundance after it exited the city, where it was potentially at the disposal of besieging armies. Procopius elsewhere tells us simply that “a long time after the Emperor Anastasius built this city, nature unaided fashioned and placed [the chasm] there” (\textit{Wars} 8.7.8-9), though in the

\textsuperscript{205} Preusser 1911, 44–5, fig. 12, pls. 54–7.
\textsuperscript{206} Croke and Crow 1983, 153–4, plates xi and xii.
\textsuperscript{207} Garbrecht 2004.
\textsuperscript{209} \textit{Buildings}, 2.2.12.
present episode the Dara chasm appears more akin to the one which was so
important to the tale of St. Michael the Archangel at Chonai.\textsuperscript{210}

The salvation enabled by the chasm discovered at Dara is clarified in the fifth
episode (2.2.13-16), which again introduces but then consequently defies genre
expectations. Procopius recounts the city’s ill preparation for flood, and the failure
of its defensive walls which acted as a bulwark against torrential river water.
During a sudden flood, rushing water breached the outer defenses and heavily
damaged the inner city. Surging waters disappeared into the chasm, reemerging
with the town’s furniture forty miles away. The description of buildings and
houses with people washed away by rushing waters compares instantly with
precedent stories of disastrous floods.\textsuperscript{211}

Without segue, Procopius incongruously turns a familiar story of disaster into one
of divinely-inspired infrastructure triumph over unruly water: “And since then, in
times of peace and in prosperity, this river has flowed into the center of the city
and filled the storage-reservoirs…and then has been borne out of the city by the
exits made for this purpose, as I have just explained.” Strangely enough,

\textsuperscript{210} See below sec. 3.8 for an extensive discussion of Chonai and the miracle of St. Michael; the
basic references are Cadwallader 2011 and Nau 1907.
\textsuperscript{211} Cf. Theophanes AM 6017, Mango and Scott trans., 262 description of Edessa’s river Skirtos in
flood in 517 AD; or Evagrius Scholasticus 4.8 / 208. See also the account of floods at Edessa in
the Chronicle of Tel Mahre 45-6, trans. Witakowski, 42, for 524/5 CE. Procopius uses similar
language to describe disastrous flooding preceding architectural intervention elsewhere in the
Buildings, e.g. at Tarsus 5.5.19. The ultimate origin of the “beneficent flood” that washes away
civilization only to save it is of course Noah’s flood of Genesis 6:9–9:17; typologically this can be
compared with the “strategic flood” that saved the Israelites and destroyed the Egyptian armies of
Procopius has in fact not just explained these exits: he has just described the discovery of the miraculous chasm. Rather, the sluice gates are described immediately thereafter, by which means Procopius tells us that the chasm is brought into operation in times of trouble, so that the city can divert water into the chasm, away from besieging armies (2.2.19-21).

After describing the discovery and unexpected river-diverting functionality of Dara’s chasm, Procopius begins the sixth long section by again contradicting himself. Water infrastructure at Dara – including reservoirs, sluice gates, drainage and distribution elements – have heretofore been described as miraculous, efficacious and complete, saving the city in times of siege and allowing it to prosper in peacetime. But here Procopius tells us that the city was – after everything accomplished by Justinian previous to this moment – still left open to damage by flood. These actions are introduced by Procopius who tells us that “I shall now relate how [Justinian] brought it about that this city should never again suffer such damage from the river, a matter in which God manifestly assisted his effort” (2.3.1).

The following lengthy section (2.3.2-23) relates the construction of the gravity arched-dam at Dara as a thoroughly top-down architectural solution to flood – in contrast with the accidental discovery of the chasm by soldiers digging for a well – designed and enacted from the highest levels of the Byzantine state.
After relating the unusual effort expended to control the river Cordes’ flow into Dara, and its benefits for the supply of drinking water, the focus on urban water shortage in the final short section (2.3.24-26) comes as something of a surprise. After all, the “river flowed into the center of the city and filled the storage-reservoirs with water to overflowing” (2.2.17). Water controlled by the dam was carefully released into a holding pool “forty feet between the dam and the outer fortifications…[and] goes in an orderly fashion into the customary entrances and from there empties into the [city’s main] conduit (ὀχεταγωγία)” (2.3.21).

But Procopius contradicts himself again here, telling us that “there was a great difficulty regarding water for the people living in this city. For they had neither any spring welling up there, nor water conveyed about the streets by a conduit (ὄχετω): neither was it stored there in any cisterns; but those very near whose streets the river flowed drew their drinking water without any trouble because of its proximity, those whose homes were very far from the river’s course were obliged to choose one of these two alternatives – either to take a vast deal of trouble in order to obtain drinking-water at all, or to perish of thirst” (2.3.24).

Procopius clearly alludes to problems with the availability, and perhaps quality, of water supplies in Dara. Quality may have been an issue because the conduit that conducted the river through the middle of the city would have been exposed to contaminating drainage and runoff, creating a high potential for pollution of drinking water supplies if drawn directly from the river in an urban environment.
Drawing water from a diversion intra-muros would also have been problematic.\textsuperscript{212} (Taking a diversion from the river further upstream, and distributing that water via conduit from a distance, or digging shallow wells near the river to use the substrate as a natural purifier, were all more sanitary alternatives, typical in other Roman cities.) Important to consider in this context, too, is the fact that low-lying areas with poor drainage are historically locations for lower-quality housing at higher risk for flood, with more prestigious residences safe on the hill-sides. This was also true in Constantinople, for instance, where water was distributed from the aqueducts at churches and public buildings at the top of hills (like the Holy Apostles) to lesser buildings like private housing below, thereby creating chains of dependency on the water supplies of public institutions and elite residences.\textsuperscript{213}

Availability of water at higher elevations was another factor at Dara. Crow and Croke note that the city’s reservoirs and cisterns are on high ground, and consequently river water could not have been used to fill them without sophisticated water-lifting equipment.\textsuperscript{214} These issues of pollution, preferential water supply from aqueducts rather than rivers, the social stratification of drainage-zones within cities, and supply-availability may thus be implied causes of Procopius’s concern for water shortage in Dara, since he elsewhere praises the availability and utility of the Cordes river for its supply of drinking water.

\textsuperscript{212} Note the prescriptions in Clapham 2004 on drawing water from rivers and streams into cisterns.
\textsuperscript{213} Scobie 1986, here at 404, for the relationship between social status and the relative elevation/drainage of urban housing.
\textsuperscript{214} Croke and Crow 1983, 158.
Whatever the cause of water shortage in Dara, Procopius prescribed its solution: the construction of a pipeline aqueduct (ὀχετός) that “led water about to every part of the city, … thus reliev[ing] the straits of its inhabitants (2.3.25).”

Garbrecht identified a stone-lined conduit in the vicinity of three springs at the village of Aytepe Köy, which run 8 km from the northeast to the higher northwest side of the city walls, where a sluice was identified, and from which point waters could indeed have been carried to most places in the city, including especially the so-called “Great Cistern.”

There is no secure archaeological evidence for the date of this installation. However, Zachary of Mitylene and Malalas attribute the construction of an aqueduct at Dara to Anastasius. Here in Procopius, construction of the aqueduct is linked, ἀλλὰ καὶ, to Justinian’s alleged construction of the Great Church and the Church of St Bartholomew. Thus at the conclusion of his Dara set-piece, Procopius circles back to the beginning, where he had informed his readers that Justinian’s water infrastructure programs at Dara began with the construction of reservoirs between walls of the fortifications and near the Church of St Bartholomew (2.2.1).

2.5 Conclusions from Procopius’s Account of Dara: Structuring Justinian’s Water Management in the Buildings

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216 Zacharias of Mitylene, 7.6, Greatrex trans., 247-251 and Malalas 17.399, Jeffreys and Scott trans., 224.
We have seen that Procopius’ account of Dara may begin with an unexpected allusion to Frontinus 16, comparing fortifications to *useless works like the Pyramids*. If Procopius paraphrases Frontinus, he has converted the original statement’s subject (aqueducts) to fortifications, leaving urban water systems in absentia. Thus Procopius introduces the explicitly stated theme of fortifications and an implicit theme of imperial water management, which both run throughout the rest of the *Buildings*. The proemium leads directly into an account of Dara beset with numerous inconsistencies, contradictions, and apparent distortions of fact. Boundaries blur between water disasters and water miracles, positive or negative in effect. Literary precedents and common-places for imperial responses to water crises are diverted in unexpected directions.

Solutions to water crises at Dara range, in their organizational dimension, from the extremely local (soldiers digging a well) to divinely-inspired solutions directed from the Great Palace at the very highest levels of state. Actors in the middle – bishops, military leaders, and local elites – are conspicuously missing in Procopius’s account. Procopius nevertheless makes an important albeit implicit first allusion to a relationship between the church and imperial urban water management at Dara, with water storage in cisterns at St Bartholomew’s.

Architecturally, solutions to urban water scarcity at Dara range from aqueducts to cisterns and water drawn directly from the river in town, while water protection schemes are described with unusual sophistication and detail.
When compared with their precedents in Roman literature and alternative discourses, it may be observed that Procopius follows the model he established at Dara by treating the subject of water infrastructure and management in a mostly conservative fashion, albeit with the introduction of distinctly novel and incongruous elements or concerns.

2.6 Hydraulic architecture in the *Buildings*

Leaving aside the constraints of Procopius’s narrative sequence, we might consider instantiations of water infrastructure in the *Buildings* as a function of architectural genre, which can be expressed as follows:

| Table 2.2: Hydraulic Architecture in the *Buildings*, organized by genre |
|---|---|---|---|
| Genre: | New: | Restored: | Citations [Place] |
| Aqueducts | 11 | 2 | 2.3.24 [Dara]; 2.5.9-11 [Constantina]; 2.10.19-25 [Antioch]; 2.11.2-7 [Cyrus]; 2.11.10-12 [Palmyra]; 3.7.1-4 [Trabzon]; 4.1.17-27 [Justiniana Prima]; 4.9.14.-16 [Heraclea/Silviri]; 5.2.1-5 [Helenopolis, Bithynia]; 5.3.16-20 [Nicaea]; 5.3.4-6 [Pythia/Yalova]; 5.4.15-18 [Mokissos]; 5.9.36 [Cyprus, St Conon]; 6.2.9-11 [Ptolemais] |
| Baths | 10 | 4 | 2.8.16 [Zenobia]; 2.10.13-14 [Antioch]; 4.10.1-23 [Chersonesos]; 5.2.4-5 [Helenopolis]; 5.3.6-20 [Nicaea]; 5.3.16-20 [Pythia]; 5.3.8-10 [Nicomedia]; 5.4.15-18 [Mokissos]; 5.9.34 [Curicum]; 6.1.12-13 [Taphosiris]; 6.2.3-6 [Bernice]; 6.4.11 [Leptis Magna]; 6.5.8-10 [Carthage] |
| Reservoirs | 3 | | 2.9.4-9 [Resafa]; 4.2.9-15 [Greece]; 4.8.18 [Athyras] |
| Cisterns | 5 | | 2.4.1-13 [Rhabdios]; 2.9.10-11 [Hemerium]; 2.10.13-14 [Antioch]; 4.2.1-8 [Thermopylae]; 5.9.14 [Palestine] |
Rather than analyze each episode sequentially as we did at Dara (for this approach see Appendix D), what follows below is an assessment of the roles and representations of various types of water infrastructure in the Buildings, comparing examples internal to Procopius’s textual context, with both classical and contemporary sources in order to better understand Procopius’s perception of water as a component of the Roman urban ideal.

### 2.7 Aqueducts

Procopius describes the construction\(^{217}\) (12) or restoration\(^{218}\) (2) of fourteen aqueducts, of which seven systems are known archaeologically, at least in part.\(^{219}\) Where components of such aqueduct systems survive – like Trabzon,\(^{220}\)

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\(^{217}\) Newly built aqueducts are suggested at Dara; Constantina; Antioch; Cyrrhus; Palmyra; Trabzon; Iustiniana Prima; Heraclea/Siliivri; Helenopolis; Pythia/Yalova; Mokissos; St Conon in Cyprus.

\(^{218}\) Restored aqueducts are described at Ptolemais and Nicaea.

\(^{219}\) Archaeological remains of aqueduct system components are known from Dara, Antioch, Palmyra, Trabzon, Iustiniana Prima, Heraclea, and Nicaea.
Nicaea, Antioch, or Heraclea— it remains difficult or impossible to definitively connect these remains with the reign of Justinian, however.

The representation of aqueducts in the Buildings is mostly conservative, and jives with precedent urban images from the Roman architectural ‘tool-kit’ for urbanism that magnified the value of aqueducts to introduce abundant water into cities from springs in their hinterlands. Renovatio imperii is a consistent theme throughout the Buildings, as introduced in the proemium of Book V, in which Justinian is credited with “repairing all the parts of cities which had become defective” (5.1), including aqueducts destroyed by “Time, following its custom” (4.9.14).

Despite the undeniable conservatism of Procopius’s praise of aqueducts, unusual inclusions stand out from the aggregate fabric of the Buildings, when

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220 The aqueduct at Trabzon is primarily known from its inscription, CIG 8696, recording its construction under Justinian with the help of Bishop Ouranios in 542 – this is arguably identical with the "Aqueduct of St. Eugenius" noted by Procopius. However, the physical remains of the system are little known – Bryer and Winfield 1985, 182 and 190 described the Zagnos Köprüsü as possibly part of the former aqueduct. See also Vasiliev 1930, 385–6.

221 See briefly Foss 1996, 13, 159, and 201; a late medieval / Ottoman aqueduct survives with substantial remains east of the city, though it remains unpublished.

222 Procopius gives Justinian credit for laying out the city anew “with stoas and market–places, and dividing all the blocks of houses by means of streets, and making water–channels and fountains and sewers,” (2.10.22) but Jodie Magness has drawn attention to post–Justinianic coins found under the pavement of Antioch’s main street, and suggested that the construction of its latest antique street surface (and thus, implicitly its water system) could only have occurred after Justinian’s reign, compare Lassus 1972 with Magness 2003, 206–209.

223 At Heraclea Perinthos/ mod. Marmaraerğlisi in Thrace, sections of the water system from Çesmeli survive, with sections of pipes near Kabyle and more than eleven cisterns – but the extent to which these features can be connected to Justinian is unclear. An older imperial–period epitaph noting the construction of an aqueduct by a military officer at Heraclea Perinthos would probably indicate that, if anything, Justinian’s work was limited to repair or restoration of a pre–existing Roman system. See Ivanov and von Bulow 2008, 76 and Sayar 1998, #72 L. 3.
compared with the precedents of Roman literature for such structures: namely 1) concern for the sources and 2) defensibility of aqueducts, and 3) the relationship of aqueducts to churches.

Procopius evinces a shift in perceptions of the appropriate sources for urban aqueducts, from springs to ground- and rain-water sources. Spring water was widely perceived to be the most salutary of sources for drinking water.\textsuperscript{224} Springs were associated with tropes for the health of empire\textsuperscript{225} and emperor\textsuperscript{226} alike after the first century CE.\textsuperscript{227} In the context of aqueducts, Procopius construes water’s superabundance positively, in contrast to the maleficent superabundance of floods and torrential downpours. Aqueducts carried “floods of crystal-clear drinking water” (4.9.14-16), in order that cities might be “abundantly supplied with ever-running water” (4.1.17-27), and “ever flowing fountains” (2.5.11). Justinian thus compares favorably with his predecessors, like Hadrian, who “gave his name to aqueducts without number,” or Constantius, who made “waters that had ceased to flow … pour forth upon the withered vitals … of the exhausted city.”\textsuperscript{228}

The lack of spring-water induced thirst, the motivation attributed to Anastasius for

\textsuperscript{224} E.g. the clear preference for spring water advocated by Hippocrates, \textit{Airs, Waters, Places} 8.8 or Athenaeus, \textit{Deipnosophistae} II.42C-D, Gulick trans., 183-4.

\textsuperscript{225} For instance, the connection between cleanliness and aqueduct functionality is made in the \textit{Speech of Thanks to Julian} written by Mamertinus, who wrote that, before Julian’s restoration of an aqueduct at Nicopolis, “everything was full of dirt and dust since the aqueducts had long since been destroyed” 9.2.4 , see \textit{Panegyrici Latini}, Nixon and Rogers trans., 408–9.

\textsuperscript{226} Corippus 1.15–51 in which the emperor is “the fertile tree, drinking from the imperial spring. Our Lord and common benefactor is the great spring of the court, the spring that enriches all … ."

\textsuperscript{227} The inscription for an aqueduct built at Kanatha in Syria is dedicated ύπὲρ σωτηρίας καὶ ύγείας αὐτοκράτορος Νέρουα Τραϊανοῦ καίσαρος σεβαστοῦ, see \textit{SEG} 7.977–8 = Dunand 1930, 275–6. Moralee 2004, 50-54 discusses this idea, the salutary ideology.

\textsuperscript{228} See above n. 152-63 for aqueducts; and for Constantius, see \textit{Panegyrici Latini} IX.4, trans. Nixon and Rogers, 154.
his construction of an aqueduct at Hierapolis, because he could not abide the
thought of citizens drinking water from cisterns or wells.\textsuperscript{229} Just so, Justinian was
led to build an aqueduct for Constantina in Syria, because her citizens “always
suffered from thirst and great difficulty of obtaining water” (2.5.9).

Elsewhere, Justinian was in fact more permissive and inclusive as regards the
sources of water which he tapped for urban supplies – where Anastasius was
allegedly aggrieved by the thought of rain- and ground-water as a primary
sources of drinking water in cities, Justinian patronized their construction
enthusiastically (see more below on cisterns and wells, sec. 2.9). And, aqueducts
constructed by Justinian were not universally sourced from springs: At Antioch,
Procopius credits Justinian with the construction of a dam, the so-called Iron
Gate – which Matthias Döring has demonstrated was originally an imperial
Roman aqueduct bridge, secondarily adapted to use as a dam that collected the
rain-waters of the seasonal Onopnictes / Parmenios torrent. As Procopius
describes it, an earlier dam was at some point broken by the force of the waters
that collected behind it, leading Justinian’s engineers to construct sluice gates
and regulate its passage through a channel for use inside the city (2.11.15-20).
Döring has suggested that the original aqueduct conduit, which led from the
springs at Daphne through the Iron Gate’s dam, went out of use either when the
dam was broken or when Justinian’s dam was constructed, so that this project in

\textsuperscript{229} Procopius de Gaza, trans. Chauvot, 18–19 for the Greek and 43–44 for the French translation. Compare the similar motivation of thirst for the construction of another aqueduct, probably in the sixth century, by one Georgios at Gortyna on Crete: see Bandy 1970, 77-8 #47.
effect coincides with the replacement of a spring-fed for a torrential rain-water source for the inhabitants of Antioch.\textsuperscript{230} At Mesopotamian Dara (2.2.24-5), river water became a viable alternative to spring water supplies for the city’s aqueduct. While aqueduct intakes were occasionally set up on rivers during the imperial period,\textsuperscript{231} they were always significantly upstream of the city itself – the situation at Dara is thus unusual, because Procopius describes precisely how water was drawn into pipes or reservoirs from the river inside the city-walls rather than through an upstream catchment. A catchment inside the city was undoubtedly more susceptible to urban pollution, besides.

Throughout the \textit{Wars} of Procopius, and following on early Roman precedents, there is a concern for the defensibility of aqueducts, which are a potential source of weakness and insecurity. During his siege of Carthage, Gelimer “tore down a portion of the aqueduct – a structure well worth seeing – which conducted water into the city,” but presumably because Carthage was also adequately supplied by wells and cisterns, “after encamping for a time they withdrew, since no one of the enemy came out against them” (\textit{Wars} 4.1.1). During the siege of Naples, Belisarius cut the aqueduct without forcing surrender, though the aqueduct’s tunnel was eventually used as an entry point into the fortified city (\textit{Wars} 5.10.1-23), a fact which later famously led Belisarius to block the aqueduct tunnels of

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\textsuperscript{230} See Döring 2002; Pamir 2014, 96; Pamir and Yamaç 2012. Most recently see Eger 2013, 124 n. 141 for evidence of the aqueduct’s continuing functionality in the ninth/tenth century.
\textsuperscript{231} “Surface water, whether from lakes or rivers, was used less often [as the sources of aqueducts] than might be expected,” see Hodge 2002\textsuperscript{2}, 69.
\end{flushright}
Rome as a defensive measure (*Wars* 6.9.1-11). This same concern for security was attributed to be a motivating factor in the construction of an aqueduct at Cyrrhus in the *Buildings*, where pilgrims came to the tomb of SS. Cosmas and Damian. There, because a “steep and altogether impassable area lay between [the spring and the city…citizens] could easily fall into the hands of the enemy…so [Justinian] dug a channel outside the city all the way to the spring, not allowing it to be seen, but concealing it as carefully as possible, and thus he provided the inhabitants with a supply of water without toil or risk” (2.11.2-7). Where the striding arches of imperial aqueducts advertised the path of water entering cities, Procopius’s concern for the visibility and security of urban water supplies is reflected in the widespread Late Antique practice of replacing highly-visible and –vulnerable bridge and tunnel systems with buried pipelines. Such considerations should also be related to Procopius’s concern, stated explicitly in his description of Thessaly, that even in places with “a surfeit of drinking-water, … the inhabitants … could not derive the least enjoyment from these things because they were in a state of constant terror and ever expected the barbarians to fall upon them” (4.3.8).

Procopius alludes to a relationship between churches and aqueducts at Dara, where both descriptions of the main conduit or oxetogogia was directly followed by church patronage (where St. Bartholomew’s was outfitted with a large cistern,

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232 Note also the story of Justinian II, after his exile, covertly re-entering Constantinople through a water pipe: see *Patria* 3.79, Berger trans., 178-9.
[2.3.24], and at Antioch, where a similar pattern prevailed in the account of Antioch’s churches of St Michael and the Virgin (2.10.19-25). Procopius is more explicit when he twice mentions aqueducts named for saints, the St. Conon aqueduct in Cyprus (5.9.36) and the aqueduct of St. Eugenius in Trabzon (3.7.1). In his text, Procopius uses synecdoche to attribute responsibility for the construction of the entire aqueduct construction to Justinian personally, though an inscription from Trabzon for the construction of an aqueduct reveals more specifics, if this is indeed the same project (which is not explicitly named for a saint in the inscription). Dated 546/7 CE, the inscription records that Justinian “with his prodigality, restored the public infrastructure (δημόσια κτίσματα) of the city with the zeal and care of god-loving bishop Ouranios.” Two additional inscriptions from Bosra in Syria record another comparable and contemporary episode of aqueduct repair, with the “generosity of despot Justinian, offered by John of the rank of archbishop,” with the involvement of a silversmith and two other individuals “who provided gold advanced [from the provincial coffers] on behalf of the people.” By contrast, such middle-range actors as bishops, bureaucrats, and city notables are conspicuously elided from Procopius’s accounts of Justinian’s involvement in aqueduct construction.

233 Cf. SEG 42.1158 = Ἐν ὀνόματι τοῦ δεσπότου ἡμῶν Ἰησοῦ Χριστοῦ τοῦ Θεοῦ ἡμῶν ἀυτοκράτωρ | Καῖσαρ Φλ(άβιος) Ἰουστινιανός Ἀλαμανικός | Γοθικός Φραγνικός Γερμανικός Ἀν— | τικός Αλανικός Οὐανδαλικός Αφρικός | εὐσεβής εὐτυχής ἐνδοξός νικητής | τροπεοῦχος ἄγιος Αὐγουστος | ἀνενέωσεν φιλοτιμίᾳ τὰ δημόσια | κτίσματα τῆς πόλεως σπουδῇ καὶ | ἐπιμέλειᾳ Οὐρανίου τοῦ τεοφιλεστ(άτου) | ἐπισκόπου · ἰνδ(ικτιῶνος) | ἐν’ ἑτούς ὑπη’

234 IGLSyr 13/1.9134 = [ἐκ φιλοτιμίας τοῦ δεσπότου Ἰουστινιανοῦ, ἀνενέωσεν] ἀγιοῦ ἀρχιεπισκ(όπου) Ἰωάννου ἀνηνεώθη | ἑκ πρεσβία(ς) τοῦ ὁσίου | ἀρχιπετασ(οῦ) Ἰωάννου ἀνηνεώθη | ἀγιοῦ δ(ιὰ) Ἀναστασίου τῶν Μαρ[. Ἰας ἁγιουρ[οῖ]| — — —
Even if Procopius’s account does not fully account for the sixth-century realities of aqueduct construction and maintenance – concerned with defensibility, alternative sources besides springs, and the increasingly prevalent involvement of the church in cooperation with local elites – he nevertheless makes gestures towards the larger contemporary situation with the rhetorical tools at his disposal.

2.8 Baths

Procopius records fourteen episodes involving the construction (10) or restoration (4) of baths during Justinian’s reign. Only two or three of these baths are known archaeologically, though one additional bath attributed to Justinian is known independently from an inscription and substantial remains, at Byllis near Berat in anc. Epirus/mod. Albania.235 Baths are – like aqueducts – represented by Procopius in a conservative fashion that depends on the traditional Roman model for urbanism, according to which baths are an expected benefit of empire and a mark of the polis. Accordingly, Procopius explicitly includes baths among those structures “which make a city notable” (4.10.21), and which give “the appearance” or “the mark of a prosperous city” (6.4.11 and 5.2.5).

Table 2.3: Baths in the Buildings

235 The few baths mentioned by Procopius that are known archaeologically remain difficult to connect back to Justinian. For baths at Carthage, see below at n. 246. At Leptis Magna are Hadrianic and Late Roman baths are known at Leptis Magna: Bartoccini gave no indication of Justinianic or late antique interventions in his study for the former, while the latter are known only through “an abortive attempt to build” in the third or fourth century; see Bartoccini 1929 and Sears 2007, 70-74. Multi-phase baths are also known at Palmyra, though Justinian’s responsibility for improvements there is entirely insecure; see most recently Fournet 2012, here at 224-8 with phased plan at fig. 20.
But episodes in Procopius concerned with baths and bathing also hint at a changing conception of the bath’s role in Late Antique society. The following issues are pertinent: Christianity; the water supplies of baths; motivations for their construction; state priorities for bathing and bath operation; and architectural or social contexts for bathing during Late Antiquity.

Christianity is perhaps surprisingly not an issue for Procopius,236 who shows no concern for the venality of baths, expressed by the church fathers as a vehicle for ascetism and a fear for Christians naked and exposed to pagan idols or demons;

236 See the debate over Procopius’s confessional status, Kaldellis 2004, 165–172 and Cameron 1985, 113–33.
or for mixed-gender bathing. Procopius’s concern is limited to undue displays of wealth and status in public baths. Indeed, baths in Procopius are at best an urbane enticement for barbarians to convert to Christianity (and become sedentary), another instrument in the author’s civilizing project to neutralize foreign peoples living at the edge of empire. 

Baths were constantly desired by the Goths and Persians, in addition to the tribal confederations of North Africa. Besides their luxury-value in a courtly context, Procopius tells us that at Leptis Magna, "by means both of the baths [βαλανείοις] and of all the other improvements [Justinian] gave it the character of a city. The barbarians who live close by, those called Gadabitani, who up to that time were exceedingly addicted to what is called the Greek form of atheism, he has now made zealous Christians" (6.4.11). In this fashion Procopius connects baths with other features of cities important to the broader civilizing, Christianizing project of Late Antique Roman emperors.

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237 Still fundamental, see Dölger 1909, 162–4 on the association of demons with water and springs; Bonner 1932, 203–208; and Böcher 1970, 204 and 50–53, on dirty water as a haunt for demons and souls of the dead; similar attitudes towards baths were also recorded in Anatolia before the population exchanges of the nascent Turkish Republic by Hasluck 1929/1973, 107–112.

238 Note the story (Wars 7.1.39–42) of a conflict between the wives of two Gothic commanders, initiated by undue display of wealth and conflicts over social status in a bath.

239 See Cameron 1985, 120–125 on conversion as a prime instrument in foreign policy.

240 Roman–style baths were a prized technology in the courts of neighboring powers, see the incidents concerning Attila and the Sassanian king Balash: for Attila see Fragmentary Classicising Historians 265; and for Balash, see the Chronicle of Pseudo–Joshua the Stylite 19, Trombley and Watt trans., 17, n. 77. Note also that Constantine VII (citing Peter the Patrician) recommended that visiting Persian diplomats should have private hot–baths at their disposal: Book of Ceremonies I.89, Moffatt and Tall trans., 398f. Notable is the fact that first – third century CE fortifications on the Persian frontier frequently featured baths inside castrum walls, while later forts in the same area put baths extra muros, probably both for fire protection and so that they could be used as places for diplomacy. Compare for instance the position of baths at the second–century legionary forts of Azraq or fourth-century El Lejjun, with their extra muros position in the early Islamic qasrs; see Kennedy 2004, 57–62 or 157, or Grabar 1978.
A city’s desire for bathing facilities was a primary motivating factor in the construction of aqueducts during the imperial period,\(^{241}\) but Procopius also alludes to rainwater supplies for new baths on the hills around Antioch, describing them in relation to cisterns that were built into the fortifications (2.10.13-14). This reflects an increasing tendency for Late Antique baths to economize their water consumption, which included drawing water from sources alternative to aqueducts.\(^{242}\) While smaller baths proliferated in Late Antique cities, large thermae complexes were modified so as to operate under straitened circumstances with less water and fuel,\(^{243}\) or appropriated for new uses entirely.\(^{244}\) The Antonine Bath at Carthage is a good case in point. If the identification is correct, this immense complex was damaged by Gelimer in the fifth century (\textit{Wars} 4.1.1), and according to the \textit{Buildings}, subsequently repaired by Justinian (6.5.8-10). After its restoration, the βαλανεῖον ἐν δημοσίῳ was “named Theodorianae, after the Empress,” replacing its earlier dedication to Hadrian.\(^{245}\) Archaeological evidence also points to an orderly contraction of this bath’s water supplies sometime between 533 and 548 CE: the aqueduct and

\(^{241}\) “The normal reason an aqueduct was built was to supply baths,” see Hodge 2002, 5.
\(^{242}\) Cf. the late Republican Stabian baths in Pompeii, where the bath’s original well–water supply was modified so as to take water from an aqueduct in the early imperial period; or the fifth century baths at Syrian Androna, which operated for at least two centuries from well–water raised with a noria; for the Stabian baths see Nielsen 1990, 1: 23 and for Androna see Mango 2008.
\(^{243}\) For instance the Bath–Gymnasium Complex at Sardis in Lydia, where the south wing of the palestra became a synagogue in the later third or early fourth century, prior to the installation of smaller hip–baths in the frigidarium; see Yegül 1986, 15–6 and 72–3, the forthcoming study by B. Bricker (forthcoming).
\(^{244}\) Cf. Anemurium in Cilicia, whose large imperial–style bath was converted to housing and industry in the later fourth century, while a smaller bath that operated until the mid–seventh century was newly built just a hundred meters to its east: see Russell 1987, 21–2.
\(^{245}\) \textit{CIL} VIII.12513.
baths were both repaired, but the supply of the Antonine baths was diminished, and modified so as to draw from two cisterns rather than directly from the aqueduct.\textsuperscript{246} Another Justinianic bath drawing its water economically, from cisterns, is known at Byllis in Epirus. This bath was never mentioned by Procopius, but according to an unpublished inscription it was funded by Justinian.\textsuperscript{247} The smaller row-type bath (24.5 x 6.4m) was equipped with a very modest two-room hypocaust and no frigidarium, and took its water from a large cistern (50.9 x 4.2m, 1200m\textsuperscript{3}) – of originally Hellenistic construction, supplied by rain-water – that was constructed under the city stadium’s south side and maintained in Late Antiquity.\textsuperscript{248}

Natural hot- or thermal-springs were another alternative to aqueducts for the supply of baths. The subject of hot-springs has lately been dominated by Dvorjetski, who has concentrated her attention on shifting cultural attitudes towards the therapeutic value of hot springs in the Levant during Late Antiquity.\textsuperscript{249}

\textsuperscript{246} Lézine and Wilson have dated repairs to the Antonine bath between 533 and 548 CE, at which time the aqueduct at Carthage was restored, and its source was fortified for protection, see Lézine 1969, 40 and most recently Thèbert 2003, 140–143; for the broader context of the bath – aqueduct relationship at Carthage between the second and seventh centuries, see Wilson 1998. The streets and sewers of Carthage continued to be repaired well into the seventh century, before the aqueduct was presumably cut again in the siege of 698. At some point, possibly during the seventh century, one section of the Antonine baths became a setting for the production of pottery, with the installation of kilns.

\textsuperscript{247} Feissel 2008, 92 notes that this inscription, a mutilated epigram, remains unpublished; see the provisional French translation offered by Ceka and Muçaj 2009, 35 “De Justinien (le dominateur), très puissant, (…), je suis le bain, (construction?), utile; (…) mais (je porte le nom) de celui (…) qui (…) par–dessus tout le monde (…)”

\textsuperscript{248} As regards the issue of supply to the cisterns via rain–water or inverted–siphon aqueduct to the hill–top city, we should note the presence of inverted siphon blocks by the church just west of the stadium, that suggest a pressure–fed pipeline system in the city, of unknown date. This aqueduct/water system remains to be thoroughly investigated.

\textsuperscript{249} Dvorjetski 2007, esp. 393–424 for late antiquity.
Dvorjetski’s moralizing approach overlooks the importance of thermal-spring baths as a less-costly, naturally-occurring supply of heat and water, the advantages of which increasingly shaped settlement patterns and hierarchies in Late Antiquity.²⁵⁰ Besides palatial embellishment at the famous hot-springs of famous Pythia for the use of the imperial court, with a church and an aqueduct for drinking water (5.3.16-20), Procopius also describes Euxine Anchialus in some detail (3.7.18-25). Here, on the Black Sea, there was an unfortified place (χῶρον ἀτειχιστον) near which bubbled up natural baths of hot water, “though such a host of barbarians dwelt nearby; and sick persons used to visit the place, gaining relief at the cost of danger. Therefore the Emperor Justinian made it a walled city, as it now is, and thus made the cure free from danger.” In fact, Anchialus had long been a city, fortified and re-fortified multiple times, with a bishop since the second century – and it continued to be a flashpoint in conflicts with neighboring polities in subsequent centuries.²⁵¹ Leaving the distortion aside, what remains at stake is how Procopius recognizes Justinian’s elevation of a village and thermal spring to city-status, and in so doing aggrandizes an important shift in settlement patterns shift that was otherwise unrecognized by contemporary sources. According to this pattern, opportunities for bathing gradually shifted away from expensive, artificially-heated and -watered baths in cities, to locations naturally blessed with abundant supplies of hot spring water.

²⁵⁰ For instance note settlement nucleation from surrounding communities towards water–blessed Tiberias, which was famed for its hot springs as well as its fresh–water lacustrine location on the Galilee; Tiberias was also equipped with an aqueduct that was maintained and extended well into the early Islamic period. See Stacey 2004, 3–10.
Several of these locations became important military centers and capitals after the seventh century.²⁵²

Besides shifting norms for the water supply of baths, we should also note a contextual shift for bathing in Procopius: Procopius maintains the traditional Roman focus on emperors who are concerned for public baths as the “marks of a prosperous city,”²⁵³ but the author is also explicitly concerned that baths are made accessible to non-resident patrons like traveling officials and magistrates,²⁵⁴ private persons visiting without bureaucratic status, like pilgrims and the sick,²⁵⁵ as well as foreign tribes living outside cities.²⁵⁶

Changing state priorities for baths are distinctly less visible in Procopius than they are in the contemporary Codex Justinianus, the Digest and Institutes, particularly when the Justinianic rescripts and opinions are compared with those

²⁵² Besides Euxine Anchialus, other important examples include Therma / Myrikion in Galatia (elevated after the fifth century); Basilica Thera/Sarikaya in Cappadocia (elevated as late as 451, see TIB 2, 157); Dorylaeum / Eskişehir in Phrygia, the center of Artabasdis’s revolt against Constantine V in 741/2; and Germia in Phrygia (elevated after the mid–seventh century, see (TIB 7, 238–242). Myrikion “wahrscheinlich wurde in der 1. Hälfte des 5. Jh. die ‘regio’ zur Stadt erhoben” (TIB 4, 208); the new city had a bishop after 451. For Germia, which lacked an adjoining settlement but was nevertheless elevated to the status of autocephalous bishopric in the mid–seventh century, see most recently Niewöhner et alii  2013. For further information on these sites, see Appendix F.

²⁵³ An explicitly public–use bath is described at Berenice, Procopius, Buildings 6.2.3–6, βαλανεῖον … δημοσίᾳ παρεχόμεν τῇ πόλει τὴν χρείαν; and for a bath with poorhouse at Curicum, 5.9.34.

²⁵⁴ Lodgings for magistrates and the veredarii (imperial couriers) are associated with baths for magistrates at Helenopolis in Bithynia, 5.2.4–6 and in Taphosiris, 6.1.12–13; baths associated with veredarii at Nicaea in Bithynia, 5.3.1–3, for whom see Silverstein 2007, 38.

²⁵⁵ The infirm are associated with thermal baths at Anchialus on Euxine, whose status was elevated to city under Justinian, 3.7.18–25; and at Pythia/Yalova in Bithynia, 5.3.16–20; guesthouses are associated with baths at Chersoneso, 4.10.1–23 .

²⁵⁶ Procopius tells us that the Gadabitani were converted to Christianity and neutralized, immediately after describing the construction of baths at Leptis Magna, see above and Buildings 6.4.11.
added, omitted, or modified from the earlier *Codex Theodosianus*, or the later *Basilica*. For instance, a rescript issued in 415 CE prohibited installing in baths any statues of gods to whom sacrifice had been made;\(^{257}\) another advised that prisoners using public baths were to be transported under guard;\(^{258}\) several others dealt with local situations, the tax-funded maintenance or operation of baths in Rome and Antioch: none of these were reenacted in Justinian’s sixth century, arguably an index of their comparative unimportance at that time.\(^{259}\)

Concerns for the financial arrangements of baths and surrounding properties were more prolific. A survey of the relevant legal literature, for instance, reveals that a rescript issued by Arcadius in 395 CE, which “hereby set aside the third part of the income from the public lands for the repair of public buildings and baths” was reenacted in both the sixth-century *Codex Iustinianus* and the *Basilica*,\(^{260}\) while an earlier rescript funding public baths from farmland belonging to the municipality was omitted from future redactions.\(^{261}\) Another rescript of 417 CE was not repeated thereafter, which prohibited burdening cities with tax to cover the cost of heating private for all counts and officials excepting *illustri* and *magistri militum*;\(^{262}\) but an entitlement for the cost of lighting in such baths was maintained.\(^{263}\) Other repetitions were specific to Constantinople, but may have

\(^{257}\) CTh 16.10.20.3.  
\(^{258}\) CTh 9.3.7.  
\(^{259}\) For Rome see CTh 14.5; and for Antioch CTh 12.1.131.  
\(^{260}\) CTh 15.1.32 = CIC CI 8.11.11 = Basilika 58.12.11.  
\(^{261}\) CTh 15.1.32.  
\(^{262}\) CTh 7.11.  
\(^{263}\) CTh 7.11.1 = CIC CI 1.47 = Bas. 6.1.98.
served as precedents for localities elsewhere: one rescript ordered that the rents of houses and workshops in the porticoes of the Zeuxippus Baths were to be allocated for the maintenance of public baths in Constantinople.264 This would indicate that encroachment in a bath’s porticoes for housing or workshops – as for instance also in the Verulanus Halls of the Harbor Baths at Ephesus, with exceedingly high quality construction and decoration265 – was an accepted fact in the sixth-century, from which came only an obligation to manage and profit from rents on public property.

Elsewhere, wholly new additions to the Justinianic legislation show how the state’s concerns have shifted towards oversight of baths operated by non-state actors like the church266 or private individuals, and contracted for public use: namely, payment of contractors repairing furnaces and pipes;267 damages claimed by municipal authorities in the event that a private bath contracted for public use has burned down and become inaccessible;268 prohibitions against an usufructuary setting up a public bath on leased properties;269 structural considerations for building rooms above or next to a bath;270 and terms for the

264 CTh 15.1.52 = CIC CI 8.11.19 = Bas. 58.12.
265 Contra Yēgul 1995, 313 who calls Verulanus in late antiquity “a small and shabby residential district,” see the marvelous results of the recent Austrian excavations directed by Ladstätter 2012, 23–27 with ground-plan and photographs.
266 The Pragmatic Sanction gave bishops formal responsibility for urban water infrastructure including baths, CIC Nov 149.2 under Justin in 569 CE = Bas. 6.3.44.14; a similar order was issued earlier by Justinian from Chalcedon in 530 CE, CIC CI 1.4.26.
267 CIC Dig 19.2.58 = Bas. 20.1.58.
268 CIC Dig 19.2.30 = Bas. 20.1.30.
269 CIC Dig 7.1.12.8 = Bas. 16.1.13.
270 CIC CI 8.10.1 = Bas. 58.11.1 and CIC Dig 8.2.13 = Bas. 58.2.13, both the opinions of third century jurists.
arbitration of investor-conflicts in baths. While the state has codified procedures for privately-maintained, publicly accessible baths in the provinces, water rights for private baths in the capital became the object of increasing preoccupation, marked by an annulment of all inherited private rights to water for baths in Constantinople during Justinian’s reign.

Apart from the Pragmatic Sanction of 530 CE, neither Procopius nor the contemporary legislation acknowledges the increasing involvement of the church in urban baths, which is widely visible elsewhere from an early date in literature, as well as archaeological and epigraphic evidence. We might quickly characterize the church-bath relationship as follows: Surplus or disposable income directed to the construction of imperial-style baths until the fourth century was thereafter mostly given over to church-building, which subsumed not only the same funds, but also the same bundled technologies and vocabularies of earlier bath buildings (especially in *episkopeia*), namely their water supplies, hypocaust-heated rooms, immensely scaled and marble-revetted interiors, monolithic basins (reused from baths as baptistery- or fountain- fonts), construction techniques for walls and vaults, and the attendant spatial effects

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271 CIC CI 8.10.5, a repetition of an opinion issued in 290 CE.
272 CIC CI 11.42/43.6 = Bas. 58.19.6.
273 See Berger 1982 and Magdalino 1990.
274 For instance the well–known baths of Placcus at the Cathedral/St Theodore complex in Gerasa, Northern Jordan, established in 454 CE, with dedicatory inscription SEG 7.871.
275 O. Brandt emphasizes that “the Christian baptistery does not ‘come’ from the baths, because it is one of them; if the word baptisterium could mean frigidarium, it means that a baptistery was a structure where you could immerge in water.” On this topic see fundamentally Brandt 2011, here at 1596.
276 The adaptation of secular building components in church complexes – including water elements — is also examined by Jacobs, forthcoming.
derived from their combination. The interchangeable vocabularies and spatial
effects of baths and churches are also related to their frequent conversion, from
the former to latter, mostly after the early fifth century. Also notable is the
frequent construction of churches immediately adjacent to pre-existing baths,
which were subsumed by episcopal management. The church-bath
relationship could also be financial in nature: churches began to include baths-
for-profit in their real estate investment portfolios at a very early date, thanks to
the donatives of Constantine to Roman churches in the fourth century.

Despite these important omissions, Procopius nevertheless points obliquely
towards a reorientation of values or priorities concerned with public bathing as
both a state interest and a cultural practice leading up to the author’s sixth
century.

2.9 Reservoirs, cisterns, and wells

Procopius ennobled the humble cistern. By including the Basilica Cistern
alongside more obvious targets for imperial patronage in Constantinople like
churches, Procopius elevated water storage installations to a status completely
without precedent in Roman literature. Urban water conservation rather than

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277 See the incomplete but still useful list of converted bath–churches with references in Vaes
the continuing operation of the baths at St. Demetrius in Thessaloniki as late as the plague
outbreak of 586 CE, a century after the church itself was built over a Roman bath complex, the
traditional site of Demetrius’ martyrdom; Démétrius, Miracula 1: 3, 39; with commentary 2: 49.
278 St. Peter’s was endowed with a balneum in Cerateas, at Syrian Antioch; three more examples
are known from fourth–century Rome; See Poccardi 2009 and Stasolla 2002, esp. 122–31, see
the very useful appendices organized by location in Italy, s.v. Rome.
conspicuous consumption (a recognition of resource scarcity), and standing rather than flowing waters, had not previously been traditional targets for imperial architectural patronage.

In the Buildings, we can also observe important diversions from Roman precedents for imperial water management, insofar as cisterns and reservoirs have 1) become a kind of public architecture; 2) are associated with peace-time imperial patronage; and 3) portended a curious conflict between perceptions of omnipotent imperial power and the reality of resource scarcity in areas of strategic importance. These are highly significant facts, when Justinian’s predecessor Anastasius was so “pained” to hear of the “calamity” of city-dwellers drinking rainwater from cisterns in Jerusalem, that he was motivated to build an aqueduct.²⁷⁹

Cisterns and reservoirs were traditionally not included among the standard forms of public architecture praised by authors under the influence of Second Sophistic traditions for the Roman urban image: namely walls, aqueducts, baths, and temples/churches. The exclusion of cisterns and reservoirs is to some degree a factor of their low visibility: context is important to consider in this respect.

Whereas classical and Roman cisterns were a standard feature for rainwater

²⁷⁹ Procopius of Gaza, Chauvot trans., 18–19 (Greek) and 43–44 (French trans.). On the identification of Hierapolis with Jerusalem, rather than Hierapolis in Phrygia or Cilicia, see the mostly convincing argument of Jones 2007. Note too the presence of the inscription at Bethlehem, dated to the reign of Anastasius and repeating the prohibition of CTh 15.2.1 = SEG 8.171.
collection in domestic areas, they were not institutionalized or experienced like Roman public architecture. Late Antique cisterns became public architecture of an entirely new type, immense and accessible vaulted spaces like basilicas or hypostyle halls, with narrow stairs at the ends that could be descended by just a few persons at a time. Whereas Roman cisterns in North Africa and Anatolia were generally outside cities, barrel-vaulted and divided by walls, cisterns in the Late Antique eastern Mediterranean were urban, aisled and vaulted columnar spaces like hypostyle halls or basilicas, sometimes with inscriptions or statues of donors.²⁸⁰

The perceived inferiority of cisterns, and the aspersion cast on them by Roman authors, are part of a nearly hegemonic hierarchy of water’s potability from spring- and rain- or ground-water sources, as related by ancient medical writers and cultural commentators: springs were better than wells or ground-water, and running water was preferable to standing.²⁸¹ Cisterns fail on both counts. Sources perceived as inferior to aqueduct-fed spring water were acceptable for soldiers and military contexts, but were inappropriate as the primary water supplies for cities in peace-time, especially if provided by an imperial patron, for whom the only acceptable response to urban water shortage was, traditionally, the construction of an aqueduct.

²⁸⁰ For cistern inscriptions see for instance SEG 48.1867 from Resafa, or SEG 31.1475 from Madaba. For statues at cisterns see below sec. 2.9 for the statues of Aetios or Longinus/Justinian at their reservoirs in Constantinople.
²⁸¹ For references to medical opinions concerned with water, see above, n. 224.
Comparing the context in which cisterns are represented at Dara from sources besides Procopius will help make this point.

Evagrius Scholasticus provides a peace-time context for the development of Dara. He writes that “Now, after this war Anastasius established Dara, a place in Mesopotamia situated at the extremity of the Roman realm which is a boundary-marker, as it were, for the two states; he turned this from field into a city, fortifying it with a strong circuit wall and bestowing on it various remarkable constructions not only churches and other sacred buildings, but colonnades and public baths and other things with which distinguished cities are adorned.” Anastasius “turned [Dara] from a field into a city.”

Evagrius leans on a more traditional Roman image of cities, and consequently fails to mention cisterns – this evasive pattern holds elsewhere; additional examples could be cited.

On the other hand, Malalas describes Anastasius’s patronage of cisterns at Dara in the context of storage-efforts during the emperor’s war-time campaign against the Persians, as part of the fortification of a “powerful stronghold (ὀχυρόν),” outfitted with abundant grain and water. Malalas tells us that “Anastasios immediately fortified Dara, a place in Mesopotamia, as a very large and powerful stronghold, lying between the Roman and Persian frontiers. In it he built two

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282 The quote comes from Evagrius Scholasticus, 3.37, Whitby trans., 182.
283 References to cisterns are basically absent in histories like Tacitus or Ammianus Marcellinus; they emerge in association with urban elites in the fifth century chronicles like Marcellinus (for years 407 and 421), and with churchmen in monastic accounts (Lausiac History, Flor 4), before taking on imperial associations after Justinian’s sixth century.
public baths, churches, colonnades, warehouses for storing grain and cisterns for water (κιστέρνας ὑδάτων).”

Procopius too, identifies Justinian’s cistern construction at Dara in this broader war-time context of the Persian campaigns. And, in the rest of the Buildings, Procopius generally follows the more normative, conservative precedent image of emperors building cisterns only in military contexts: the author places Justinian’s cisterns and reservoirs at locations that are explicitly identified as fortifications (e.g. Thermopylae), or fortified refugia (e.g. Rhabdios or Hemerium), or as urban staging grounds on a war-time frontier (e.g. Antioch and Dara). Construction of cisterns and reservoirs at monasteries (e.g. 5.9.14) also fits this characterization: monks were soldiers for Christ in the good fight against sin and the devil, the ultimate war. Consumption of very little or inferior water from wells and cisterns was a mark of ascetic behavior, and self-denial.

It is in this peace-time context, then, that Procopius’s narrative of Justinian’s involvement at the Basilica Cistern becomes especially important. In Constantinople, cistern and reservoir construction was normally mediated by the intervention of patricians and urban prefects, until Justinian, when such

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284 Malalas 16.399, Jeffreys and Scott trans., 224.
285 For instance, Brown recounts how the ascetic renouncers who followed Amun into the Egyptian desert hermitages at Kellia and Nitria “burrowed into the depressions among the dunes, to form a series of tiny man–made oases, each with its own well, dug into the brackish water that seeped erratically beneath the sands from Lake Maroetis,” see Brown 2008, 215 and on Manichean ascetics’ self–denial of water, 202.
constructions also became an imperial prerogative.\textsuperscript{286} We know from Malalas and the \textit{Chronicon Paschale} that the urban prefect Longinus started the work on the Basilica Cistern, but Procopius gave credit to Justinian.\textsuperscript{287} A statue known to have stood above the reservoir in the Basilica’s courtyard could hypothetically be identified as, in its original dedication, either the urban prefect Longinus or the emperor Justinian: the \textit{Patria} preferred the identification with Justinian.\textsuperscript{288}

The frequency of non-imperial cistern and reservoir construction in Constantinople before Justinian reflects their popularity as a space for patronage and competition between elites for water-storage in the water-scarce capital. Whether these structures were at the service of larger, state-directed water management needs for distribution or consumption in public areas, or served as terminal neighborhood reservoirs under the control of their patrons – remains unclear.\textsuperscript{289} In the Roman imperial period, monumentally-scaled cisterns were more typically used as castella or intermediate distribution points, outside

\textsuperscript{286} Apart from the reservoirs at Constantinople, Resafa, and Athyras described in the \textit{Buildings}, Justinian’s involvement with reservoir construction is also attested independently at the Nea in Jerusalem, unmentioned by Procopius but monumentally huge, and embellished with an inscription that names the emperor as its patron, in association with the presbyter and abbot Constantine. For the Nea cistern’s inscription, see \textit{SEG} 27.1015 = ed. pr. Nahman Avigad, \textit{IEJ} 27 (1977) 145–151: Κ(αὶ) τοῦτο τὸ ἐργον ἐφιλοτιμήσα ὁ εὐσεβ(έστατος) Βασίλεις Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἰωςταντίνου | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἰωςταντίνου | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἰωςταντίνου | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἰωςταντίνου | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἰωςταντίνου | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἰωςταντίνου | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἐναβόωνος | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἐναβόωνος | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἐναβόωνος | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἐναβόωνος | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἐναβόωνος | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἐναβόωνος | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἐναβόωνος | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἐναβόωνος | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἐναβόωνος | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντίνου | ἴδιο(ες) Φλ(άουιος) Ἰουστιανὸς προς τοὺς ἑτεροτοῦς σπουδ(ίους) Ἐναβόωνος | 梭σσω(τοῦ) προς(ή) Εὐσεβίου τοῦ Κονσταντί

\textsuperscript{287} On this see Crow – Bardill – Bayliss 2008, 17–18; \textit{Chronicon Paschale} ann. 528, Whitby and Whitby trans., 110 or Malalas 18.482, Jeffrey's and Scott trans., 286.

\textsuperscript{288} \textit{Patria} 2.40, Berger trans., 74–5.

\textsuperscript{289} For a list of Constantinopolitan reservoirs and cisterns, see primarily Janin 1964\textsuperscript{2}, 198–215 for the literary accounts, also Forchheimer and Stryzgowski 1893 and Crow – Bayliss – Bardill 2008, 125–156; and most recently Altuğ 2012.
By contrast, the increased tendency to use reservoirs as terminal places of direct withdrawal and consumption inside cities is visible in the archaeological record for Late Antiquity. Late Antique structures were also more likely to be associated with the names of patrons, which were sometimes embellished with inscriptions, or even statues that have been identified as portraits of the donor. Besides the Basilica Cistern, such a statue is also recorded by the *Patria* to have stood at the fifth century Aetios Reservoir, for its eponymous patron, a competitor of Valentinian who was eventually executed for unnamed crimes. In my opinion, cisterns and reservoirs in Constantinople should be compared with the neighborhood-type structures in the provinces, where they are typically situated next to large houses, churches, or baths, or other administrative structures. There, cisterns and reservoirs more plainly served a competitive function, as a means for accruing resources and power, by creating water-dependencies in the surrounding neighborhood, where ramified pipe-delivery systems gradually carried water to fewer consumers. This pattern may in fact be visible in Constantinople, where the *Patria* records the frequent relationship of elite houses

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290 The large Roman reservoirs in North Africa were located outside the cities, rather than intra muros as becomes more typical in the late antique eastern Mediterranean. These installations were truly castella, used indirectly for the technical process of water distribution, but not directly for withdrawal and the satisfaction of daily water needs in an urban context, at least as originally intended. Their architectural form is nevertheless relevant, with access stairs on the interior for cleaning and maintenance that compare well with the primary access arrangements for later examples.

291 Aetios was executed after unspecified crimes against the state, and remembered by Procopius as “one of the last of the Romans” *Wars* 3.3.15. For the cistern and statue of Aetios, see *Patria* 2.70, Berger trans., 98-9 and quoting here from *ODB* 1:31  s.v. Aetius. Note also that the *Chronicon Paschale* records that “water was let into the cistern of the lady Pulcheria Augusta” in 421, a possible imperial cistern–building episode before Justinian, though the translators note that the author was probably confused with the cistern of Aetius, finished this same year, see *Chronicon Paschale* ann.421, Whitby and Whitby trans., 68.
to cisterns and/or baths in association with the names of particular quarters of the city.\textsuperscript{292}

Cisterns in the provinces were never patronized by emperors until Justinian; they were suitable forms of architectural patronage for middle-range local elites like bishops, however: this is why Pseudo-Zachariah the Rhetor’s gushes to tell of “wonderful cisterns in the city of Dara that received water” in the context of bishop Thomas’s intervention for the money and good will of emperor Anastasios’ money and good will.\textsuperscript{293} Epigraphy and other literary sources attest to the widespread involvement of bishops in the construction of hydraulic infrastructure, including cisterns and reservoirs, well before Justinian’s rescript of CE 530 officially gave responsibility for urban water infrastructure maintenance to the local bishop and three leading men (\textit{viri bonae/τρεῖς τῶν εὐπολέπτων}).\textsuperscript{294} Proconsuls and prefects may also have been responsible for cistern and reservoir construction in provincial cities, though their involvement is less apparent from the epigraphic record, where bishops and other churchmen are more visible.

\textsuperscript{292} For instance see \textit{Patria} 3.83-4, Berger trans., 180-1 for the cistern of Bonus, “his house was there,” during the reign of Heraclius (610–641); \textit{Patria} 3.141, Berger trans., 198-9 for τὰ Γερμανοῦ, the house of Germanus which was built during the reign of Valentinian I or Gratian (r. 364–375 or 375–383) and later converted into a bath; \textit{Patria} 3.197, Berger trans., 218-9 for τὰ Σμάραγδες with bath during the reign of Tiberius I (578–582).

\textsuperscript{293} Zachariah of Mytilene 7.6, Greatrex trans., 247–251: “While King Kavadhh was fighting with the Tamorâyê and other enemies of his country...[the Emperor Anastasius gave gold to bishop Thomas for management of construction projects in the city] A large bath and a spacious storehouse were built, and an aqueduct that came to the outskirts of the mountain, and wonderful cisterns in the city that received the water. And persons to hasten the work were frequently sent from the king to the bishop, and they all brought back excellent reports of his integrity and justice to the king; and he was greatly pleased with the man.”

\textsuperscript{294} \textit{CIC CI} 2.1.4.26.
One component of imperial disdain for cistern- and reservoir-water should be sought in their relation to notional concepts of resource scarcity and abundance. In Book I, Procopius describes how the Basilica Cistern was constructed with economizing measures taken to preserve the overflow from the Hadrianic aqueduct. We see the same motivation emerging from Procopius’s treatment of Athyras, in Thrace, later in the Buildings, where Justinian built “a reservoir there, in which by storing at just the right time the unnecessary excess of water, he dispensed it as needed to the inhabitants” (4.8.18). Because Procopius elsewhere stuck to traditional models of aqueduct-supplies for cities, he may have surprised his readers when he made Justinian out to be an arbiter of water conservation practices unheard of at the level of imperial patronage. Justinian became, effectively, the Late Antique water-equivalent of Jimmy Carter encouraging people to consume less and wear sweaters to save heating gas. The new motif of economization is blended back into abundance, however, in the description of Resafa, where Justinian “stored up a great quantity of water (ὑδατων θησαυρίσας…ἐσκευάσατο) and thus provided inhabitants with a bountiful supply” (2.9.6-7). Despite their traditional inferiority in the hierarchy of urban water sources, by emphasizing Justinian’s foresight in pursuit of economization, Procopius renders cisterns and reservoirs as a positive if unorthodox tool with which emperors can create abundance from scarcity.

295 The reservoirs project at Resafa is firmly connected by epigraphy to a local bishop, see SEG 48.1867 and most recently, Ulbert 2008, here at 143–146.
We see elsewhere in the *Buildings* how cisterns and wells have become important to the imperial project. At Antioch, one of the five largest cities in the sixth-century empire – “Justinian built baths and cisterns on these hills inside the city-wall. He dug a cistern in each tower, remedying by means of rain water the shortage of water which had previously existed there” (2.10.14). Outside of Antioch, Procopius narrates the completion of projects at *phouria* that functioned as *refugia* for local populations in times of duress, and which provided water derived from sources other than an aqueduct or springs: at Rhabdios (2.4.1-13), cistern construction coincided with the erection of fortifications, with channels for rain-water "dug … into the rock in many directions.” At the mountainside fort of Baras (2.4.22-24), Procopius describes with great elaboration the following instructions given by Justinian: “He bade them dig within the fortifications until they came approximately to the level of the plain. And when this work was completed according to the Emperor's instructions, water was found there, contrary to all expectation, running in from the spring.” This is, of course, a rather circuitous description of a well, dug down to the level of the water table.

Because Procopius writes so disdainfully about wells and cisterns in the *Secret History* 26, echoing the complaints of conservative Romans before him, we should consider that Procopius’s praise for reservoirs, cisterns, and wells in the *Buildings* could have been a tactful way of drawing attention to what he described as a fundamental transformation of the *polis* and empire’s relationship
to water, or expectations of its abundance. Nevertheless, Procopius considerably expanded older topoi concerned with the palette of water architecture projects befitting an emperor’s attention, elevating the prestige accorded to reservoirs and cisterns by associating them with the same quality of abundance that so defined the water-supply projects of previous emperors, and which had previously been limited to aqueducts. This was likely not a mere rhetorical invention by Procopius, but arguably reflects real changes of priority at the imperial level, that elevated the status of ground- and rain-water sources: Justinian is also attributed with the installation of the Holy Well in the baptistery of Hagia Sophia (with the stone well-head, where Christ met the Samaritan woman, brought from Palestine), and an explicitly rainwater-fed cistern richly decorated with carved animals for the exclusive use of clerical ablutions in that church’s south aisle.296 Justinian’s innovations persevered, or at least became commonly accepted, because his successors297 (and neighboring caliphs298) are similarly connected to reservoir and cistern construction.

296 See Patria 4.22 and 4.26, Berger trans., 260-7 for the Holy Well and the water installations at Hagia Sophia, attributed here to Justinian’s original construction and embellishment of the church
298 For Hisham (r. 724–743) building reservoirs and subterranean conduits on the hajj route to Mecca, see al–Masudi, de Meynard trans., 5: 466.
2.10 River management: bridges, dams, and drainage

The Buildings of Procopius says: “There is a river in Galatia which the natives call Siberis … This river often rose suddenly to a great height and caused the death of many of those traveling that way. The Emperor was disturbed when these things were reported to him, and he put a stop to the evil thenceforth by bridging the river with a strong structure capable of resisting the stream when in flood, and by adding another wall in the form of a jetty on the eastward side of the bridge; such a thing is called a promachon or a breakwater by those skilled in these matters. He also built a church to the west of the bridge to be a refuge for travelers in the winter season.” Procopius’s passage follows a rhetorical model familiar from other episodes in the Buildings, and from earlier Roman panegyrics for imperially-directed construction: it begins with the emperor gaining knowledge or foresight of catastrophe, owing to his concern “for the safety of the State.” Justinian responds to disaster, past or impending, quickly and efficiently. He organizes skilled labor and marshals resources from afar in his palace at Constantinople. Using the classical language of patronage, and in synecdoche for a whole network of laborers, Justinian is inscribed as the patron of all the work and resources invested in monumental construction. The power to divert or control rivers – marked by a monumental physical signifier, whether a simple wooden cross or architecture like bridges or dams and dikes – is a standard trope in both hagiography and imperial panegyric, but hagiographers

299 Brown 2006, 120 indicates that traces of this bridge were found in the course of the Tahirler Project survey, though they were not included in the fourth/2001 season’s report, accessible at http://courses.washington.edu/tahirler/reports.html.
contemporary to Procopius employed a very different, decidedly less architectural toolkit for the same effect, namely to ensure the safety of life at the crossing.

The life of Theodore of Sykeon, written perhaps fifty years after Procopius’s *Buildings*, presents a very different solution for the same problem on the same river, if not potentially the very same crossing. The hagiographer, making no reference to any bridge built by Justinian, says:

“The river Siberis, as it ran through the village of Sykeon, passed close to the cornfields and was undermining the arable land and little by little carrying away much of the soil; so the Saint, trusting fully in God, came and ordered the river in the name of Christ to change its bed and no longer approach the cornfields. After planting a wooden cross and offering a prayer, by the grace of God he induced the river to quit those fields. In the same river several men had met a violent death when crossing it, so this ever memorable man went right into the middle of the river at the spot where the accident had occurred and by offering fervent prayer to God he, by the mercies of Christ, made the river, from that time forth, always safe and easy to cross.”

In this passage, Theodore’s piety and knowledge of God supersedes human *techne* and knowledge of architectural responses to uncontrollable water or weather. The author is at pains to stress the physicality of the miracle with the motif of the saint's staff, which left a permanent, physical monument on the landscape in the form of the tree, and also that the chief benefit of this miracle was utility and *philanthropeia* – the proper result of classical *euergetism* – precisely as also in Procopius. Owing to the visibility of church involvement in

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infrastructure like bridges, one might suppose that hagiography in fact served as a rationalization or aetiology for these wider, evolving patterns of investment in areas that were traditionally state prerogatives.\textsuperscript{301}

Such overlapping approaches reveal the formation of alternative discourses offering different solutions to the same problems of empire, and underline the conservatism of Procopius’s reliance on normative Roman standards, which called for a representation of Justinian as an emperor engaged in massively scaled landscape transformations, which helped constitute the imperium which he claimed. Indeed, Procopius tells us (4.2.11-12) that Justinian was capable of the “the most striking union of the most opposite elements” – like earth and water – “which are thus forced to yield to man’s skill and to bow to his superior power.” Bridge and dam construction are obvious manifestations of this power; episodes of repairs to fortifications frequently also included the diversion of rivers near towns. On the seasonally-flooded river Dracon outside of Helenopolis in Bithynia, Procopius describes a larger, more complex, and multi-component intervention into the entire rivershed, which included forest and marsh clearance to facilitate the river’s flow-through, hill-leveling and river diversion, construction of new wagon-roads, and the erection of two bridges (5.2.10-13).

\textsuperscript{301} For instance an inscription built into a bridge at Temelli records its construction by a bishop Paul, see Mitchell 1982, #226; Foss 1977, 59 identified this Paul as the same bishop who ordained Theodore of Sykeon as bishop of Anastasiopolis around 580 CE.
But a distinct pragmatism has also crept into the *Buildings*. For instance, at 
Bizana in Armenia, Procopius tells us that “nothing was done by this Emperor” 
(3.5.13): he describes how “there are many pools of standing water there” which 
makes it “very open to the enemy’s attack, [and] most unhealthy for the 
inhabitants.” The drainage problems made building fortifications impossible, so 
Justinian “pass[ed] over this town” and resettled its inhabitants nearby. Similarly, 
the two towns of Photicê and Phoenicê in Epirus “stood on low-lying ground and 
were surrounded by stagnant water,” for which reasons of poor drainage 
Justinian “reasoned that it was impossible for walls to be built about them”: he 
built *phouria* on nearby hills, instead (4.1.37-38).

Contemporary sources elsewhere also point to a shift in procedure and attitudes, 
with less programmatic, more arbitrary and reactive imperial interventions in river 
management, specifically on the Maeander plain: Feissel draws our attention to 
an important inscription, discovered at Didyma, which records Justinian’s rescript 
issued in response to a petition concerning the tax status of alluvial land around 
Miletus. The citizens of Didyma, a kôme upgraded to the status of polis and 
renamed Iustinianoupolis between 527 and 533, successfully appealed to the 
emperor to have the burden of their own tax assessment (61 solidi) transferred to 
territories belonging to Miletus. Specifically, they suggest that this sum be taken 
from “the places which have been turned into land by the Maeander river, having

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previously been sea," which "have now become subject to taxation." In the context of the Maeander delta’s continuous augmentation, Thönemann reads this action as "simply not covered by the existing legislation at all;" rather this was "an ad hoc judgment," "determined entirely by the accidents of local petition and imperial patronage."

2.11 Pollution

Procopius’s framework for water management was statist or top-down, and driven by infrastructural problems of water shortage and superabundance. The problem of pollution exposes the weakness of this approach in exclusion, leaving Procopius at a loss for options. In the second book of the Buildings, Procopius begins to tell of Justinian’s successful efforts at managing polluted urban water at Syrian Hierapolis, a clean lake source corrupted by dumping garbage and washing, but the author unexpectedly trails off mid-sentence (2.9.12-17). Was this section left unfinished, or was the problem of urban water pollution simply beyond the author’s ken?

Military zones could be regulated more directly than towns, insofar as soldiers could be ordered not to use rivers upstream of urban areas as latrines, for

303 ibid., 298–299: Τῶν ἀπογεωθέντων υπὸ τοῦ Μεάνδρου ποταμοῦ, ἰς τὸν ἔμπροσθεν χρόνον θαλαττίων ὄντων (l. 61–2) ... ὑποφόρων δὲ γενομένων ... (l. 11–2).
304 The legislation in question are Gaius’s doctrine of accretion, and CIC Nov 20 (CE 440), which do not distinguish between short- and long-term changes in river alluviation, but rather are concerned with the back-and-forth of property boundary-line changes along changing rivers; they order that alluvial lands made arable by luck or labor are not subject to taxation, presumably so as to limit frequent changes to cadasters. See Thönemann 2011, 312.
305 Quotes from ibid., 314.
instance.\textsuperscript{306} And, it was common advice in tactical literature that latrines
belonged outside camp perimeters, or that horses were to be watered
downstream from settlements.\textsuperscript{307} But urban pollution was more difficult from a
state perspective, because the inhabitants of cities were more difficult to control.
Procopius shows an awareness of pollution as a vector of disease, but he offers
no solutions. This is arguably because industrial byproducts and biological
contamination are less susceptible to architectural or physical intervention in the
environment after the fact. The state never sought to impose itself on polluting
activities or behaviors in relation to water-sources. Rather, it provided procedure
for private citizens seeking damages against one another: legislation in the sixth
century concerned itself with the corruption of private wells \textit{quod vi} (the forcible
or secretive change of another’s properties),\textsuperscript{308} and damages for private springs
polluted by fulleries or industrial activities nearby.\textsuperscript{309}

\textbf{2.12 Conclusions: Characterizing water in the \textit{Buildings}}

The value of the \textit{Buildings} is not predicated upon the un-/reliability of individual
sections, but rather upon its character and goals as part of a larger work that
witnessed a period of decisive change in the way that Romans perceived the
proper management of water. These representations of water infrastructure and
management stand apart from Roman precedents or contemporary sources: the

\textit{Buildings} remains superficially conservative insofar as it adopts Roman hydraulic

\textsuperscript{306} \textit{CTh} 7.1.13 = \textit{CIC Cl} 12.35.12.
\textsuperscript{307} On military awareness of the effects, but not the precise cause, of water-source pollution, see
Haldon 2014, 256, citing also older sources like Vegetius 3.2.12.
\textsuperscript{308} \textit{CIC Dig} 43.24.11 = Bas. 58.23.11.
\textsuperscript{309} \textit{CIC Dig} 39.3.3 = Bas. 58.13.3.
paradigms into the genre of panegyric. But upon closer inspection, Procopius’s text reveals itself as an index of evolving water management behaviors and attitudes, long in motion, which were not begun but merely formalized during the reign of Justinian. The *Buildings* absolutely creaks with the irreconcilability of the sixth-century’s reality, and the inherited language and concepts adopted by Procopius in his panegyric, which both constrained the ideological limits of his representations of water, and upon admixture of genres provided him with space for innovations that reflected real changes in imperial attitudes to older Roman cities and water management practices. These innovations may have unnerved Procopius’s fellow cultural conservatives, whether or not this was intended by the author. Such incongruities are not isolated or “arbitrary,” as Cameron postulated, but rather stand as a cohesive body of literary evidence. Whether or not we read the *Buildings* as wholly supportive of Justinian’s regime (following Cameron’s paradigm), or conversely à la Rousseau and Kaldellis as subversive, we should acknowledge that the *Buildings* is in fact deeply reflective of the changed character of water infrastructure and management in Roman cities during Procopius’s sixth century.

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310 Cameron 1985, 86.
3.1. Introduction

The *Washington Post* recently reported on the urgent need for repair of Washington D.C.’s sewers and water mains, many of which were installed during the Lincoln administration in the 1860s.\(^{311}\) This danger is not localized to the capital, but extends out into the American provinces, where decay and downright negligence are exacerbated by natural disasters and misuse, which threaten the infrastructure of urban water supply to which American society has grown accustomed.\(^{312}\) What is the greatest threat to recovery according to the *Post*? Not a gap in technological prowess, or a shift in cultural attitudes that makes recovery of these systems less imperative, but rather a lack of administrative will to find the billions of dollars required to do the job – more than $625 billion is needed to repair America’s aging water systems nationally, a cost that is daily exacerbated by leaky pipes losing a quarter of all water in transit, before it even reaches consumers.\(^{313}\) Less visible in the *Post’s* account are other factors that should concern us. Industrial accidents pollute city water supplies, as they did in West Virginia and North Carolina in early 2013;\(^{314}\) overconsumption and urban/rural imbalances threaten the residents of towns in the American

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\(^{311}\) Halsey 2012.  
\(^{312}\) In the 1950s, a quarter of American houses lacked indoor plumbing in toilets. In the 2010s, less than one half of a percent lacked them.  
\(^{313}\) American Society of Civil Engineers 2011.  
\(^{314}\) Achenbach 2014.
Southwest and California;\textsuperscript{315} and natural disasters are still regularly attributed to our collective, national sins: usually abortion and homosexuality.\textsuperscript{316}

Technological solutions are eagerly sought, but none appear forthcoming. Even including desalination, the technologies at our disposal – dams, bridges, aqueducts, pressurized pipe distribution – these were all discovered by Hellenistic and Roman hydraulic engineers two thousand years ago, anyways.\textsuperscript{317} The pace of climate change today is arguably accelerating, but water supply problems in cities remain – as in antiquity, see infra chapter 1 – not only a climatic problem, but rather mostly administrative, social, and cultural problems.\textsuperscript{318}

As Kaika describes it, modern western cultures are characterized by this same sense of wonder for water-technology – any problems we might have should be fixed with architecture and engineering advances, rather than at the level of culture or society. This sense of wonder for engineering and technology is the driving cause for modern touristic adventures at the Hoover Dam, which draws 7 million tourists annually.\textsuperscript{319} Not coincidentally, Kalka points out, we are beset by

\begin{footnotesize}
\begin{enumerate}
\item Reisner 1993.
\item Examples are legion, but for instance see the list by Garcia 2012.
\item For instance see Wilson 2008, and for a useful global overview of the development of water’s technological history, putting Mediterranean developments in comparison with other areas and cultures, see Mithen 2012.
\item deBuys 2011.
\item http://www.nps.gov/nr/travel/ReclamationDamsAndWaterProjects/Hoover_Dam.html.
\end{enumerate}
\end{footnotesize}
the fetishization of water as a commodity. In a Marxian sense, this means that the sophistication of technology enables us to separate 1) water’s source in nature from the taps in our homes, and 2) water’s distribution from its social costs. These are cultural blinders which, until systems fail, make it difficult to tangibly relate our own consumption behaviors to water planning and conservation, or to understand how seemingly distant environments and people can be bound up with our own lives through water supply networks. We moderns parade our Roman inheritance by dressing up water infrastructure in the guise of Roman architecture like temples, as at the Pulgo Water Temple, which was built to commemorate the completion of the Hetch Hetchy aqueduct’s supply to San Francisco in 1934 (Fig. 3.1). All of the water supply technologies that we depend on daily were originally Hellenistic or Roman inventions, including desalination (Fig. 3.2). The difference is the way that they have been scaled up and improved since antiquity with modern building materials and labor systems.

Regardless of how one might position modern western water systems vis-à-vis ancient Rome or Constantinople, we could do worse than to look to Gibbon’s Decline and Fall, itself written just as modern water systems were emergent in late eighteenth century London, to better understand our own complicated inheritance from Roman water culture. Gibbon, following Frontinus, eulogized

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320 Kaika 2005.
321 This is the fetishization of commodities, discussed by Marx 1867, Bk. I.i.4.
Roman aqueducts for their utility, their ability to facilitate urban growth. Gibbon wrote that, in the time of Trajan, or between 98 and 117 CE:

All the … provinces of the empire, were embellished by the same liberal spirit of public magnificence, and were filled with … temples, … baths, and aqueducts, all conducive to the health, the devotion, and the pleasures of the meanest citizen. … Aqueducts, deserve our peculiar attention. The boldness of the enterprise, the solidity of the execution, and the uses to which they were subservient, rank the aqueducts among the noblest monuments of Roman genius and power. … The solitudes of Asia and Africa were once covered with flourishing cities…whose existence was derived from such artificial supplies of a perennial stream of fresh water.

Here Gibbon makes explicit the relationship of running water to empire and health, of artificial water supplies tied firmly to high population densities and the survival of urban culture as a whole. It might come as no surprise that we can observe a similarly Gibbonian impulse in the historiography of Late Antique cities.\textsuperscript{322} There, a functionalist interpretation of water infrastructure has also predominated – Roman aqueducts were simply either maintained or abandoned.\textsuperscript{323}

This has unfortunately precluded any detailed discussion of how aqueducts were perceived, changed, and adapted to new intentions and circumstances; or how a new palette of water-management options evolved over the longue durée cultural through the course of several centuries, leading up to the roundly well agreed

\textsuperscript{322} Note for instance Albert Grenier 1960, 226 who follows Rostovtzeff before him when he says that “la ruine des aqueducs avait été, avec la ruine des grandes villes, l’origine de toute notre histoire générale depuis la fin de l’ère de prospérité romaine.”

\textsuperscript{323} That is to say, when summoned as evidence in larger historical arguments, aqueducts tend to be reduced to the moment of their construction, or their collapse and failure – which is usually attributed to earthquake, see below.
upon seventh or eighth century horizon for the survival of most Roman cities and their aqueducts in the Eastern Mediterranean. Rather than simply writing of broad seventh or eighth century water system collapse – which is not entirely borne out by the archaeological evidence anyways – we might aspire to consider Late Roman water culture as it changed, why it changed, and on what terms, as Romans themselves might have experienced or understood it.

As a genre of architectural and cultural production, aqueducts provide an excellent space for examining these changes: this chapter begins with a very brief introduction to techno-ideological history of aqueducts and spring-water supply systems in Hellenistic and Roman cities, before considering how these technological dimensions constrained aqueduct survival in Late Antiquity. Then we will introduce an inscription that highlights the uniquely Roman relationship between spring water consumption and empire, as a spring-board into a wider discussion of the transformation, survival and demise of Roman aqueducts during Late Antiquity. Here, we will consider how aqueducts were a locus for broader social conflicts and re-negotiations that concerned the perceived value of water in cities. Then, we will examine how aqueducts were adapted in Roman cities to new intentions – often church or state directed, rather than as purely organic markers of encroachment – that shifted cities away from

324 See for instance Haldon 1985, esp. p. 86-7 for the basic point [expanded in Haldon 1997] that “cities were no longer centres of self-governing administrative regions responsible for providing both their own and imperial revenues…By the seventh century, cities were becoming merely the seats of administrative establishments which regulated the surrounding regions…City buildings important to the state were now maintained by the latter, with defences being frequently first on the list.”
characteristically Roman patterns of display and drainage, towards new ideals and applications for utility, industry, and storage. Finally, an examination of water resources in the metropolitan and military capitals of the later empire will assess how water availability may have structured shifting urban morphologies and settlement patterns after the fourth century in the Eastern Mediterranean.

3.2 Aqueducts and spring water supplies in Mediterranean history

Originally, the θαῦμα or wonder of producing water in great quantities where it did not naturally belong was deeply linked to kingship and the divine across the ancient Mediterranean.\textsuperscript{325} The tradition of establishing sanctuaries on the sites of natural springs was deeply ancient, but artificial water systems could create the same effect (whether by gravity flow open / unpressurized channels or closed / pressurized pipes).\textsuperscript{326} Besides technological classifications, it is also important to distinguish between the contexts in which these systems developed: first for elevated temple-sanctuaries and palatial / elite residences, and only much later for broader distribution in non-elite communities, beginning in the Hellenistic period in the city states of western Anatolia like Priene, before they reached an apogee in the imperial Roman period.

\textsuperscript{325} The representation of water supply systems in antiquity is of course just one corollary of the broader encounter between imperium and nature, including also river diversion (Cyrus diverts Euphrates to allow army crossing on foot across the river into Babylonia, see Herodotus I.89), river management for agriculture (Nikotris on the Euphrates, see Herodotus I.185-7), dam or bridge construction (Xerxes on the Hellespont, see Herodotus VII.34), canal building (Xerxes canal across the Athros in Northern Greece, see Herodotus VII.22-24), and so on.

\textsuperscript{326} Birge 1994, 240 notes more than eighty shrines or temples identified by Pausanias in association with springs, fountains, or other water sources nearby.
We should locate the technological- and contextual- origins of open channel and inverted siphon systems in notional concepts of kingship and the divine – too little explored in scholarship – before we consider how these systems proliferated in Roman cities and were variably inherited by denizens of the empire during Late Antiquity.

3.2a Open channel / unpressurized gravity flow systems
The Assyrian king Sennacherib built an extraordinary open channel system that survives today at Jerwan (north of Mosul, Iraq) (Fig. 3.3). Delivering vastly greater volumes of water than contemporary Greek systems, Sennacherib’s aqueduct was built between 703-690 BCE to supply water to his capital at Nineveh, or as some would have it, even to the Hanging Gardens of Babylon.\(^{327}\) Supplied not by a spring but by waters drafted from the Khosr river, this system is more properly a canal lined with masonry walls – near Bandwai it is 80m wide and 20m in depth – though its remarkable bridge crossing over the Khenis river, with sluice gates on the river below, explains the ambiguous relationship of this structure to aqueducts. Four inscriptions repeat a refrain for kingly conquest over nature that would resonate in later Roman centuries, ascribing responsibility for construction to the monarch, boasting of his imperium: “Sennacherib, king of the world, king of Assyria, (says): ‘For a long distance, adding to it the waters of [rivers and springs], I caused a canal to be dug to the meadows of Nineveh. Over

\(^{327}\) Dalley 2013 made this argument; see also the critical review by T. Potts, “Looking for the Hanging Gardens” in the New York Review of Books, 26 Sept 2013.
deep-cut ravines I spanned a bridge of white stone blocks. Those waters I caused to pass over upon it."  

An open channel aqueduct system at the Middle Elamite royal capital of Susa in Persia is even older, dating from c. 1500 – 1100 BCE,\textsuperscript{329} around which time gravity-flow systems are also known at the Minoan sanctuary-city of Tylissos and the Mycenaean palace at Pylos.\textsuperscript{330} If the inverted siphon was also invented in this period, it is doubtful that the technology survived the Minoan/Mycenaean collapse, because all of the Archaic and Classical Greek systems carried water by simple, unpressurized flows through open channels alone. Witness, for instance, the Peisistratid tyrants’ open-channel line from Mt Hymettos that terminated in central Athens below the Acropolis, or the Eupalinos tunnel and pipe on Samos built by the tyrant Polycrates, both from the sixth century BCE.\textsuperscript{331}

Open channel systems were widely adopted for Roman and Byzantine period aqueduct construction, beginning with Rome’s first aqueduct, the Aqua Appia built after 312 BCE (with frequent imperial and Late Antique repairs thereafter), to the seventh century CE aqueduct system built for Salamis in present-day Northern Cyprus, near Famagusta.\textsuperscript{332}

\textsuperscript{328} Translation of Inscription B, from Jacobson and Lloyd 1935, 20.  
\textsuperscript{329} De Mecquenem 1931, 330-343.  
\textsuperscript{330} Mays 2010.  
\textsuperscript{331} Crouch 1993, 59 and Apostol 2004.  
\textsuperscript{332} Most recently on the Salamis aqueduct see Stewart 2012.
3.2B Inverted siphons

Inverted siphons work on the technological principle of water rising to its own level (Fig. 3.4). That is, water led under pressure through a sealed pipe down a valley on one side will rise on the other side to nearly the same height or altitude, less the factors of pipe diameter and friction. They are the opposite of ‘normal siphon’ systems, by which water is raised from one reservoir over a hill to another reservoir at a slightly higher level.\(^\text{333}\) Excepting a disputed example from Knossos, inverted siphons were probably invented in the sixth or fifth century BCE. At the Palace in Minoan Knossos as early as the Neopalatial period (c. 1700 – 1400 BCE), Sir Arthur Evans found terracotta pipes fitted and cemented into one another, but it remains debated whether the system he found worked as an inverted siphon under pressure, or was simply a gravity-flow system carried in a pipe, as seems more likely.\(^\text{334}\) Indeed, inverted siphons are known nowhere else before the sixth or fifth century BCE. The period between the purported Minoan Knossos system and the sixth/fifth century BCE did however witness the proliferation of longer distance, open-channel spring-fed waterlines in stone channels or pipes. Inverted siphons developed for larger scale use, distributing water for the non-elite public in cities only after the sixth- or fifth-century BCE, probably first in Asia Minor in the period of Roman imperium.

\(^{333}\) Temporelli and De Novellis 2010, here at 446. The siphon was comparatively little used: one example comes from Termini Imerese, near Palermo, where “an intermediate tank [was] positioned above the grade line giving origin” to a siphon combined with an inverted siphon, or a so-called “double siphon” (ibid, 451).

One of the oldest inverted siphons can be found at the free city of Olynthos, in north Greece. This aqueduct terminated at a public fountain in the agora, from which point it was distributed to baths, as well as basins and cisterns near residential insulae. It dates sometime between the sixth and fourth centuries BCE, with a fifth century date being more likely. Olynthos, despite being among the oldest inverted siphons, is also something of an exception so far as the broader scheme of urban water distribution was concerned. The oldest inverted siphons were not adopted to supply the non-elite public – who still relied on rivers, wells, and cisterns – but rather carried water destined for sanctuaries and palaces or elite residences.

A close chronological contender to the Olynthos system is the Galermi aqueduct at Syracuse in Sicily, traditionally dated to the reign of the Deinomenid tyrant Gelon around 450 BCE. No terra-cotta or stone pipe sections have survived, and the siphon's presence is inferred only from the elevation of the line's source high on a mountain, which would have created a significant head of pressure and

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335 Olynthos's five mile line was observed by Robinson in 1930 leaving the area of Hagios Nicholas and Polygyros, entering the city from the N. Some of its sections were associated with black-figure pottery, for which reason it was dated sixth – fourth centuries BCE, the latter date favored by Crouch 1993, 172-3.

336 Several other possible Hellenistic siphons can be disregarded.

1) The Methymna aqueduct on Lesbos features an inverted siphon, but its date has been debated – Merckel and Koldewey though it Hellenistic, while Yolos more sensibly categorizes it as Roman. See Merckel 1899, 506 and Lolos 1997, 310.

2) The third century BCE Lysimachean aqueduct at Ephesus was probably not a siphon: its ceramic pipes lack flared or belled ends that would have promoted a tighter fit between sections to maintain pressure. In any case its source remains unknown, making conclusions difficult one way or the other. See Wiplinger 2006, 121-126 and Wiplinger 2008, 313.
naturally facilitated the creation of an inverted siphon.\textsuperscript{337} There is no firm indication of the line’s terminus, though Gelon is known to have built temples for Demeter and Kore contemporary to the creation of Syracuse's aqueducts. Temples for Diana or Athena were also suggested as possibilities for the terminus of the aqueduct by Schubring.\textsuperscript{338}

More secure is the well preserved but rather later inverted siphon built at Pergamon by Eumenes II (197 - 159 BCE). A 3km long inverted siphon of stone pipes was set on the 45km Madradağ aqueduct line in order to raise water up to the level of Pergamon’s acropolis, where it terminated in a fountain outside the ancient sanctuary of Demeter. The Antigonid palace supply was a happy corollary of the aqueduct supply to the temple precinct.\textsuperscript{339}

Roman aqueducts adopted inverted siphons in delivery systems about the same time, using a similar strategy of terminating or distributing lines near temples: the earliest siphon in Rome\textsuperscript{340} seems to be the Capitoline terminus of the Aqua

\textsuperscript{337} The Syracuse conduits, which pass in a tunnel under the sea to the island of Ortygia, were destroyed by the Athenians during the Sicilian Expedition, according to Thucydides VI.100. For the Syracuse siphon, see Crouch 1993, 119 and Crouch 1990, 271-278, with references to the earlier literature, chiefly the unreliable Neuburger 1930, 56.

\textsuperscript{338} Diodorus Siculus 11.26 notes Gelon’s construction of temples to Demeter and Kore contemporary to the creation of water supply and drainage systems in the city, following his triumph over the Carthaginians; 5.2 records the importance of Demeter and Kore to the Syracusans more generally. See also Schubring 1865, here at 637.

\textsuperscript{339} Marcus Aurelius (c. 170 CE) later added an extension to the Madradağ line that supplied a baths complex in the lower city. See Garbrecht and Fahlbusch 2004, 189-90.

\textsuperscript{340} Soon after Marcius’s siphon on the Capitoline, arguably the next oldest Roman siphon system is from Alatri in Lazio (134 BCE), which used small-diameter cast lead pipes that are ably discussed by Hodge and de Montauzan. Its terminus within the Roman city of Alatri is not known. Its pipes are 10.5cm in diameter, linked together for a siphon at a maximum depth of 100m. One stamp survives, for the builder L. Betilienus Varus (\textit{CIL} I\textsuperscript{2}.1529) who ‘fistulas solidas fecit’. See
Marcia, completed by Q. Marcius Rex in 140 BCE, whose statue by the temple of Jupiter Optimus Maximus is noted in a military diploma of 64 CE. Denarii struck by Marcius Philippus c. 56 BCE show a horse and rider on a bridge, below whose arches is inscribed AQUA MAR: the equestrian group may be a reference to Marcius’s statue (Fig. 3.5). There are no traces of an aqueduct bridge crossing between the Quirinal and the Capitol, so we are left to conclude that the coin reverses are an early instance of visual shorthand for aqueduct, when the system in question was most probably a siphon off the main line, carrying a small supply in lead pipes up to the temple. The Aqua Marcia was later fitted with another inverted siphon, outside the city, that supplied the villa of Manlius Vopiscus, “a technical feat that aroused the admiration of Statius” in his Silvae (89 – 96 CE). All the other aqueducts in Rome, from the earliest (Aqua Appia, in 312 BCE) to the latest (Aqua Alexandrina, 226 CE), were not inverted siphons. Rather, they were simple, open gravity-flow channels that delivered water in

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341 See the Oxyrhynchus Epitome of Livy, s.v. 140 BCE, col. VII, lines 88-90: [Aqua Marcia in Capitolium contra Sibyllae carmina [perducta].
342 CIL III.846: ex tabula aenea, quae fixa est Romae in Capitolio post aedem Iovis O.M. in basi Q. Marcii Regis pr(aetoris).
343 See Crawford 1975, 425.
344 For the quote see Hodge 1983, 191, citing Statius’ Silvae 1.3.66-7. Hodge observes that Roman engineers adopted inverted siphons only where the valley to be crossed was deeper than 50m; otherwise gravity-flow bridges were preferred.
tunnels or atop striding arched bridges, either of which could maintain the water's delivery height as it streamed into the eternal city. After this brief review, we can conclude then that the earliest introduction of inverted siphons, perhaps in Syracuse but definitely in Rome and Pergamon, was often focused on temple complexes, with secondary benefits for royal or elite residences. At temples, inverted siphons were an artificial upgrade to the much older tradition of setting sanctuaries at natural springs, as were so famous at the Kastalian Spring of Delphi. The embellishment of unwatered holy places with fountains was one way to facilitate the expression of different facets of deity, and to provide water important for the maintenance of ritual purity or cultic rites. For instance, one might add a fountain to a hill-top shrine dedicated to Zeus Akraios, for whom water as a weather god had obvious connotations, but where a spring might not naturally occur. Because of the tendency to carry water uphill towards divinity in Roman cities, the Theodosian closure of temples in 395 CE thus had especial consequences for urban water distribution. We consider the fate of temple water during Late Antiquity in more detail below (see sec 3.14).

The visionary Arthur C. Clarke famously observed that sufficiently advanced technology is indistinguishable from magic. In a pre-industrial society, the ability

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345 Rabun Taylor has also speculated on the existence of other siphons at Rome, including up to two siphons on the Pons Agrippae for the Aqua Marcia or Anio Vetus from the period between 33 and 19 BCE. See Taylor 2000, 140.
346 Herod was an early adopter of both aqueducts with siphons, and palace bathing complexes.
347 Note several instances of aqueducts added to acropolis sanctuaries of Zeus Akraios, see below sec. 3.14.
to make running water appear in quantity in elevated, otherwise dry locations was a crucial component in the architectural expression of divine and earthly power. Complexity begets chaos, however, and inverted siphon systems were especially vulnerable to catastrophic failure – such failures could have quick and far-reaching consequences when large-scale, first-degree systems that supplied cities were involved. Accordingly, siphons were most profitably employed for the third- or fourth-degree distribution systems – easily repaired – that made water flow within neighborhoods or around individual houses, rather than the highly-complex first- or second-degree large-scale systems that supplied so many cities after the proliferation of inverted siphons in the mid-first century CE in Asia Minor (e.g. Lycian Patara) and a bit earlier in Gaul. A quick review of the Aqua Claudia is sufficient to make the point.

The surviving bridge sections of the Aqua Claudia (38 – 52 CE) that climb the Caelian and the Palatine were also arguably part of an inverted siphon system: rather than an arcaded bridge as tall as the Palatine itself, pressurized pipes on a slightly lower bridge were used to climb the hill. Nero tapped this line at the temple and garden of Spes Vetus on the Esquiline, just inside Porta Praenestina, at one of the highest places in the eastern city where several aqueducts entered

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348 Pompeii, with its numerous water pressure towers, provides excellent evidence for the ways in which inverted siphons were adapted for intra-urban delivery systems. The fistulae of Roman lead pipes are a window onto these smaller scale pressure systems, as studied by Bruun 1991. Notably, only one fistula is known from Constantinople [C/G 8611], “found in the nineteenth century as part of the fountain inserted into the serpent column on the Hippodrome." It is thought to date from the fourth or fifth century. See Crowe, Bardill, and Bayliss 2008, 142, with the quote from 227. Zonaras, ed. Büttner Wobst III, 157 also refers to a large lead conduit that Justinian reclaimed for building materials.
the city.\textsuperscript{349} Nero extended the Aqua Marcia from here to the top of the Caelian, where it terminated in a series of reservoirs adjacent to the Temple of Claudius.\textsuperscript{350} Another branch was added by Domitian to supply the Domus Flavia on the Palatine. The Aqua Claudia was apparently prone to technical problems: it was repaired in 71 CE after nine years of inoperation, only to be repaired again by Titus just a decade later.\textsuperscript{351} It was repaired a few decades later by Hadrian, and then by the Severans, before Late Antique repairs in the fourth century and by Pope Hadrian in the 770s.\textsuperscript{352} The Aqua Claudia’s unusually frequent repairs may be the results of fire or earthquake, as has been speculated, but also important is the fragility of large-scale siphon technology. The loss of pressure over a bridge, or a single blocked pipe could endanger systems that stretched for tens of kilometers, and supplied thousands of people with drinking water. This greatly complicated the organization and execution of repairs.

Dangers to siphon systems were acute and multiple – these included the immense pressure on pipes (1 atmosphere for every 10m in siphon depth), their gradual clogging with chalky sinter deposition from hard spring water at rates that varied according to local water and pipe conditions, and the necessity of

\textsuperscript{349} Frontinus 1.20 and 2.76. The aqua Appia, Augusta, Tepula, Anio Novus, and Marcia all ran through this place, ad spem veterem .
\textsuperscript{350} The temple itself was probably destroyed in this construction, part of its area and platform were then annexed into the Domus Palatina.
\textsuperscript{351} CIL VI.1257 for the repair from 71 CE.
\textsuperscript{352} For Hadrian’s repairs see Frontinus 2.72; for the fourth century repairs see Coates-Stephens 1998, here at 173 n. 20 and for Pope Hadrian’s repairs, LP 97.59.
maintaining perfectly airtight pipes along the length of the siphon to guarantee functionality and flow through the rest of the system.\textsuperscript{353}

### 3.3 Technological implications for aqueduct survival after antiquity

Inverted siphons were significantly more complex than open flow systems; they were more difficult to build and maintain. There is a direction relationship between the scale and complexity of siphon systems, and their tendency towards entropy, breakdown, and abandonment or replacement with simpler open-flow systems.

We can observe this tendency towards entropy and simplification – the replacement of pressurized with unpressurized systems – in archaeological evidence from across the Eastern Roman world. At Petra, probably sometime in the third century CE, the top halves of some water pipes in the Siq line were apparently crushed intentionally to “preserve the pressurized pipe from destruction through over-pressure inside,” thus transforming the inverted siphon pipeline into a small gravity-flow channel: similar interventions are known at Priene.\textsuperscript{354} At Pergamon, the Madradağ extension bridge was not repaired to full height after the earthquake of 262 CE, and a four-pipe conduit was installed on the lower arcade. Garbrecht associates the installation of a twin open-channel conduit on the lowest course of the Madradağ extension bridge with damage

\textsuperscript{353} Bridges from the aqua Claudia were still used as property boundaries in 1066, near the vineyard and monastery of S. Lawrence in Sassi, cf. Hülsen 1927, 296 s.v. L32 “S. Laurentii in Sassi.”

\textsuperscript{354} Bellwald 2004, here at 81.
incurred in any of the earthquakes between c. 358 - 368 CE. In the late fifth or sixth century, again possibly in relation to earthquakes of 467/8 or 526/8, a four-pipe system from the same spring was installed, following the contours of the hills to avoid the necessity of bridges.\footnote{For these repairs and simplifications of the Pergamon aqueducts, see Garbrecht 2003, here at 127-8 and Garbrecht and Fahlbusch 2004, 193.}

Probably the best known example of a Roman inverted siphon is the aqueduct at \textbf{Aspendos} in Lycia – a city perched above the Lycian plain on a sixty-acre flat-topped and fortified hill (Figs. 3.6-7). The city’s aqueduct and inverted siphon probably sustained comparable simplifications after the third or fourth century, which carried flowthrough via gravity to structures on the surrounding plain, at the expense of reverting the acropolis back to its former (Hellenistic) dependence on rainwater sources. Built by one Claudius Tiberius Italicus probably in the mid-third century CE at a cost of two million denarii,\footnote{IGRP III.804 and see the Appendix E.#62. For the construction dates, see Ward-Perkins 1955, 115-123 who points to the inscription and building materials for evidence of a date probably in the early or middle third century, with late second and late third as extreme limits. His reasoning is accepted by Kessener and others, who have concerned themselves with the technological functionality of the aqueduct’s bridge and inverted siphon. For the terminal date of the aqueduct bridge’s functionality, see Kessener 2011, 77-83.} the aqueduct is so complicated that hydraulic engineers today still argue about precisely how the water-towers functioned.\footnote{The function and purpose of the water towers is explained, with reference to new laboratory experiments and a thorough review of the older literature, in a paper by Paul Kessener, forthcoming in the proceedings of the \textit{De Aquaeductu atque Aquae Lyciae} conference, as a Babesch Suppl. / ÖAI Sonderschrift (2015). See previously Kessener and Piras 1998.} The basic picture is that water was carried south some 20km from the Gökcepinar ['Heavenly'] springs to a hill 1.5km across the valley north of the city, where it was fed into a pressurized channel that carried over a long arcaded
bridge, with the two massive pressure towers at either side. Despite wide agreement that the Aspendos aqueduct represents a triumph of Roman engineering, there has been much less acknowledgment of the system’s fragility and relatively quick demise and abandonment, probably after an earthquake between the later third century and 363 CE. This equates to an operational range of as much as 130-170 years, or as little as a few decades. There are no signs of repairs to the water towers: subtle differences in building techniques match from tower to tower, indicating deliberate choices in the composition of materials and labor in a single construction event, rather than multiple phases.358

Kessener has argued that the bridge’s header tank – marking the conversion of the line from an open gravity-flow conduit to a pressurized line, at the beginning of the inverted siphon before its descent – should be identified with a small rectangular construction of rubble and chipped bricks a few hundred meters north of the north pressure tower, near Sarıbalı village. While admitting that the structure is likely a header tank – before its apparent reuse for domestic purposes – the building technique used in the structure in question has, however, absolutely nothing to do with the fine ashlar and brickwork of the aqueduct bridge or pressure towers. Further, the tank is not on a direct line from the aqueduct, but is some twenty degrees or more to its west.359 Rather than a primary component of the inverted siphon system at Aspendos, the tank is arguably a relic of the

358 My thanks to Paul Kessener for this observation.
complex bridge-and-tower system’s abandonment, consequent with the salvage of the open-channel system carrying water in from the springs so far as the “header tank,” which fed the water into pipes for use downhill in the plain, rather than across the valley on the acropolis. The depth of the valley (~40m) from hill to hill likely created too much force for the pipeline to climb back up to the acropolis on the other side; arguably, the new pipeline instead fed the late Roman baths that were built southeast of the acropolis, with a simple open-channel, gravity powered descent.

Despite their fragility, the Roman state recognized the strategic potential of siphons: they were secure when buried as pipelines, could increase population-density potentials within fortified complexes, and by virtue of their point-to-point construction, facilitated control over the water from its terminal distribution point. These are especially important considerations in contexts where a city had an elevated, fortified acropolis used as a stronghold, which could be provided with water via siphon. For instance at Ancyra, an inverted siphon supplied the citadel with water, probably from springs at Elmadağ [c. 1250-1500m ASL, 15km]. The spring was connected via an open channel of limestone slabs for some 13km, before it was channelized into stone-blocks for the inverted siphon’s pressurized descent in the city.\footnote{Bennett took a different view, and argued that the inverted siphon blocks belonged to an aqueduct that should be sourced in the headwaters of the Ankara Çayı; see Bennett 2003, here at 8. French suggested a source in the Çubuk plain, see French 2003, here at 36.} Foss and Bennett argued that this siphon provided a
secure intra-muros supply for the citadel. Fıratlı was also inclined to this view: based on the location and elevation of inverted siphon blocks found in the city, he postulated a header tank in the area of Mamak – Aşağı İmrahor [c. 1000-950m ASL], from which water flowed 1-2km down to Cebeci [where stone-block pipes are first known, 870m ASL], and back up to a receiving tank in Atpazarı at Hisarkapısı, at the highest elevations of the citadel’s southeast flank [c. 940m ASL]. The municipality built a tank for the same purpose here in 1930, and it is still called Sutepe ['Water-hill'] Mahallesı today. The aqueduct at Ankara functioned at least until the fourth century, when an inscription records its restoration (see Appendix E.77) – how long the supply to the citadel was maintained is unclear, though its operationality must necessarily precede construction of the medieval walls that included sections of stone siphon blocks, perhaps in the later seventh or eighth century.

Inverted siphons continued to be built and maintained in Late Antiquity, though more often these were smaller scale, for third- and fourth- degree distribution of water to consumers on the principle of the inverted siphon, rather than for large-scale systems on which whole cities were dependent for supply. For instance, the Scholastikia baths at Ephesus were supplied by a branch of the gravity-flow Selinus/Marnas aqueduct line that ran through the theater towards the baths. Ceramic pipes ran down Akademiegasse under pressure (losing just a few

361 See Foss 1977, here at 64 and Bennett 2003, here at 8.
362 Fıratlı 1951, here at 350-1.
363 See Kaytan 2008, 28. Pipes and two fountains were also found near Hisarkapısı at the Temple of Rome and Augustus, see Fıratlı 1951, 352.
meters in elevation) before climbing back up the north wall of the bath’s caldarium: these pipes show signs of frequent repair and replacement in Late Antiquity; their last phase probably dates to the early or middle seventh century.\textsuperscript{364} An inverted siphon was also newly constructed at Hierapolis, where a shallow siphon crossed north across the St Philip bridge, before climbing a short distance back up the hill to supply the octagonal bath complex that was constructed there in the fifth century, contemporary with the martyrion.\textsuperscript{365}

Elsewhere, a fuller accounting of all the known inverted siphons from Asia Minor in primary supply roles reveals that nearly all of them – excepting portions of systems in Ephesus, Kibyra, Hierapolis, and perhaps Smyrna – were no longer functional after the fourth or fifth century.\textsuperscript{366}

The heavy stone- and clay-pipe elements that were frequently used in inverted siphons – owing to their capacity to withstand pressure, albeit inconsistently\textsuperscript{367} –

\textsuperscript{364} By virtue of the employment of pipes, identical to those found in the securely early-seventh century, water-powered stone mill complex in Hanghaus 2. See Pickett, forthcoming.
\textsuperscript{365} On the remains of pipes crossing the St Philip bridge, see D’Andria and Caggia 2007, 78 and D’Andria, Scardozzi, and Spanò 2008, 97.
\textsuperscript{366} For these boldened examples again refer to their listings in Appendix F. Besides the four that survived into late antiquity, inverted siphons in Asia Minor (confirmed or speculated) include Akmonia, Alabanda, Alinda, Ankara, Pisidian Antioch, Antioch on the Orontes, Apamea Kibotos, Aspendos, Blaundos, Gerga, Kremna, Laodikeia, Magnesia, Myslas, Miletus, Neocaesarea, Oenoanda, Patara, Pergamon, Philadelphia, Prymnnessos, Tralleis, Trapezopolis, and Tripolis ad Maeandrum. Speculation for the existence of an inverted siphon is usually on the basis of surviving sections of stone-pipe, though these were also used in open-flow systems, as at Cappadociam Tyana: see Appendix F on the unnecessary use of stone pipes in this open-flow system.
\textsuperscript{367} Note the observation by Coulton that stone blocks were considered for 19th century siphons supplying Glasgow in Scotland, but testing demonstrated a tremendous variation in their ability to withstand pressure – some split at little more than 20m of head, while others were intact with 30m of head; see Coulton 1987, here at 78.
were long-lived objects that found regular reemployment in medieval structures: notable for instance are the re-used stone siphon blocks embedded in the fortifications at Ancyra; stone siphon blocks re-used as façade decoration in the Seljuk turbe near the Artemision at Ephesus;\(^\text{368}\) stone siphon blocks re-used in the Seljuk bridge over the Eurymedon at Aspendos;\(^\text{369}\) stone siphon blocks employed as façade decoration in an Ottoman structure on the kale at Neocaesarea / Niksar; and heavy clay pipes reused in an Ottoman palace built at Dont, near Fethiye in Lycia.\(^\text{370}\)

### 3.4 Perceiving natural and artificial water shortage

Like famines, droughts are often socially-created forms of scarcity – that is, strategic and intentional interruptions in addition to system mismanagement or breakdown – which can exacerbate natural climatic events. Scarcity tends to disproportionately affect a society’s lower strata. The awareness of such distinctions between natural and artificial periods of water scarcity should be emphasized in the evidence from ancient and Late Antique sources.

As meteorological phenomena, natural droughts recorded in the textual sources for the period from 100 BCE – 800 CE have been admirably well-studied by Telelis, Stathokoupulos, and McCormick.\(^\text{371}\) The value of such attestations for the

\(^{368}\) ÖAI publication of the Seljuk türbe near the Artemision is forthcoming.

\(^{369}\) Kessener and Piras 1998b, see esp. 153-4 and 162 figs. 9-10.

\(^{370}\) TAM II/1.128 and Tietz 2003, here at pp. 337-339.

\(^{371}\) See Telelis 2008, 167-207 which published meteorological events in tabular form, drawn from Telelis 2004; Stathakopoulos 2004); and McCormick et alii 2012.
scientific reconstruction of historical climates is a matter of debate, though their status as reflections of historical perceptions of meteorological phenomena is in no doubt. We might question, for instance, whether the disproportionate abundance of meteorological observations recorded by historians of the mid-sixth century is reflective of an absolute increase in the number of such phenomena during this period, or whether such attestations are merely reflections of the well-known apocalypticism that pervaded Justinian’s reign.\textsuperscript{372} Accounts by Malalas and John of Ephesus regarding the famous comet of 530 CE – “a presager of doom” – also widely included drought among its portents.\textsuperscript{373} A general sense that disasters preceded and foretold, or followed and gave retribution, for the ill state of mankind’s affairs is pervasive in all periods, from historians of all stripes during the period under consideration. Ammianus Marcellinus tells us that in the year 363, after the temple of Apollo in Daphne was burned, outside Antioch, that there was “such a fearful scarcity of water that some brooks dried up, as well as springs which had before overflowed with plentiful jets of water; but later these were restored to their former condition.”\textsuperscript{374} Theophanes follows an account of Galerius’s moral failures and persecution of Christians, “lawless deeds,” by telling that “immediately once again there ensued wars and revolts, famines and

\textsuperscript{372} For an illustration of McCormick’s quantitative assessment of the textual sources, see McCormick 2012, here at Fig. 6 “Climate Events from Written Records, 100 B.C.—800 A.D.,” which shows a very hard spike in observations of meteorological events during Justinian’s mid-sixth century, during a period of acknowledged apocalyptic sentiment, on which see Meier 2003

\textsuperscript{373} See Theophanes AM 6023, Mango and Scott trans., 276 n. 3 for the quote, from the translators’ comments.

\textsuperscript{374} Amm. Marc. 22.13.4.
plagues and incessant droughts.\textsuperscript{375} McCormick’s recent analysis clearly demonstrates that awareness of weather abnormalities peaked during Late Antiquity generally, as compared to the imperial period, when historians like Cassius Dio were rather less interested in such phenomena. McCormick records 47 drought events, comprising 9.4\% of the total sample (499 events): only six of these occurred before the third century CE.

On the other hand, artificial droughts are equally visible in the textual record, which reflect not only meteorological phenomena but also a widespread awareness of technological failure that could endanger urban water systems, too. Besides references to systems repaired by Justinian in the province, which carried “floods of crystal-clear drinking water,”\textsuperscript{376} in order that cities might be “abundantly supplied with ever-running water,”\textsuperscript{377} Procopius is very explicit in his \textit{Secret History}, when he identifies the collapse and neglect “of one of the municipal [Constantinopolitan] aqueducts, which furnished not a small share of the city water,” and its subsequent disrepair even after Justinian had been notified, as cause for the “constant crowds who had to use the wells, and all the baths were shut down.”\textsuperscript{378} Just so, Choricius of Gaza identified neglect as a primary cause for the urban drought localized in sixth-century Caesarea Maritima, on the Palestinian coast. To quote from Mayerson’s translation:

\begin{footnotes}
\item[375] Theophanes AM 5797.
\item[376] \textit{Buildings} 4.9.14-16.
\item[377] \textit{Buildings} 4.1.17-27.
\item[378] \textit{SH} 26.
\end{footnotes}
“Such things [aqueducts] need to have very frequent care; consequently, since there was neglect, there no longer as unhindered a passage for the flowing water as before, but the movement of the water was checked in many places and the water flowed slower than usual. As a result, it came about that it passed by some fountains made idle by the lack of water, and the drawing of water from others yielded less than was needed. And what is more, men in the prime of life were in fierce competition with those who were pushing one another in their wish to draw water. At any rate, women, old men, and children came back, some with empty vessels, for some a great struggle produced half-filled ones to carry away, while many children went off crying because their vessels had broken…”

As also in Procopius, we see from the excerpt of Choricius how system failure and natural drought had the same effect, namely shortage that resulted in social disorder.

Naturally-induced droughts are also connected to urban water system failure. Theophanes is quite direct when he writes that, twice in the year 562/3 AD, “there was a drought” or a “shortage of water,” “so that the public baths were closed and murders” or “fights” “occurred at the fountains.” Similarly, the drought of 765/6 AD – following upon the unlawful ordination of the Slavic eunuch Niketas as patriarch of Constantinople – was so intense that “even dew did not fall from heaven and water entirely disappeared from [Constantinople]. Cisterns and baths were put out of commission; even those springs that in former times had gushed continuously now failed.” The combination of natural occurrence and artificial failure was the motivation for Constantine V’s restoration

379 Mayerson 1986, here at 271.
380 Theophanes AM 6055, Mango and Scott trans., 349.
of Valentinian’s aqueduct, “which had functioned until Herakleios and had been
destroyed by the Avars.”381

The intentional creation of water scarcity was a successful tactic to create
pressure and discomfort in both military and political power struggles. It was a
popular strategy in siege warfare: when the Emperor Julian besieged
Constantius at Aquileia, all else had failed, and “the generals endeavoured to
compel the citizens to surrender by want of water. So they cut the aqueducts.”382

Offensive aqueduct-cutting was probably limited and surgical: if a city was to be
re-occupied, permanently disabling its water systems was not logical. We have
already located Procopius’s concern for water shortage as a corollary of urban
security, and the author provides several accounts of aqueducts cut during war:
Belisarius cut the water from Naples’ aqueduct in the course of his siege there,383
while Vitigis disabled some of the aqueducts at Rome,384 and Gelimer allegedly
led the Vandals to tear down a section of Carthage’s aqueduct.385 John of
Ephesus provides an interesting detail in his account of the Arab king Mundhir’s
siege at Dara, during which Mundhir disrupted the city’s water supplies not by
cutting the aqueduct lines, but by diverting the sources away from the aqueduct

381 Theophanes AM 6258, Mango and Scott trans., 608.
382 Amm. Marc. 21.12.17.
383 Procopius, Wars V.9-10.
384 Procopius, Wars V.19.
385 Procopius, Wars IV.1.1. Interestingly, Ibn Khaldun’s Muqaddimah 3.16 and 4.4 uses the
Carthage aqueduct as an example of a structure, built by an earlier civilization, that must have
been built by successive dynasties rather than a single ruler, because it is impossible to destroy,
even though Khaldun reports parties assembling for the purpose of using the aqueduct as a
quarry, with only minimal success after the greatest of efforts.
intakes.\textsuperscript{386} The strategic creation of water shortage was hardly limited to foreign wars: among the various recensions of the story of Patriarch Macedonius (469-511), who was the object of a carefully orchestrated revenge campaign by the emperor Anastasius, Zachariah of Mitylene describes how, after a morning spent obtaining false testimony against his enemy, “the emperor ordered that their monasteries were to be denied water entering the baths, conceding them only enough to drink.”\textsuperscript{387} Just so, shuttering public baths was a common first step in re-establishing control after riots in Constantinople, Alexandria, or Antioch.\textsuperscript{388}

3.5 Aqueducts, spring water, and Roman imperium

An inscription from early second century Kanatha in Syria reads:

\footnotesize

\begin{verbatim}
hydrate\vspace{0.5em}
\end{verbatim}

For the salvation and health of the emperor Nerva Traianus Caesar Sebastos, called Germanicus and Dacianus, the aqueduct bringing water into Canatha was built by the foresight of Cornelius Palma, the emperor’s presbyter and antistrategos.

By dedicating his municipal improvement not just to the emperor’s person but to his \textit{σωτηρία} and \textit{ϑερία}, salvation and health, our patron signals his engagement with what Moralee has called ‘the salutary ideology’. This is the notion that the health of the empire depended upon the health of the emperor, an idea which

\textsuperscript{386} John of Ephesus, VI.5.
\textsuperscript{387} For the story of Macedonius, see especially the account in Zachariah of Mitylene, from which we quote here, at 7.7-8; compare with Theodore Lectore 474.96, and Evagrius Scholasticus 130.
\textsuperscript{388} See infra on bath riots sec. 4.7-9.
\textsuperscript{389} SEG 7.977-8 = Syria 11 (1930) 275-6.
had wide currency throughout antiquity, and which was inextricably tied to water architecture. In a fifth century mosaic from a bath in Antioch called *Apolausis* or *enjoyment*, for instance, σωτηρία became the personification of the safety, salvation and health of the state, crowned with the *corona civica* familiar to imperial representations. She was *Salus Augusta*, *Salus Publica*, and in the villa *Salus Privata*.

Such representations appear on the obverse of a Roman Republican coin after the first century BCE, with *Salus* and her avatar *Valetudo* on the reverse. During the empire, it was the responsibility of the Arval Brotherhood to make annual sacrifices to Salus for the health of the emperor at the temples of the Capitoline triad, in addition to the temple of *Salus publica*. The daughter of Asklepios, Salus was identical to her sister Hygeia, the goddess of health. Salus and Soteria or Hygeia are typically represented as draped figures, standing or seated, feeding a snake on the ground or wrapped around her. During and after the reign of Constantine, coins with legends reading SALUS REI PUBLICAE no longer featured Salus personified, but included images of victory, the emperor, or the chi-rho with alpha and omega, instead.  

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390 Moralee 2004, 50-54.
391 An odd series of coin issues from the fourth century Roman west represented Salus, made perhaps for the usurper Tetricius. This may have been because she was highly recognizable and thus could validate the coin’s worth in some sense.
392 Idem. 54.
Moralee has argued that in Late Antiquity, “Salus Publica became…a vague symbol with little to relate its iconography specifically to the centrally promulgated ruling ideology that it once so effectively personified,” but this is to forget the early Byzantine icons of Mary *Salus populi romani*, and to mistake a decline in the frequency of Salus’s personification with a decline in the importance of the concept she represented. More obvious than icons or coins was the state’s continued investment in Salus publica – ideologically and financially – via the supply of spring water to cities via aqueducts for baths and fountains, which were still deeply linked to ideas of state, municipal, and personal health: the health of cities and empire. Though it is occasionally argued that fountains were primarily venues for the physical expression of patron identity and ideological display, this can only be a byproduct of widespread appreciation for the utilitarian value and centrality of fountains in public water systems, reflected by long periods of continuous maintenance and deep wear marks from use at fountains in Late Antique cities (Fig. 3.8).

Biases favoring spring water for consumption were ancient. Long before spring-supplied aqueducts became a regular feature of Mediterranean cities, the *Airs, Waters, and Places* of Hippocrates delineated a hierarchy of water potability in the fifth century BCE. Waters were assessed by linked criteria of weight (light or heavy) and flow (living or standing). Lighter, living or running waters were

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393 Moralee 2004, 54.
394 e.g. Longfellow 2011.
considered more salutary than dead, standing water. Marshy water and water from wells, cloudy water, or water from springs with mineral content that did not appeal to taste or smell, these were considered heavy. After fresh rainwater – which was recommended as ‘the lightest’ but came with the caveat that it spoiled quickly – the best and healthiest waters came from springs that “issue[d] from high elevations and deep-soiled hills.” When aqueducts proliferated across the Mediterranean in Roman cities, we should note a creeping change in the perceived hierarchy of water source purity, as the Roman architecture of water supply began to be incorporated into these older classical norms.

Aqueducts as architecture allowed formerly distant, rural spring water to be imported into Roman cities. While large rivers in the *chora*, well upstream of target cities, were occasionally chosen as locations for aqueduct intakes, smaller spring-fed confluences of larger bodies of flowing water were the most common choices. As aqueducts proliferated, they were steadily incorporated into Classical and Hellenistic rhetorical traditions of the praise of cities and medical thought concerning the potability of different types of water sources. While the first century physician Celsus advised drinking spring water second in preference to fresh rain water, Pliny the Elder says that he is “much surprised that persons

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395 *De aere locis aquis* 7-9. Hippocrates set these good springs in opposition to those which emerge from rocks and are hard or quite alkaline, as well as those springs which were thermal and carried large amounts of iron, copper, silver, sulfur, alum, bitumen, or soda in them that made them unsuitable for consumption, even if they could have other medicinal uses, for which see Hippocrates, *De liquidorum usu*.

396 Celsus *De Medicina*, sec. II.18.11, Spencer trans., 199 “Rain water is the lightest, then spring water, next water from a river, than from a well, after that from snow or ice; heavier still is water from a lake, the heaviest from a marsh” [Aqua levissima pluvialis est: deinde fontana; tum ex flumine, tum ex puto; post haec ex nive, aut glacie; gravior his ex lacu; gravissima ex palude].
should be found to set so high a value as they do upon cistern [aka rain] water." Though accepting, aliae alibi, that “different kinds [of water are best] in different places,” Pliny nevertheless recommends that the best water came in living flows from springs, through aqueducts. Alas, Pliny was ever the homesick bureaucrat abroad. For him, “the Aqua Marcia by acclamation takes first prize for the clearest water in the whole world, [the spring] which gives Rome its coolness and salubrity, one of the gods' gifts to our city.” Frontinus was dismayed to discover the waters of the Aqua Marcia being used in baths and by fullers, which led to a legislative attempt to reserve it for human consumption. This was an artificial supply of imported water for Rome which was, for Pliny, the finest in the natural world. In the third century CE, Athenaeus relied on Homer to reorder

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397 NH 31.21 = “eoque miror cisternarum ab aliquis maxime probari.”
398 NH 31.21 = “aliae alibi.”
399 NH 31.24 = “Clarissima aquarum omnium in toto orbe frigoris salubritatisque palma praeconio urbis Marcia est, inter reliqua deum munera urbi tributa.”
400 Frontinus 91.5-92.1: “No less a water than Marcia, so very delightful for both its coldness and its clarity, I detected being delivered to baths, to fullers, even for purposes of which it is distasteful to speak. A decision, therefore, was made to separate all the waters, and then to arrange for them to be distributed individually. Marcia, as an obvious starting-point, would thus be reserved entirely for drinking. The others would be assigned to appropriate uses, each according to its particular qualities.” Of course, the Aqua Marcia is not actually in Rome – its source is 90 kilometers away in the Anio Valley, on which see Pliny NH 31.24. Interestingly, Pliny naturalizes more of the water’s journey than is strictly true, and incorrectly attributes the construction of the conduit to the king Ancus Marcius, rather than to praetor Quintus Marcius Rex’s service to the Republic in 144-140 BCE, whose work he recognizes only as a repair. But Quintus Marcius built the Aqua Marcia, with the wealth of Corinth and Carthage looted after 146 BCE, and it was then repaired by Marcus Agrippa in 33 BCE (Cass. Dio XLIX.42.2), and expanded by Augustus between 11 and 4 BCE. For Augustus’s work see Frontinus 12, Res Gestae 20, and for the cippi of Augustus naming the aqua Tepula, Iulia, and Marcia, see CIL VI.1249 = 31561.
401 Nero famously outraged everyone by swimming in the Aqua Marcia’s intake at its spring pool in Anio (Tacitus, Annales 14.22). Pliny reported that the Marcia had been illicitly tapped by private citizens in his day (NH 31.24), and for that reason supplied too little to the city before later changes. Hadrian made repairs, in addition to Septimius Severus in 196 CE (CIL VI.1247) and by Arcadius and Honorius in the later fourth century (CIL VI.1248 = 31559). Caracalla added a line from the fons Antoninianus and a branch to his eponymous baths, and Diocletian did the same. See Platner rev. Ashby 1929, 24-27.
ancient sources in his own hierarchy of water potability, prioritizing the consumption of spring water drawn through aqueducts:

"[Homer] prefers to all others the water of springs and those which flow through fertile and rather deep soil, as Hesiod does also: 'A spring perpetual and ever flowing, which has not been fouled' [=Op. 595]... Running waters, including those drawn from an aqueduct, are as a rule better than standing water, and when aerated are still softer."\(^{402}\)

In the *Res Gestae*, Augustus set the standard for emperors that followed him, when he described his personal responsibility for aqueducts as part of the *renovatio* of Rome’s Republican water infrastructure. In his reign, Augustus established the primacy of the aqueduct’s striding arches as the *sine qua non* of imperial patronage of water management architecture.\(^{403}\) When water shortage struck a Roman town, the imperial response was not to dig wells or build cisterns – it was to build an aqueduct. Among Augustus’s successors, we find that Hadrian was widely praised and credited for his support of cities across the empire, building “aqueducts without number.”\(^{404}\) The same spirit and mentality led Herodes Atticus to build an aqueduct for Alexandria Troas, which was “ill-supplied with baths, and ... the inhabitants drew muddy water from their wells,

\(^{402}\) Athenaeus, *Deipnosophistae* II.35A-47E, trans. Gulick (1927), 152-209 for a long series of passages concerned with the relative value of water versus wine; this discussion describes a number of springs and water sources, and preserves a number of otherwise lost sources. This passage comes from II.42C-D, trans. Gulick (1927), 183-4

\(^{403}\) *Res Gestae* 20 = I restored the channels of the aqueducts which in several places were falling into disrepair through age, and doubled the capacity of the aqueduct called the Marcia by turning a new spring into its channel = Ρίβος αὐτῶν ὑδάτων ἐδίπλωσα πηγήν νέαν εἰς τὸ ῥεῖθρον αὐτοῦ ἐποχετεύσας.

\(^{404}\) In the *Scriptores Historiae Augustae*, Hadrian is said to have frequented the Baths of Trajan among common rabble, and at 20.5-6 to have [given] “his name to aqueducts without number” [aquarum ductus etiam infinitos hoc nomine nuncupavit]. See also the similar account in the epitome of Dio Cassius LXIX.5: “[Hadrian] assisted practically all of them [allied and subject cities], giving to some a water supply, to others harbors, food, public works, money and various honors...”
and had to dig cisterns to catch rain water. Accordingly [Herodes Atticus] wrote to the Emperor Hadrian to ask him not to allow an ancient city…to perish from drought, but to give them three million drachmae to procure a water supply [via aqueduct].”

The third- and fourth-century Latin panegyrics maintain this link between imperium and aqueducts, running water and healthy cities, as it pressed on into Late Antiquity undiminished by the third century crisis. The Tetrarch Constantius is praised for repairing aqueducts and baths, making “waters that had ceased to flow, and new rivers as well, pour forth upon the withered vitals of the exhausted city.” In a speech of thanks made to Julian by *comes sacrarum largitionum* Claudius Mamertinus, Nicopolis ad Istrum is described as a pile of “lamentable ruins” because “everything was full of dirt and dust since the aqueducts had long since been destroyed…It is enough to know that after one or two letters of the greatest of Emperors all the towns of Macedonia, Illyricum and the Peloponnesus suddenly assumed a youthful appearance with their walls built anew, that water flows plentifully in every location, places which not long ago appeared parched and panting in thirst are now washed off, inundated, drenched.” Important here is recognition of the aqueduct’s role in cleanliness and urban hygiene, in addition to its more obvious role in slaking a city’s thirst.

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406 This quote from the very end of the third century, in a speech addressed to a provincial official in Gaul, in which Eumenius praised Constantius’s direction of military labor to restore aqueducts and baths at Lyon or Autun. See the *Panegyrici Latini*, for Constantius p. 154, sec 4; and for Constantine and Julian, secs. 5.4.4 and 3.9.2/3.10.1.
A lack of spring water was a conceit in Late Antique inscriptions that described the motivations for construction of aqueducts. In Stratonikeia, a man with the title ‘father of the city’ built or restored an aqueduct in the fifth century. His aqueduct was ennobled with an inscription that read:

“Playing the lyre sweet as honey, Pindar declared that on an earth of vast prairies, where Ambrosian air and fire are indefatigable, only running limpid water is superior, which happy men desire. Conscientious of this, Apollinarios, father of Stratonikeias, constructed and consecrated the new aqueduct, and brought water for the city and its inhabitants, bearing a respite from their great pain.”

More than just a preference in beverages, a lack of spring water induced pain, and – whatever the status or history of local rain-/ground-water cisterns or wells – was a culturally-constructed form of drought that had become a danger to the larger community and empire. This pain was also felt by the emperor Anastasius, as told by a Greek panegyric written at the beginning of the sixth century. Procopius used the metaphor of thirsty cities abundantly in his descriptions of aqueduct construction projects attributed to Justinian in the de Aedificiis. Following upon the precedent established by Augustus, these examples demonstrate the longevity of aqueducts – as an architectural response to community-scale water shortage at the level of state or imperial patronage – even if, as we saw in the previous chapter, there are subtle shifts in the field in which Procopius deployed the idea of the aqueduct. Nevertheless the

409 Procopius de Gaza, pp. 18-19 for the Greek and pp. 43-44 for the French translation.
410 See the discussion on Justinian via Procopius in the previous chapter.
relationship between imperium and flowing water with imperial health and abundance of spring water was maintained.

The late sixth-century panegyricist Corippus, praising Justin II (r. 565 – 574), cultivated this relationship between emperor, spring water, prosperity and health. Addressing his emperor, Corippus opined that:

“You are the fertile tree, drinking from the imperial spring. Our Lord [Christ] and common benefactor is the great spring of the court, the spring that enriches all, which stretched your branches over the wide earth and let the people rest in your shade. Grant to me that I may drink from this spring.”

The abundance and distribution of spring water to the thirsty was a mirror for the emperor and court’s relationship to God.

Theophanes’ aforementioned account of the repair of Constantinople’s aqueduct under Constantine V responded to the same impulse which inspired Augustus and Anastasius alike to build aqueducts, namely urban thirst that surpassed the availability of water from cisterns and wells. By the eighth century, however, we can observe that this monumentalizing impulse for water management through aqueduct construction had basically withdrawn into the capital. Water was critical not only as supply for a large high-density population, but also as a component of imperial ideology. These centripetal tendencies, focused on the imperial court and capital, were exemplified by Constantine V’s semi-legendary importation of

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412 Theophanes AM 6258.
thousands of high-skill laborers and technicians into Constantinople for the reconstruction of Valens’ Aqueduct in 765/6 – though the numbers given by Theophanes smack of rhetorical exaggeration, the episode nevertheless indicates the author’s perception of the immense scale of labor, expertise, and investment drawn to the capital by aqueduct renovation at this time. Further, the introversion of skilled labor and technology onto the capital meant that, henceforth, these could be mobilized for provincial projects only with explicit imperial approval.\textsuperscript{413}

The practical and ideological introversion of aqueducts – with their longstanding connotations of health and imperium – onto the Byzantine capital after 765/6 came, however, only after centuries of provincial aqueduct construction mediated by the Roman state, whose organization is revealed by literary and epigraphic evidence, as well as by the aqueducts themselves.

3.6 Construction

Bridged aqueduct construction was the most expensive of any architectural genre in the ancient Mediterranean, perhaps fifty times more costly than many churches.\textsuperscript{414} The most detailed study of its kind, a German doctoral dissertation

\textsuperscript{413} Parallel is the question of provincialism and imperial church-types; for instance were cross-domed or domed octagon church-types explicitly imperial forms, developed in the capital and then exported to the provinces? Security of form was related to control over the technologies and skilled labor required for construction; by this account, aqueducts were arguably guarded even more strenuously than churches.

\textsuperscript{414} See Engels, Hupperich, Müller, and Olberding 1983, 245 where they cite 16,165 person-months or roughly 485,000 total person-days for the construction of the Side aqueduct.
from 1983 by four engineering students assessed the specific topography and labor-needs of the first century CE aqueduct built for Side, which runs over two dozen bridges and through lengthy tunnels for nearly 30 kilometers, from a Taurus mountain spring called Oymapinar, down to the Pamphylian city on the coast. After considering each section of the conduit, all the relevant building processes, and early industrial rates at which they could have been accomplished, the Germans concluded that the aqueduct’s construction would have required 1,350 laborers working full-time for six months a year over two years. To put this in perspective, the structure of a Late Antique church like Kızıl Kilise in Cappadocia – whose form is typical of Southern Anatolia and Syria – could probably have been built by just 50-60 people over two years working only four months a year in the summer.415

Monetary costs for aqueducts have been assembled by Duncan-Jones – mostly from Italy and North Africa – which range from a donation at Perugia in the amount of 100,000 HS,416 eight million HS from a donor at Aspendos,417 to 350 million HS for the Aquae Claudia and the Anio Novus in Rome.418 Pliny the Younger’s account of budget overruns at Nicomedia are justly famous [Letters 10.37-8], with a similar tale of incredible construction deficits from Alexandria

415 Pickett, forthcoming on energetics of basilica construction.
416 CIL 11.1946.
417 IGRR 3.804.
418 Pliny, HN 36.122. For these and other references see Duncan-Jones 1982, 31-32. NB too the relative cost of baths from around the same period, during the second century, which in Italy ranged between 60,000 (ILS 5677) to 600,000 HS for a balineum (ILS 5757), and 2 million HS for the Neptune Baths at Ostia, promised by Hadrian and built by Antoninus Pius (ILS 334): see idem p. 157 for Italy, with comparable prices from North Africa p. 91.
Troas recounted by Philostratus in his life of Herodes Atticus. An episode in Josephus, repeated by Eusebius and Jerome, includes the story of how Pilate provoked riots when he spent Solomon’s Temple treasure, the Corban, on the construction of Jerusalem’s aqueduct.  

Potential for conflict over the cost and resources of construction is exposed in a frequently repeated story about the construction of Valens’ 185km long Halkali aqueduct and eponymous bath for Constantinople, which the emperor saw fit to demolish the fortifications of nearby Chalcedon to reuse its building materials. In the course of the demolition, a stone engraved with an oracle was found that predicted how these very events would precede an invasion of that city by the Goths, which is precisely what happened. Though the Byzantines triumphed over the Gothic threat at the end of the fourth century, the willingness of imperial authorities to destroy the defenses of a provincial capital to satisfy the water-needs of another city, even Constantinople, is quite striking. Throwing or carving thousands of pipe conduits in clay or stone, even without the added expense of arched aqueduct bridges, was a considerable expense. We lack good estimates for labor and investment in pipeline conduit systems – if a ten-kilometer long, double-strand of pipes had thirty-six cm individual pipe-lengths, this would require c. 60,000 pipes, no small investment by any standard. Such cost may have been a motivating factor in the Caliph Mu’awiya’s decision to tear down the

419 See Eusebius, *HE* 2.6.
420 Socrates *HE* 4.8 = Sozomen *HE* 8.21 = Cedrenus I.543.
pressurized stone pipeline that supplied Hippos, to transport its pieces in boats over the Galilee/Tiberias lake, and then reassemble them for a new supply to Mu’awiya’s qasr, a fortified palace and bath complex at al-Sinnabra.\footnote{See Alexandre 2013.}

Epigraphy is a rich source for costs and details of aqueduct construction, during the imperial period and Late Antiquity. A survey of 100 aqueduct inscriptions from the Eastern Mediterranean, never assembled or analyzed together in previous scholarship, can draw out important differences and continuities as regards the management of aqueduct construction between the Hellenistic period and Late Antiquity.

3.7 The epigraphic record for aqueduct construction in Late Antiquity

While the Roman Republic and independent Hellenistic city-states like Priene also developed municipal spring-fed water systems \textit{without} the patronage of a centralized state benefitting from the direction of a king or emperor,\footnote{The Hellenistic development of complex, communally ordered urban water systems, as at Priene, is an important corrective to K. A. Wittfogel “hydraulic thesis” that complex water systems depend on strong central authorities, as elaborated in his fundamental work \textit{Oriental Despotism: A Comparative Study of Total Power} (1957). For Priene see most accessibly Crouch 1993, here at 151-167; and Crouch 1996; and Fahlbusch 2003.} the Roman imperial contribution undeniably was the proliferation and naturalization of these systems in cities across the Mediterranean, as can be understood from the epigraphic record, in even a summary assessment of construction episodes reported in inscriptions found in the major collections and compendia. The hundred-strong dataset under consideration below (Appendix E) represents most
if not nearly all of the aqueduct construction or repair inscriptions from the Eastern Mediterranean between 300 BCE and 700 CE, summarized below (Table 3.1 and Figs. 3.9-10).

<table>
<thead>
<tr>
<th>DATE</th>
<th>EPIGRAPHIC ATTESTATIONS</th>
<th>SITES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hellenistic</td>
<td>7+</td>
<td>Doliana, Lagina, Oropos, <strong>Pergamon</strong>, Priene, Athens, Delphi, Olympia, Delos, Andania, Amphipolis</td>
</tr>
<tr>
<td>first century CE</td>
<td>23</td>
<td><strong>Amathonte</strong>, Anazarbos, Syrian Apamea, Balboura, Beroia, Kanatha, Delphi, Dyrrachium, Ephesus, Kyrenia, Metropol, Mylasa, Myra, Lycian Olympos, <strong>Patara</strong>, Polyrrhenia, Sardis, Smyrna, Soloi, Thyateira</td>
</tr>
<tr>
<td>third century</td>
<td>6</td>
<td>Side, Olba, Carian Panamara, Thyateira</td>
</tr>
<tr>
<td>Imperial [between first-third]</td>
<td>9</td>
<td><strong>Amaseia</strong>, Delphi, Eleutheropolis, Jerusalem, Latorea near Ephesus, Palmyra, Panamara, Perinthos, Stratonikeia, Thyateira</td>
</tr>
<tr>
<td>fourth century</td>
<td>9</td>
<td>Pisidian Laodikeia, Caesarea Maritima, Tropaeum Traiani, Ancyra, Psallida, Tralleis, Tyana, Samos</td>
</tr>
<tr>
<td>fifth century</td>
<td>9</td>
<td>Elaiussa Sebaste, Cilician Zenonopolis, Asar Tepe, and Akkale; Pontic Amisos; Pisidian Antioch, Carian Stratonikeia</td>
</tr>
<tr>
<td>sixth century</td>
<td>9</td>
<td>Bosra, Trebizond, Jerusalem, Scythopolis, Gortyna, Cilician Olba, Serdica, <strong>Abila</strong>, Soloi-Pompeiopolis</td>
</tr>
<tr>
<td>seventh century</td>
<td>2</td>
<td>Salamis, Pepouza [Phrygia]</td>
</tr>
</tbody>
</table>

Table 3.1 – Inscriptions recording the construction or repair of aqueducts. For texts with bibliography, refer to Appendix E. Boldened names refer to locations with descriptions in extenso of city water infrastructure, in Appendix F.

The assembled evidence basically corresponds to the trajectory of the so-called ‘epigraphic habit’ – a hard drop after the first-second century apogee (24 and 23
examples) is followed by only moderate recovery between the fourth and sixth centuries (9 examples each), and a dead signal after the seventh century.

3.7a Hellenistic inscriptions for water supply

Hellenistic epigraphy records different modes by which the cost of aqueducts could be underwritten: with royal, communal, and individual donations. One inscription recovered at Herakleia Latmos is a letter from Antiochos III to that city; it mentions royal funding or ἀνήλωμα εἰς τὴν ἐπισκευήν of the aqueduct / ύδραγωγίου [#2]. An inscription from Carian Lagina records the construction of an aqueduct, τὸ ύδραγώγιον τὸ φέρον ἐπὶ τὴν κρήνην, by one Chrysaor Iasonos Koraeios, without giving any details of his rank or status [#3]. An inscription from Megalopolis in the Peloponnese records the construction of a conduit / ὄχετος by Antiochos, when he served as agonothete [#7]. An inscription from sometime after the third century BCE (late first?) at Priene records the construction of an aqueduct and reservoir financed by one Phile the stephanephoressa or priestess, wife of Apollonios: ἀνέθηκε παρ’ ἑαυτῆς τὸ ἐγδόχιον τοῦ ύδατος καὶ τὰ ἐν τῇ πόλει ύδραγώγια [#4]. Others reflect the use-conditions of aqueducts in Hellenistic communities: an important inscription from fourth century BCE Oropos in Boiotia [#1] prescribes the supply of water for a bath, drawn from a rain-water conduit that drained a temple’s platform; another is concerned for the protection of conduits in the neighborhood of a temple (from first century BCE Andania in the Peloponnese, [#6]). It is important to note that these Hellenistic inscriptions for water conduit construction and maintenance reflect the application of similar
attitudes and community investment patterns – from individuals of different ranks and responsibilities – to conduits carrying both rainwater (primarily with ὄχετος) and spring-water (primarily with ὑδραγώγιον).

3.7b Imperial inscriptions for water supply

Hellenistic patterns for building urban aqueducts of rain or spring water narrowed after the beginning of the Augustan Principate, as imported spring water carried on aqueducts began to be the preferential supply for urban baths, fountains, and domus; new organizational patterns emerged to support their construction. With new infrastructure came new bureaucratic mechanisms to underwrite construction. We can identify five basic modes of financing imperial aqueduct constructions:

1) Direct imperial support, with donated funds or military labor, indicated by the emperor’s name in the nominative; or, inscriptions recording the presence of legions or centuria involved in construction. See for instance Anazarbos [#9], Amathonte [#10], Angustina/Famagusta [#11], Zadar in Dalmatia [#16], Ephesus [#20], Olympos [#25], Sardis [#26], Athens [#34], or Argos [#37]. For legions and centuria, e.g. Jerusalem [#54-5], Caesarea Maritima [#52], and Eleutheropolis [#71] all from second century Palestine.

2) Direct private support, with frequently famous or wealthy residents and non-residents donating large lump sums to communities for aqueduct construction. Patrons are named in the nominative, unless the inscription records a dedication (like a statue) set up as an honorific on their behalf by another organization, like the boule, in which case their names are listed in the accusative absolute. For the former, see for example Mylasa [#8], Kyrenia [#13], Soloi [#14], Smyrna [#21], Hadrianoi [#38], Aspendos [#61], or Side [#62].

3) Bureaucratic mechanisms, with regional officials acting to oversee or organize imperial and/or local finances and materiel for construction at the community level, with per + accusative or διὰ + genitive for overseers of the works, with various ranks. See for example Sarmizegetusa in Dacia [#15],
Ephesus [#18], Patara [#22], Sardis [#26], Canatha [#35], Nicaea [#39], Caesarea [#52], or Jerusalem [#53].

4) Private intervention with imperial authorities; appeals made by individual on behalf of community, in order to obtain imperial subventions, indicated by emperor’s name in nominative + διὰ and bureaucrat’s name in genitive. See for example Soloi on Cyprus [#14], Patara [#22], or Nicaea [#39].

5) Subscription. Funds are grouped by communities to be directed towards aqueduct construction; sometimes these funds were subventions from other munera or obligations, like the financing required of curials for gladiatorial games or sacrifices, or they were collected on behalf of the polis, the boule or demos. See for example Balboura [#23], Odessa [#40], Aphrodisias [#41, priest paying for aqueduct instead of gladiatorial games], Dağmarmara [#49, priest paying for aqueduct instead of meals], Eumeneia [#57], or Dağmarmara [#69].

In some sense, the Roman bureaucratic upgrade of precedent Hellenistic patterns was their admixture: the procedures of Roman bureaucracy and the values of Hellenic elite culture facilitated the coordination of royal or imperial funds with communal and individual sources of support, where previously they had largely been kept separate.

Ranks represented in imperial Roman aqueduct construction and repair included the following: emperors, proconsuls and consuls or governors, senatorial families, neokorate priests of the imperial cult, priests of various cults, prytaneis, managers of trade in

423 Note emperors in inscriptions from Cypriot Salamis/Famagusta [#11] and Amathous [#10], Cilician Soloi [#14] and Anazarbos [#9], Dalmatian lader/Zadar [#16], Ephesus [#20], Olympos [#25], Sardis [#26], Apamea on Orontes [#31], Athens [#33], Eleusis [#34], Nicaea [#39], and Amathous [#43]
424 Legates on behalf of emperors: at Sarmizegetusa [#15], Proconsuls and consuls or governors e.g. at Kyrenia [#13], Soloi [#14], Smyrna [#21], Patara [#22], Apamea on Orontes [#30], Canatha [#35], Smyrna [#48], or Dağmarmara [#49].
425 Senatorial families: e.g. at Ephesus [#46], Aezanoï [#55], or Latoreia near Ephesus [#67].
426 Neokorate priests of the imperial cult e.g. at Ephesus [#44], Panamara, Hagioi Deka/Gortyna on Crete #12, Iotape [a priestess, #66].
cities styled as *agoranomoi*,\textsuperscript{430} comarques,\textsuperscript{431} military officials,\textsuperscript{432} former slaves,\textsuperscript{433} and synkletoi or officials on small-town councils.\textsuperscript{434}

\textbf{3.7c Late Antique inscriptions for water supply}

In form and language, imperial and Late Antique examples attest to the continuity of Hellenistic forms of euergetism and community subscription for aqueduct construction after the imperial period. For instance, individuals intervening for imperial support were still indicated by the formula per + accusative (Serdica, [#94]) or διὰ + genitive (Bosra, #102).

Despite this linguistic and formal conservatism, organizational differences for Late Antique aqueducts are nevertheless quite clear from the epigraphy. While local officials with or without direct imperial support dominated the Principate, provincial governors (consuls or former consuls) were more frequent patrons for aqueduct construction and maintenance during the later third to early fifth century.\textsuperscript{435} The disappearance of curial and priestly investments in aqueducts was supplanted by a diversification, heretofore unnoted, of local interest in water-system patronage from all ranks from the end of the fourth to the early sixth

\textsuperscript{428} Priests of various cults e.g. at Mylasa [#8], Delphi [#29], Stratonikeia [#58a and b].
\textsuperscript{429} Prytaneis e.g. at Prusias [#65].
\textsuperscript{430} *Agoranomoi*, e.g. at Laodikeia [#63] or Thyateira [#60].
\textsuperscript{431} Comarques, e.g. at Thyateira [#27].
\textsuperscript{432} Military officials at Perinthos in Thrace [#32].
\textsuperscript{433} Former slaves at Latoreia near Ephesus [#67].
\textsuperscript{434} For synkletoi or officials on small-town councils see e.g. at Metropolis near Latoreia and Ephesus [#68].
\textsuperscript{435} For provincial governors from the later third to early fifth century, see e.g. at *Samos* [#73], Tralleis [#75], Psallida [#76], possibly *Ancyra* [#77], and *Caesarea Maritima* [#79].
centuries. A range of titles declare their responsibility in stone for water systems at this time – πατὴρ τῆς πόλεως, bishops and churchmen, artisans, as well individuals who styled themselves as literati with epigrams but gave no indication of their rank, and a few magistri militum in Cilicia. Churchmen appear as patrons of urban water systems conspicuously early, well before the Justinianic formalization of episcopal management of urban water systems in 530 CE.

These early examples of episcopal investment in water construction – reinforced by the archaeological and literary evidence – are followed in the sixth century by an utter explosion in the number of bishops investing or intervening with imperial authorities on behalf of aqueduct construction and maintenance in their communities. New, too, is the Late Antique appearance of individuals giving land with springs, aqueducts, or canals to cities for their management. At Asar Tepe in Cilicia, a governor gave concessions to a city including land with an

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436 πατὴρ τῆς πόλεως at Stratonikeia [#83].
437 A silversmith or jeweler at Bosra [#101].
438 E.g. at Samos [#73] or Pisidian Antioch [#88-90] where systems were nevertheless restored to favor churches in the city’s distribution scheme, both with converted bath-churches at critical supply/distribution points in Samos and Pisidian Antioch, respectively.
439 Magistri militum (at Akkale and Elaiussa Sebaste [#84 and #86], Asar Tepe [#85]
440 E.g. early bishops patronizing water systems at Phrygian Laodikeia Combusta / Ladik in the 340s CE [#80], or at Zenonopolis in Cilicia in the later fifth century, 488 CE [#87]; to which we might add the work of bishops at fountains near Anazarbos (Dagron and Feissel 1987, 247 #117), or the work by the bishop Theodoret at Cyrrhus in Syria, 445-8 CE attested in his letters, see Theodoret of Cyrrhus, Epistle 81, Azêma trans., 192-199.
441 CIC CI 1.4.26 for the edict issued at Chalcedon in 530 CE, giving responsibility for aqueducts, baths, ports, walls and towers, bridges, and so forth to “the reverend bishop and three men of good repute.”
442 For sixth century bishops involved in aqueduct construction, see e.g. Abila [#93], at Serdica with a candidatus and the emperor Tiberius [#94], near Olba in Cilicia [#95], at Soloi in Cilicia [#96], possibly at Gortyna in Crete [#97], at Trabzon [#100], Bosra [#101 and 102], and at Salamis [#103].
aqueduct or canals, ὑδάτων γὰρ ρῦσιν [#85]. At Amisos / mod. Samsun, a magnificentissimus comes named Erythrios sated a city’s thirst and donated springs in the service of an aqueduct and baths for public use, for which he was commemorated with a gold portrait statue [#91].

Together with presumably less expensive baths and fountains, aqueducts were obviously desirable forms of patronage. It may have been precisely the exchangeability and invisibility of aqueducts that made them an ideologically valuable field of patronage: temples and basilican churches had to look and be built a certain way, but aqueducts or fountains were all the same so long as water flowed out a pipe at a terminus, whether that water came over thirty kilometers and twenty-four aqueduct bridges as at Side, or through only a few hundred meters of rock-cut tunnel, as at Messene in the Peloponnese.

Technicians working with Late Antique aqueducts are also identifiable in the epigraphic record. A man identified as an architect and manager of aqueducts was buried in the Late Antique Kerameikos cemetery in Athens, Ἀνδρέα ὑδραγουγοῦ καὶ ἀρχιτέκτωνος τῶν υδάτων [#80]. Another man identified as a circutor saburrae [κερκείτωρ σευόρας] built a funeral monument for his wife: he was responsible for cleaning sand out of the aqueduct at Tyana in Cappadocia, during the later fourth century [#72].
3.8 Sourcing aqueducts

We have examined epigraphic evidence for the construction of aqueducts; there is also an abundance of Roman legal literature concerned with spring and irrigation disagreements between private land-owners.\textsuperscript{443} Somehow, embattled rights to spring sources of urban aqueducts are not especially visible in the literature.\textsuperscript{444} We simply do not read, for instance, of farmers or landowners complaining to the authorities that their private spring sources for villas or irrigation systems were disrupted by aqueduct construction, or subjected to eminent domain and repossession by the state.

Interurban competition for spring water resources, on the other hand, may be slightly more visible, if we look to Late Antique hagiography. Michael the Archangel famously saved his shrine at Anatolian Colossae by diverting away the flooding waters of two rivers, set upon the shrine by inhabitants of the neighboring city of Laodikeia. Cadwallader has keenly described the context of interurban competition between Colossae and Laodikeia that surrounds this narrative: the two cities had for centuries competed for imperial Roman honors, rank, and status. Lacking in Cadwallader’s analysis, however, is any conflictual definition of the dam that was built to flood the Archangel Michael’s sanctuary.\textsuperscript{445} Dam building campaigns are perpetual sources of unrest across the world today,

\textsuperscript{443} E.g. CIC CI 3.34; note also the man who built a fullery on the spring in his estate, sending polluted waters onto his neighbors’ property and making him liable for damages at Dig. 39.3.3 = Bas.58.13.3
\textsuperscript{444} On water conflicts in ancient literature, see Bruun 2000.
\textsuperscript{445} See Cadwallader 2011.
of course, which sacrifice one community’s interests for another’s, disrupting rural patterns in favor of the provision of hydropower electricity or drinking water to a larger city. Just so, the crux of the St Michael story is, in fact, 5,000 men from one city laboring to divert a river with dam construction in the disputed territory of another town.

To quickly paraphrase the earliest redaction edited by Nau\(^{446}\) (lately translated by Cadwallader)\(^{447}\) which was compiled from at least three separate traditions sometime in the fifth century: after the apostles Philip and John defeated a giant...
serpent at Phrygian Hierapolis, they came to a nearby place called Chairotopa, at which they prophesied that God’s archistrategos, the archangel Michael, would appear to “perform dazzling wonders.” And indeed, “a certain godless idolater” from Laodikeia was blessed with a vision of the Archangel that preceded the healing of his mute daughter at a local spring. The man built a small chapel at the spring, which was cared for in the years thereafter by an ascetic named Archippos, from Hierapolis. The pious caretaker was forced to contend with “unbelievers and enemies of the truth” who “snarled like lions wanting to bring the sacred spring to an end.”

After unsuccessful attempts to mingle the waters of the nearby river Chryses with the spring, and thereby dilute its powers, the Devil inspired a grander project: *the construction of a dam by some 5000 men “to divert the rivers* [Lykokapros and Koufos], which merged together at the spur of the mountain by the holy spring, against God’s holy place, in order that the shrine might be plunged beneath the water, for the place was ideally situated to be engulfed by a flood.”

Fortunately, Michael the Archangel appeared in glory to save the caretaker of the shrine, and to prevent the waters from overcoming the site – instead, he opened up a chasm into the rock, and sent the waters funneling underground before the chapel.

The crucial point is that five thousand Laodikeians had come out of their own city walls over more than fifteen kilometers to another polis, where they intended to

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448 Cadwallader 2011b, 326.
449 Ibid., 327.
450Procopius describes a similar miracle with torrential water channeled into an unexpected chasm at Dara, *Buildings* 2.2.11-13.
build a dam that would impound a local stream, coincidentally important to Chonai as a shrine for a fledgling cult of the Archangel. Why might the Laodikeians have wanted to do this? Cadwallader describes an environment of long-standing competition between the two cities for honors and religiosity; we might also look to the more materialistic advantages of dam construction and spring impoundment. Roman and Byzantine dams were built for several purposes: to manage siltation processes and to create arable land behind check-dams, for rivershed management and flood control, and to supply aqueducts from the drinking water stored behind dams in reservoirs.

Does our text provide any clues as to what sort of dam this might be, other than an evil one that destroys a town’s holy place? The rivers responsible are described as “swollen with an immense amount of water, mountain torrents bursting,” “two other rivers [that] began their downward course near that place, about three miles to the east … [merging] together at the spur of the great mountain.” While Cadwallader has, not without reason, placed Michael’s sanctuary near the ancient site of Colossae itself,\footnote{See Cadwallader 2011a and Meinardus 1980 for commentary on the topography of the text and its relation to the present area.} we should also note the presence of a group of check-dams without clear date that, quite interestingly, may be found running across deeply cut valleys just southwest and southeast of the kale\footnote{The Chonai / Honaz kale is located at 37°44'57.96"N, 29°16'13.44"E.} at Chonai/mod. Honaz, “at the spur of the great mountain,” above the...
620m ASL contour. These are clearly positioned to manage two converging torrents of water as they descend down the mountain (from east and south), that crest during the winter rains, but which also provide a perennial trickle that today supplies reservoirs and a fountain near the foot of the mountain in town, even during the warmer months. On the other hand, if we follow Cadwallader and understand the text to refer to St Michael shrine's at Colossae, before the settlement's relocation to Chonai, we might observe the aforementioned stream descending from the Honaz Dağ at the south as it joins with another east-west flowing stream, just between the two hüyük's of Colossae, at about 335m ASL.

In either case, the dam described in the tale of St Michael could have been intended to manage Maeander flooding further downstream, or to supply drinking water for Laodikeia from either the Chonai source or the Maeander stream near Colossae. Both fit the profile for Roman hydraulic engineering preferences rather well, so far as the creation of an aqueduct catchment out of a river's tributary at its source is concerned. At Colossae (335m ASL), this would involve damming the two small tributaries running upstream from Michael's church in order to impound drinking water, and then diverting this supply into an underground conduit before its confluence with the larger Maeander river system. A path

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453 Check dams in deeply cut mountain valleys can be found at 37°44'38.39"N, 29°16'0.28"E and also a few miles to the east, as per the text, at 37°44'26.90"N, 29°17'24.26"E: the author had not ground truthed these locations at the time of writing.
454 See the catchment basin at Honazdakı Göz, a photo of which is visible in Panoramio at 37°45'5.14"N, 29°15'55.86"E.
455 For the site identified as Colossae, see 37°47'13.78"N, 29°15'36.31"E.
456 Compare with e.g. Caesarea Maritima's low level aqueduct and fourth century dam; and on dams and spring or tributary impoundment for Roman aqueducts generally, see Hodge 2002, 69-70.
thence to Laodikeia, following the banks of the Maeander, would naturally fall about 55m before reaching the city’s water castellum (c. 280m ASL). Several possible paths connecting the 14km between Laodikeia and Colossae may be postulated. Chonai (620m ASL), on the other hand, provides enough difference in elevation between itself and Laodikeia so as to allow for literally infinite paths connecting a water conduit between the two cities, which are just 17km apart. Either scenario could help explain why a dam might have been built by Laodikeians by force in the territory of its neighbor Colossae, and become a cause for interurban conflict and competition for control of water supplies. So, in addition to the theological particularities or attractions of a cult for angels, discussed by Peers, we might also consider the advantages of a saint responsible for water management, and consequently the centrality of divine water control in images and church dedications for the archangel that remained popular in Byzantium and neighboring polities for centuries. Besides an early recension of the text in Ethiopic indicative of an African cult of the archangel, we also find him localized for veneration at the miraculous springs of Pythia and Germia in Anatolia, on the Greek islands of Symi and Lesbos, and after the tale’s translation into Latin in the eleventh century in Western Europe, at Mt Gargano in Italy or Mont Saint Michel in France.

3.9 Primary use life of aqueducts

Even after an aqueduct was built, its primary use-life was no less fraught with the possibility of conflict, due specifically to pollution, diversion, and the above-mentioned threat of system collapse, which became a source of anxiety for Late Antique authors we discussed above, such as Theophanes or Choricius. Roman literature elsewhere was consistent in recommending aqueducts as reliable sources of drinking water. Late Antique sources are less certain. An anecdote in the *Life of Hypatios*, from fifth century Thrace, tells of how an aqueduct near the monastery became polluted – by Satan or ignorant people, either one, says the author – inspiring holy Hypatios to instruct the worried monks to give up the aqueduct supply and dig a well in a specific spot, which miraculously revealed a supply of sweet ground-water.\(^{458}\) It just so happens that this spot was also immediately adjacent to the kitchen. In effect, the monks were scaling-down and ‘opting out’ of the Roman system, whose water-by-aqueduct had become suspect, in preference for an independent source.

Coulton noted that “the reign of Augustus … seems to be the time when….cities began to feel that the longed-for peace was sufficiently well established to justify the more or less elaborate water supplies” without concern for their security.\(^{459}\) The *Pax Romana* facilitated not only an urban shift down onto the open plains, but also an eventual urban (over-) reliance on long distance bridge-and-tunnel

\(^{458}\) See the *Vita Hypatii* 19, trans. Festugiere 1961, 2: 34.
\(^{459}\) Coulton 1987, 73.
aqueducts, which were comparatively expensive and highly visible, and thus prone to insecurity. While wells in many cities had been filled in after the introduction of aqueducts (e.g. Ephesus, Caesarea Maritima), the trend towards the Late Antique development of alternative sources, alongside new secular/ecclesial public contexts for large-scale water storage – is distinctly visible in the archaeological evidence well before aqueducts systems began to fail (e.g. at Ephesus, Jarash, Salona, Thessaloniki, Apamea on Orontes). At Nicopolis ad Istrum, sixth century resettlement of an older legionary fort and city did not attempt a reconstruction of the aqueduct, but instead pursued alternative sources, despite the city’s status as a metropolitan capital.\footnote{Poulter 1995, 6 and 45-6.}

3.10 Diversion and the legal status of aqueducts

The chief concern of imperial authorities for aqueducts was the protection and preservation of their supply from illicit diversion, as they coursed through cities in water mains and conduits.\footnote{Bruun 2010.} In Justinian’s Code and the Basilica, water was legally obtained by means of a rescript for a beneficium, upon direct request from the emperor, which secured rights to water in whatever quantity. This replaced the older Roman method, current through the late fourth century, whereby water quantities were based on rank, and obtained through pipes of \( x \) diameter, as appropriate – though supplies could also be gained with a personal request to
the emperor for persons of whatever rank. Payment for the privilege of a direct tap was a non-issue, “for it would be execrable that the houses of this fair city should be provided with purchased water,” but those with the privilege were free to negotiate servitudes for smaller consumers down the line.

Concern for fraudulent diversion from aqueducts was targeted at a range of consumers: villas, estates, water mills, farms, and gardens, as well as baths. Such behavior was severely punished: landholders were subject to confiscation of property, and fines between one and ten pounds of gold. One hundred pounds of gold penalty was reserved for perpetrators of illicit diversions from Hadrian’s aqueduct in Constantinople, which saw all of its previous water contracts annulled/revoked in a law issued by Theodosius II in 440-1 (CIC CI 11.43.6 = Bas. 58.19.6). This law made the waters of Hadrian’s aqueduct the exclusive privilege of the imperial house and of public baths and fountains. A law of 389, repeated in the medieval legislation (CTh 15.2.4 = CIC CI 11.43.2 = Bas. 58.19.2), specified that water rights in Constantinople were to be enjoyed from reservoirs or secondary service pipes rather than directly from the main lines. However, another law, similarly repeated in later sources (CIC CI 11.43.11 = Bas. 58.19.11 Restitutus), stated that "no one, in this holy city or in the provinces, shall be permitted to draw any water from any public aqueduct or spring without an imperial rescript issued in the customary manner."

462 This was how Statius obtained the right to draw water from an aqueduct for his estate in the Alban hills; Martial’s request for the same was embodied in a poem; see Millar 1977, 497; also Statius Silvae III.I.61-4 and Martial Epigrammata IX, 18.
Table 3.2: Legal Sources Concerned with Aqueducts

<table>
<thead>
<tr>
<th>Aqueducts – Action and Penalty</th>
<th>Theodosian Code</th>
<th>Justinian’s Code</th>
<th>Basilica</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landowners w/ aqueduct crossing their land exempt from extraordinary burdens (munera)</td>
<td><em>CTh 15.2.1</em></td>
<td><em>CIC CI 11.43.1</em></td>
<td><em>Bas. 58.19.1</em></td>
</tr>
<tr>
<td>Daphne palace in Antioch – water supply diminished by diversion. Punishment of one pound of gold for each obol of water taken illicitly.</td>
<td><em>CTh 15.2.2</em></td>
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</tr>
<tr>
<td>Houses of rank with baths get no more than 2-3 inch pipes; lesser houses 0.5-1.5 inch pipes. Any more than granted punished by fine of 6 pounds of gold, and loss of existing privileges.</td>
<td><em>CTh 15.2.3</em></td>
<td>---</td>
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</tr>
<tr>
<td>Water diverted to farms from aqueduct; punished by forfeiture of property</td>
<td><em>CTh 15.2.4</em></td>
<td><em>CIC CI 11.43.2</em></td>
<td><em>Bas. 58.19.2</em></td>
</tr>
<tr>
<td>Water rights to be enjoyed from reservoirs or secondary pipes, not main lines; punishment according to status.</td>
<td><em>CTh 15.2.5</em></td>
<td><em>CIC CI 11.43.3</em></td>
<td><em>Bas. 58.19.3</em></td>
</tr>
<tr>
<td>Drawing water from mains instead of reservoirs; punishment according to status with loss of water rights</td>
<td><em>CTh 15.2.6</em></td>
<td>---</td>
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</tr>
<tr>
<td>Ancient water rights upheld; punishment for diversion of aqueduct water to irrigation or gardens.</td>
<td><em>CTh 15.2.7</em></td>
<td><em>CIC CI 11.43.4</em></td>
<td><em>Bas. 58.19.4 Restitutus?</em></td>
</tr>
<tr>
<td>Concerning diversion of water from aqueduct in Campania, Italy. Penalty of five pounds gold.</td>
<td><em>CTh 15.2.8</em></td>
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</tr>
<tr>
<td>Concerning diversion of water from Claudian aqueduct in Rome. Land owner punished by forfeiture of property; conniving officials punished by fine of as many pounds of gold as inches of water diverted illicitly with their assistance.</td>
<td><em>CTh 15.2.9</em></td>
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</tbody>
</table>
Rescript for water rights presented not to provincial rectors, but to imperial tribunal; punishment of 50 pounds gold.

All servitudes of Hadrian’s aqueduct attached to property (houses, villas, baths) are declared entirely void; water redirected to palaces and public baths/fountains. Punishment 100 pounds gold.

Villa, estates, water mills, gardens diverting water from service pipes or public springs; punished with confiscation of property.

In capital or in provinces, no water to be drawn from aqueducts or spring without imperial rescript filed with the tribunal; punishment of 10 pounds of gold.

Archaeological evidence illustrates that diversions from main-lines (rather than from reservoirs) were common practice in Late Antique cities with functioning aqueducts. The degree of security or prominence of a distribution point, in addition to the tidiness of its construction, may be good markers for distinguishing between licit and illicit diversions.

**Ephesus**, for instance, preserves evidence of a very well-organized (and presumably legal or state-approved) system of water distribution in the later fifth or sixth century. There, water was led off into pipes directly from the line of the Selinous/Aristion aqueduct, as it coursed by the carceres of the Stadium. These installations are unpublished (Fig. 3.11-12).
Critical points in urban water distribution could also be secured by installing reservoirs and cisterns or distribution boxes in defensive architecture like city walls and towers. For instance at Side, water was multiply drawn off the aqueduct into pipes at the points where it crossed into the city at the inner line of fortifications, which date to the later seventh/eighth century CE. A large Late Antique bath was left outside the inner walls, but a large reservoir was installed just within it, at the top of the colonnaded street that bisects the town inside the walls. Where the aqueduct fed into this secured reservoir, a number of pipes were drawn off directly from the aqueduct’s open channel, for destinations intra-muros (Fig. 3.13). This situation – with distribution to the Late Antique city from a secured location related to circuit fortifications – has parallels at Gortyna on Crete, Justiniana Prima, Syrian Apamea, Ancyra, Anemurion in Cilicia, and probably Nicaea and Syrian Antioch. Generally, water distribution in late antique cities appears to have become progressively less ramified with fewer places of withdrawal, from neighborhood fountains and aqueduct-fed cisterns.

3.11 Repairing aqueducts

Problems with the maintenance and decay of aqueducts and supply systems could also create artificial drought for thirsty consumers. While in the imperial period, the cleaning and repair of aqueducts was a state concern that required

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463 See the reservoir in the late antique fortifications, discussed by Rosenbaum, Hüber, and Onurkan 1967, s.v. Anemurion pp. 1-18, here at 1.
464 Procopius indicates the construction of cisterns within the fortifications by Justinian at Antioch, see Buildings 2.10.13-14; see Appendix F for archaeological evidence of the relation of aqueducts to fortifications in the other emboldened cities listed here.
major undertakings of labor organization, Late Antique juridical texts and inscriptions refer to imperial edicts that ordered “a privatization of public services,” requiring land owners to clean channels and provide clearance for aqueducts adjacent to their properties, themselves. Bruun wisely questions the efficacy of this system.

By the early seventh century, in the *Pseudo-Gospel of Matthew*, Christ in his infancy demonstrates his power over water in a distinctly architectural fashion, even at play, unblocking a line that had been stopped up by demons. “As he sat there, Jesus made for himself seven pools of clay, and to each of them He made passages through which at His command He brought water from the torrent into the pool, and took it back again.” Satan inspired another young boy to block up the passages he had opened; Jesus became angry and smote him. Jesus somewhat reluctantly resurrected the lad, then “brought water into the pools by the aqueduct.” This is a rather unusual and very late introduction of aqueducts into hagiography, where previously saintly solutions to water shortage were distinctly non-architectural, with rain miracles and the discovery of springs rather than infrastructure predominating. The tale as presented in the *Pseudo-Gospel* is allegorical, in the sense that no cities were involved, but only the hydraulic equivalent of a child’s sand-castles on the beach. The seventh-century

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465 So Frontinus, secs. 119-124.
466 Bruun 2010, 8 for the quote; and see *CTh* 15.2.1 for Constantine ordering the consularis aquarum in Rome to order this service from property owners around the city’s aqueducts. This edict was repeated in *CIC CI* 2.43. Similar injunctions are repeated in inscriptions, see infra Appendix E #56 from sixth century Bethlehem.
appearance of aqueducts here could nevertheless be stretched in relation to the progressive disfunction of such systems after the sixth century in many cities across the Eastern Mediterranean, a situation so alarmingly visible that Christ himself became involved, where even saints were impotent or uninterested.

Most common were probably not demonic children but rather problems coercing private land owners to maintain aqueducts (after the state relinquished that responsibility), and problems with earthquakes or sinter, a calcium carbonate deposit laid down in pipes carrying hard spring water with high mineral content. After progressive deposition of thick sinter sediments, pipes were basically ruined, and could only be repaired through total replacement. Sinter’s formation-rate is sometimes pegged at ~1mm a year, though in many places it may be demonstrated that sinter formed with considerably more rapidity.\textsuperscript{468} At Ephesus, for example, the Upper Agora’s south fountain was supplied by a spring with incredibly high mineral content, necessitating the frequent replacement of its pipe. Here, we can see sintered pipes of the exact same dimensions and fabric stacked around the fountain intakes, which suggest that repairs were needed within a relatively short period of time, perhaps just a decade or two. High mineral content in the spring supplying this fountain may have contributed to its conversion after the early fifth century: the aqueduct was maintained but it was

\textsuperscript{468} E.g. Hodge 2002, 228 concludes from the evidence of the Eifel and Nîmes aqueducts that between 1.00-1.15 mm is an acceptable average annual rate of sinter accumulation. Rather, sinter accumulation rates are locally determined by the water’s speed, temperature, and flow-path (siphons or angled pipes accumulate sinter faster than straight pipes), in addition to hydrochemistry and biogenic factors.
no longer used to supply drinking water from the fountain, which was repurposed as a mill to grind grain for bread. That the aqueduct was maintained even when its water was no longer consumed, is suggestive of a Late Antique bias against water sources that produced heavy sinter formations. This bias would not have been without some reason: hard water is proven today to be a risk factor for nephrolithiasis, or kidney stones.469

Dysfunction and repair are also widely associated in the literature with earthquakes and invasions. However, both are in fact difficult to positively identify in the archaeological record, though they remain facile explanations for urban water system change and collapse.470 Well-attested examples of aqueducts rendered dysfunctional by earthquakes are comparatively rare given the overall number of cities with aqueducts, and the seismic activity that characterizes the wider eastern Mediterranean.471 Visibility and chronology are important problems in this regard, inside and outside cities. Outside cities, aqueduct bridge repairs are common and easy to identify but difficult to date or contextualize – these usually include the reinforcement of bridges with buttresses or fillings set between or under arches. Inside cities, careful study of contextualized pipe typologies is necessary to identify repairs and additions to older lines. When

469 Bellizzi et alii 1999
470 See examples in Appendix F where earthquakes had no apparent effect or where there is evidence for the repair of aqueducts after earthquakes, for instance at Corinth; Arabian Pella and Umm el Jimal; Asian Troy; Pisidian Kibyra; Cilician Anazarbos and perhaps Pompeiopolis; Cypriot Amathonte and Salamis; Samos, and Stobi.
471 Again see Appendix F, for examples of aqueduct systems with good evidence for dysfunctionality caused by earthquake damage, for instance at Sagalassos, Phrygian Hierapolis, Ephesus and Pergamon, Aspendos, Anemurion, Kourion, Petra, and perhaps Gadara and Beth Shean.
pipes were damaged, the most frequent solution was to simply lay new strings of pipe alongside or above the older ones, which were sometimes robbed out and reused for building material (Figs. 3.14-18).

A systematic study of the potential effects of earthquakes on aqueducts is a desideratum: in the course of my work at Ephesus, I was quite surprised (along with Wolfgang Lenhardt, Austria’s representative in the European Seismological Commission and an expert on archaeological evidence of earthquakes) that there was no clear evidence that seismic motion cut any of the city’s exposed ceramic pipelines, though Wiplinger has identified clear signs of shearing that destroyed a bridge along the Değirmendere aqueduct line outside of the city, probably before the fourth century CE.472

It should be emphasized that in most cases – e.g. where aqueducts did not have sophisticated inverted siphons along their primary supply lines, but were simple gravity flow channels – maintenance of aqueduct systems even after an earthquake was not a matter of technological prowess. Mortar, ceramics, and labor with oversight were all that was needed. Arguably, many aqueducts were more frequently damaged by long term neglect and problems with sinter accumulation, than by sudden earthquakes or invasions. These latter events

472 See Wiplinger 2013 for evidence that the Değirmendere aqueduct was cut by earthquake before the fourth century.
likely only punctuated and completed much longer processes, which cumulatively prevented the maintenance and restoration of urban water systems.

Continued investments in aqueducts also meant the maintained value of consumption locations at the end of a conduit. Baths and fountains were important because they were locations for public assembly; not because they were the only locations where one could bathe or drink water in cities. Public baths and fountains were particularly crucial in the negotiation and representation of identity and rank through inscriptions and sculpture, the limits and acceptable venues for which were in flux during Late Antiquity. Richard and Longfellow have contributed comprehensive assessments of perceptions of the value of fountains in Roman and Late Antiquity; leaving fountains aside for the aforementioned authors, we will examine baths in more detail in the next chapter.\footnote{Richard 2012 and Longfellow 2011.}

### 3.12 Extra- or Inter-urban diversion of aqueducts

Water diversion from aqueducts sometimes occurred at an inter-urban scale, with one community leading off water from the supply of another. Even with careful craftsmanship in the diversion, it can be difficult to assess whether or not these supplies were carried off legally. For instance at Tel Tanninim – sometimes called Krokodeilon, outside of Caesarea Maritima – ASOR excavations in the 1990s revealed a thriving Late Antique agro-industrial settlement (fourth – eighth century) with water wheels, fishponds, reservoirs, and perhaps a bath, all
supplied by a very carefully made diversion from the High-Level / Channel A aqueduct to Caesarea Maritima.\textsuperscript{474} Coincidently, Choricius of Gaza reports that Caesarea’s fountains failed in the sixth century, a situation which surely was not helped by an entire town’s diversion of their waters for industry further up the line.\textsuperscript{475}

Another form of inter-urban diversion may be observed at Akkale on the Cilician Coast. Here, a \textit{magister militum} and competitor to emperor Zeno named Illos, in the late fifth century, is attributed in an inscription with restoring the aqueduct line that was designed to feed water into two cities, \textit{Elaiussa Sebaste} (where it was used for baths and fountains on the agora, converted later for a Christian basilica and large cisterns) and \textit{Korykos} (where it fed into a massive extra muros terminal reservoir constructed sometime in Late Antiquity, today used as a soccer pitch).\textsuperscript{476} Back upstream, the rebel Illos also took the opportunity, with or without an imperial rescript, to divert a section of the restored aqueduct to his own fortified villa on the coast, in order to supply a private bath complex and an immense reservoir which, to judge from its scale, was likely \textit{not} used for immediate consumption on site, but rather could have served to restock the water supplies of sea-faring ships that docked at Illos’s private harbor.

\textsuperscript{474} Stieglitz et alii 2006, 60-1 and 85-7 for Tel Tanninim.
\textsuperscript{475} Mayerson 1986.
\textsuperscript{476} For the inscription see Appendix E.#85.
A more common form of diversion was to supply water for irrigation. Indeed, Frontinus indicates that roughly one third of water carried in aqueducts to Rome was delivered to locations outside of the capital.\textsuperscript{477} Special imperial permissions were required to make such a diversion legal: these rights were thenceforward attached to property, rather than to land-owners personally. Wilson draws our attention to evidence from Latium and Etruria for such rural diversions in Italy during the Republican and imperial period: an inscription thought to refer to the Aqua Crabra clarifies methods of offtake via \textit{foramen} or apertures and offtake nozzles, in addition to the hours when it was permissible for different owners to draw water. An inscription from Latium lists persons and estates with the number of pipes and hours that were permitted them for water offtake from an aqueduct.\textsuperscript{478}

Justinian’s \textit{Digest} (8.3.2 and 43.20) and a range of archaeological evidence indicate that such scheduling systems, and state concerns to prevent illicit diversions for irrigation, were both common and subject to Roman law in the sixth century.\textsuperscript{479} Archaeological attestation of aqueduct systems diverted extra muros for irrigation or productive activities (like mills) in the eastern Mediterranean during Roman and Late Antiquity include Pisidian Kibyra, Lycian Myra, Asian Ephesus, the Silifke line in Cilicia from Bahçederesi Köy, Cilician Dömuztepe

\textsuperscript{477} Frontinus 78.
\textsuperscript{478} On irrigation’s water supply from aqueducts in the Roman period, and the Aqua Crabra and Latium inscriptions, see fundamentally Wilson and Thomas 1994, 147-9 and also Morley 1996, 103-7.
\textsuperscript{479} See infra appendix F for more information and references for these emboldened extra-urban systems in late antiquity.
and Olba, Galatian Ancyra, Lycian Eudokias, Phrygian Hierapolis and Amorium, Phrygian Pepouza, Hierapolis, and Pessinus, Carian Aphrodisias and Mylasa, and possibly Cypriot Kourion or Antioch in Pisidia.  

3.13 Intra-urban diversion

Water was also diverted from locations intra-muros to new consumers, or redistributed directly through the conversion of old structures with aqueduct-supplies, to new functions. We might postulate that direct conversions were ostensibly dependent on the permission of the imperial administration for their activities, so far as the legal sources were concerned, though in practice water theft was always a reality. The last agent of restoration seems, in many cases, to have become benefactor of water in systems that were progressively less ramified, and oriented towards fewer consumers and places of withdrawal, including newly built terminal cisterns that became the foci of developing, mixed-use neighborhoods in the former civic hearts of older Roman cities.

3.14 Intra-urban diversion: reuse of water from temples

Temples had an especial, if overlooked role in Roman and Late Roman water management, serving both as primary consumers and places of distribution within cities. Water was of course an essential component of purificatory rites,  

480 In the absence of an aqueduct at Amorium, the river’s presence on coinage may be indicative that it was harnessed by the city for irrigation on the plain, instead.  
481 See for instance the list of water’s uses given in the Tean inscription (SEG 33.997), which includes, to quote SEG 38.2020, “purification, washing preliminary to public sacrifice, ritual bathing, and the bath of the brides preliminary to the wedding ceremonies. … In sanctuaries of
but temples also afforded the opportunity for the imposition of institutional control over water resources in the armature of urban water distribution as they entered and exited from temple precincts, often at ideally elevated locations within cities.

Let us recall, for instance, how the Aqua Claudia terminated in reservoirs and a castellum at the Temple of Divus Claudius, at the very heart of the empire in first century Rome. Frontinus writes that:

“these hills [Caelian and Aventine], before Claudia was brought in, received water from Marcia and Julia. Later on, the emperor Nero built an arcade to carry Claudia from Spes Vetus to a distributory point near the Temple of the Deified Claudius. The existing supplies were not augmented thereby, but were entirely replaced. He added no new delivery-tanks, using instead the ones already there; and the old designations remained although the water itself was that of a different supply.”

While ancient Greek temples were quite commonly situated on spring or thermal water sites, none were recipients of lines from aqueducts – in classical Greek cities, aqueduct lines were connected to fountains situated on agorai and along streets. While watery-sanctuaries abounded in the Hellenistic period, and had increasingly elaborate fountain-houses, they too favored natural rather than artificial supplies. This changed in the Roman period – and continued into the Byzantine period – as artificial supply lines were introduced that recreated the effect of natural supplies inside elevated sacred precincts, as we discussed at the beginning of this chapter, infra sec. 3.2B.

Apollo water can be the vehicle of divine communication (visions, signs) and in those of Asklepios it is used for curative baths. Also Hera, Artemis (cf. the epithet ἄμυνατης; her sanctuaries are often located in marshes, near rivers, lakes and streams) and Demeter (water seems to have played some role in her mysteries) have special connections with water.” These aspects of water’s relation to cult in Greek sanctuaries are discussed by Cole 1988.

482 Frontinus 76.5-7.
On especially high ground, unexpected water supplies might even have been perceived as *thauma* or wonders – witness for instance Pausanias’s account of the famous Upper Peirene spring on the Acrocorinth at *Corinth*, or an inscription’s account of the miraculous appearance of a spring at the temple of Didyma while troops were caught inside during the Gothic siege of 267. We already saw in the first chapter how the middling Roman city of *Jarash* was provided with a temple placed in an important node on the city’s water network, at the end of an aqueduct, placed at an elevated position like a water tower.

Several inscriptions record the circumstances under which temples – mostly for Zeus, interestingly – were the dedicated recipients of water from newly-built aqueducts.

At Asian *Smyrna*, an inscription records how the emperor Trajan’s father Ulpianus built an aqueduct that terminated at the temple of Zeus Akraios at the end of the first century CE, ὕδατος ἐπί τὸν Ἀκραιον. A temple aqueduct at Panamara – the extra-urban sanctuary for Zeus and Hekate near the Carian city of Stratonikeia – is also noted in an inscription, which records the erection of

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\[483\] ἐκ τοῦ εἰσάχθεντος ὕδατος ἐπί τὸν Ἀκραιον ἐν ταῖς στρατευματικοῖς ταῖς Μάρκων ὑίου καὶ πάτρου κατὰ τὸ ἐχῆς = IK 23 2.1, 680

\[484\] For the miracle of Zeus at Panamaros, widely represented on coins produced in the city’s mint until the later third century, see *BCH* 55 (1931): 85; and note the more recent work by Williamson 2011, who notes the creation of a cult here after 39 BCE via 1) monumental inscriptions on the temple walls; 2) an epithet change from Zeus Karios to Zeus Panamaros; 3) a Senatus Consultum de Panamara signifying asylia and the formal recognition of cult with the engagement
statues by one Marcus Sempronius Clemens and his wife on behalf of the
memory of past priests there. One of these priests, as indicated by the
accusative absolute, had previously built an aqueduct that carried water to the
sanctuary of Hekate.\textsuperscript{485} The inscription is fragmentary at a critical line, but if we
follow its use of the accusative absolute, κατεσκευακότα ύδραγώγια και ύδατα
eἰσαγειωκχότα εἰς τὸ ἱερόν τῆς Ἑκάτης, the construction of the aqueduct must
have been one of the virtues of the commemorated priest rather than the patron
 Clemens, in the nominative.

Elsewhere, temples are connected to aqueducts at \textbf{Anazarbus} (where
inscriptions record the contemporaneity of temple and aqueduct construction
under Domitian);\textsuperscript{486} \textbf{Ankara} (where pipes were found in the vicinity of the Temple
of Rome and Augustus in the citadel);\textsuperscript{487} \textbf{Antioch in Pisidia} (where pipe
elements flanked the entrance to the temple of Augustus on the Platea
Tiberia);\textsuperscript{488} \textbf{Damascus} (at the site of the Temple of Jupiter/Cathedral/Umayyad
Mosque); \textbf{Jarash} (where the Artemis temple functioned as a node in the network,
see above Chap. 1); at \textbf{Petra} (for the pools / \textit{paradeisos} of the Great Temple
complex); at \textbf{Selge} (where the inverted siphon could have ascended to the level
acropolis temple, later converted into a church); at \textbf{Tyr} (where water reservoirs
were built under the platform around the so-called Rectangular Building); and of

\begin{itemize}
\item of external donors;
\item 4) a grand festival, the Panamareia; and
\item 5) an iconographic change to Zeus as rider god on coins produced in the local mint.
\end{itemize}

\textsuperscript{485} See infra Appendix E.59a-b.

\textsuperscript{486} See infra Appendix E #9 and \textit{IK} 56.1. #21.

\textsuperscript{487} Fıratlı 1951, 352.

\textsuperscript{488} Mitchell and Waelkens 1998: 151.
course in Jerusalem at the sites of both the Temple Mount and the Jupiter Temple / Holy Sepulcher.\textsuperscript{489}

The distributional role of water from temples took on new importance after 395 CE, when Theodosius closed the empire’s temples, and their resources – including water, gold, and vast estates – were reallocated.\textsuperscript{490}

We have already discussed for Jarash, where the temple of Artemis was formerly an important recipient in the city’s water network, and after it was intentionally dismantled for building materials in Late Antiquity, its supply was maintained and diverted to new consumers that included a water-powered saw mill. Ephesus provides several additional, excellent examples of the diverse ways that water could be reappropriated from obsolescent temples in Late Antiquity.

1. The Temple of Domitian, on massive substructures on the west side of the Upper Agora, was built when Ephesus received its first title as neokorate city in 79/80 CE.\textsuperscript{491} This title granted it status to celebrate the imperial cult on behalf of

\textsuperscript{489} All of these emboldened sites excepting Jarash and Selge were metropolitans; for a description of their water networks in late antiquity see entries for the emboldened toponyms in Appendix F, below.

\textsuperscript{490} On the phenomenon of temple treasury reallocation after the official closure of temples in 395 CE, which I propose was parallel to the reallocation of temple water supplies, see Bonamente 2011, 62-4.

\textsuperscript{491} For the temple of Domitian, see the original reports in Keil 1932, 51-61; Miltner 1960, 21-22; Eichler 1961, 72-74; and especially Vetters 1972/1975, 311-331.
province Asia, and coincided with the paving of the Embolos and the introduction of the Marnas aqueduct into the city. Immediately east of the Temple was the Hydrekdocheion, also called the Fountain of Laekanius Bassus, built contemporary with the temple in 79/80 CE. The fountain’s water supply was studied by Klaus Jung in 2003, who identified the Upper Agora Fountain to the southeast as its source in the original phase (from the Throessitica aqueduct), but noted – following excavations in the 1960s and 2000s – the introduction of two pressurized lines from the southwest, in the direction of the Domitian temple, in Late Antiquity. Old and new excavations on the Domitian’s temple terrace as recently as 2010 revealed a variety of south-north pipes entering the complex, even after the temple proper was destroyed at the end of the fourth century.

During the fifth and sixth centuries, the site was robbed out for building materials down to the vaulted substructures, and a fortified enclosure was built on top. Inspection by the author in 2014 indicated that the temple podium and fountain used the same pipes in at least Late Antique one phase. If the Değirmendere aqueduct was – following Wiplinger’s recent conclusions – no longer functional after CE 368, then the Domitian’s temple complex supply must have been reconnected to the Marnas/Throessitica supply line from the S. Here we should also note that Josef Keil and Hermann Vettets identified Late Antique cisterns

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493 E.g. IK 17, 1, 3008 for the Domitianic paving of the Embolos.
495 Idem.
496 On the date see Passchier and Wiplinger 2013, 296 and generally Wiplinger 2013.
built into the vaulted substructures of the Domitian’s Temple terrace, while the drain of a Late Antique latrine in the temple’s northeast corner contained a fill with coins from as late as the reign of Constantine V (CE 741-775).

2. The so-called Serapeion is located immediately west of the Celsus Library and southwest of the Lower Agora; it was re-exposed for the first time in a century last summer. When originally excavated and published by Rudolf Heberdey in 1915, the unusual proliferation of water pipes here led him to identify this structure as a nymphaeum. Josef Keil rejected the nymphaeum interpretation just a few years later on the basis of fragmentary inscriptions found around the temple propylon, and proposed the identification – still accepted today – that the structure was a temple dedicated to Serapis. Last year’s excavations re-exposed a variety of open-channels, in and around the cella and surrounding niches, which compare with water features found in confirmed Serapeia, where water installations were employed to recreate the sacred flows of the Nile within their precincts. Unfortunately only one small and unidentifiable fragment of a pipe was recovered during the 2013-4 project at the Serapeion. In addition to the conversion of the temple’s cella for use as a church during Late Antiquity, the

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499 For the initial discovery and report on the Serapeion, see briefly Heberdey 1900, 89; before Heberdey 1915, 77-88.
500 Keil 1926, 265-270; for the inscription, which reads τοῖς ἐπὶ Θεοῦ / μοῦ Νείλου Σαράπιδι θύουσι see Vidman 1969, 156, #303.
501 Wild 1981.
temple’s water supply was also re-allocated to new consumers. Shops on the west side of the lower agora – excavated between 1997 and 2000 – revealed glass and metal workshops from Late Antiquity. One of these shops was penetrated by water supply lines led in from the direction of the Serapeion at the Agora Propylaion’s southwest. These pipes – consisting of two different pipe forms, capped and joined together at their sides – led water into a cistern created within the vaulted substructures of the Lower Agora. This supply line is also well positioned to have supplied the basins flanking the west entrance of the Lower Agora’s northwest Propylaion, which were installed during Late Antiquity.

3. The Olympeion was built on the occasion of the city’s second neokorate title under the Emperor Hadrian. The temple itself is poorly known, and has been little excavated. However, the Church of Mary, built in the temple’s south stoa, is much better known after the excavations led by Josef Keil in the 1920s and 1930s, and in the 1980s-90s by Stefan Karwiese. To the church’s east was a large complex with baths, a latrine, and reception areas identified as an episkopeion, or bishop’s palace and administrative center. In addition to new

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502 The Serapeion was also converted to use as a church, with the installation of a bema and altar at its east side. A small baptistery or water tank was built at the bema’s south, with water supply coming down the wall into a pipe fit into a groove in the wall behind the tank – it is unclear whether this was fed by a pipe diverted from an aqueduct, or via rainwater collected off the roof. Krinzinger et alii 2001, 258. It should be noted that the primary supply for water in the Tetragonos Agora otherwise came from the northeast [via the Sirince/Selinus aqueduct lines] or the southeast [through the Mazaeus Gate by the Celsus Library, via the Değirmendere or Marnas/Throessitica aqueduct lines]. Compare with the plan in Ortloff and Crouch 2001.

504 See the review in Karwiese 1995, 311-320; cuts were made in this area after 1973, see Vettes 1973, 178f.

505 See Reisch 1932.

supply pipes that entered the complex from the east, Karwiese’s excavations also revealed a double line of pipes coming from the Olymppeion at north, which were laid on re-used cornice blocks from the temple. A related building trench nearby contained coins from the reign of Anastasius (c. 491-518), which marks these activities as definitively Late Antique interventions on water supplies that were carried to the church precinct from the temple complex. Further, the type of pipes employed in this diversion make for good comparison with examples from the Lower and Upper Agoras, as well as pipes found in a magnificent (but essentially unpublished) distribution complex uncovered in the early 1990s by the Stadium, which were similarly dated to the early sixth century.\footnote{Ibid., 23; see also ÖAI archive photos e.g. EPH-3725 and 3737.}

Palestinian \textbf{Beth Shean} offers little-noticed archaeological evidence for another temple supplied by aqueduct: in this case by an inverted siphon carrying water to the temple of Zeus Akraios, perched on the tell above the city.\footnote{For the temple see Tsafrir and Foerster 1997, here at 111-2, where the authors compare with the octagonal church on the platform at \textbf{Caesarea} (supplied wholly by neatly-collected rainwater into newly-built cisterns).} The temple was replaced sometime after the fifth century CE by an early Byzantine round church.\footnote{Kennedy 2000, here at 202.} Consequently the temple is known only from its foundational remains that were incorporated into the early Byzantine church and subsequent Islamic constructions on the tell (possibly an early Islamic qasr, built before the 749 earthquake).\footnote{For a dating by the capitals and architectural sculpture, see Nocera 2013; Kennedy suggests that the acropolis was abandoned by the Zeus cult “no later than 404 [CE] and not subsequently...} These were excavated by UPenn’s Clarence Fisher in the early...
1920s, before they were totally destroyed by progressive excavations that sought
remains from earlier, namely Biblical periods. The church on the tell was situated
at about 130 BSL, about 25m above the streets in the lower town. There are six
springs near Beth Shean at elevations sufficient to bring water to the lower city
via gravity, and also to the Zeus Akraios temple or round church on top of the hill,
under pressure through pipes.\textsuperscript{511} Two aqueduct channels have been excavated
at Beth Shean, and three more have been postulated but not identified or
published.\textsuperscript{512} It is hypothesized that one of the latter, unidentified lines, might
have supplied buildings at the top of the hill – this can be supported with little-
recognized data from the earlier Penn excavations. We know that the Hellenistic-
Roman temple at Beth Shean had at least one medium-sized reservoir: the
church was built over part of the temple platform, slightly off-orientation, and
Fisher’s plan indicates an 8 x 8m reservoir off-angle under the church that was
filled with building debris from the temple.\textsuperscript{513} All we know of water in the church
itself is a much smaller water receptacle – a little tank likely fed by rainfall
directed in from the atrium pavement. But Fisher’s plan also indicates another
channel, following the curvature of the church’s inner colonnade, and then

\textsuperscript{511} Fahlbusch 2002.
\textsuperscript{512} Tsafir and Foerster 1997, here at 88, where the authors also note d that “it is significant that
no cistern or water reservoir of the Roman-Byzantine period was found; rather, the main problem
became the maintenance of an adequate drainage system to conduct waste water and winter
floods out of the city onward the Jordan Valley.” The tell is an important exception, with at least
three cisterns or reservoirs on the summit known archaeologically, two of considerable size.
\textsuperscript{513} Fitzgerald 1931, 32 for a detailed description of the excavation of the church and the reservoir
and water channels found beneath it.
crossing south to intersect with a channel from the east, near a feature named “Byzantine Reservoir” that measures about 10x5m – no small thing, at 4m deep it would have held 200,000 liters of water. For the reservoir’s eastern channel, we should look to the lower terrace houses, where water channels of two types were found: lined channels covered by stone slabs, and chains of linked ceramic pipes. The precise function of the pipes is unclear – Fisher found domestic cisterns here, but he explicitly noted that the ceramic pipelines in the houses did not connect to these Late Antique domestic cisterns.\textsuperscript{514} The pipelines run southeast along the Long Terrace North (House IV.3) and Long Terrace East (House III) in a way that disrespects any domestic arrangement in the houses – they do not appear to be simple rainwater drainage channels from the roofs.\textsuperscript{515} These channels are better interpreted as components of a system independent of the houses, for the benefit of structures on the south side of the tell – arguably a water supply carried in pressurized pipes down from the spring up the hill and through the North Gate, where a “Byzantine reservoir” (interior 7.8 x 4.22 x >1.79m = >58,900m\textsuperscript{3}) lined with mortar was noted in excavation\textsuperscript{516} – before descending around the lower terrace and through the houses. Whether this pipe was installed before or after the house’s construction is unclear. Where was this water headed? We started with the one “Byzantine” reservoir near the church. There is no evidence to suggest a bath on the tell, though this can’t be ruled out. The character of the channels themselves might be compared with some found

\textsuperscript{514} Ibid. 8.
\textsuperscript{515} Ibid. 5-16.
\textsuperscript{516} Rowe 1930, 24.
near the Sigma and the West Baths in the lower town, dated by coins to the latter fifth or early sixth century; where they fed a complex of water-powered flour mills installed that are variously dated as Late Byzantine, Umayyad Early or Abbasid Middle Islamic. The arrangement of walls near the “Byzantine reservoir” south of the church on the tell might even suggest a similar arrangement there, with either a water-powered mill for grinding flour [note the round tabun oven a few meters away], or an animal-powered mill that could raise water from the reservoir to the immense residential complex above, that sprang up after the church’s obsolescence, sometime between the late sixth and mid-eighth century. Further work in the UPenn Archive’s level books would be required to prove or disprove these hypotheses, though this was beyond the scope of the present work. Either way, there was a substantial water system on the tell at Beth Shean, which was potentially supplied by a springs (at -76 to -103m ASL) carried through pipes in an inverted siphon up the elevation of the tell (-131m ASL), to the temple and the church or Umayyad residence that succeeded it.

3.15 Intra-urban diversion: industrial reuse

Pre-existing water networks in cities were also commonly adapted for new industrial applications in Late Antiquity. While sometimes viewed as encroachment or symptoms of decline, several examples from Ephesus will help demonstrate how these installations could also be related to new administrative

517 See Mazor and Najjar 2007, 71-95 on the post-Odeum complex, here at 87 for the dismantling of the Odeum that coincided with the renovation of the west bath and the installation of new drainage lines.
centers in Late Antique cities, thereby implicating local elites in the adaptation of these water networks for new purposes.

At Ephesus, evidence for carefully planned industrialization facilitated by aqueduct water comes from a careful examination of pipes in the city undertaken by the author in 2013-2014, which revealed one particular form of pipe in locations across the city, consistently in association with mill complexes: the so-called “Big Red Pipe.” Examples of the Big Red Pipe are related to mill installations in Ephesus at three locations – at Celsus Library [#93], by the Octagon/Terrace House 2 Workshops [#650], and at the south Fountain in the Upper Agora [#’s 20-23].

1) The Octagon was first uncovered in 1904. A Big Red Pipe [#650] is located behind the present guard house on the Embolos, between the Octagon and the Androkles fountain, immediately north of Terrace House 2, oriented west-east. A mill installation existed immediately east of and on a line with this pipe, just behind the Octagon. Ladstätter has recently described this water mill as fifth century in date, the earliest of a larger group of mills that were installed along the west side of Terrace House 2. At its east or lower side, the pipe is blocked by

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519 For the Terrace House 2 and Octagon water-mill complex, see the short articles in Wefers and Mangartz 2010, and Wefers and Mangartz 2011.
520 The final publication of these mills is forthcoming. For now, on the Octagon mill’s fifth century date, see Ladstätter 2012, 85. The older reports may be found in Vetters 1984, 218-225. My thanks to Sabine Ladstätter for discussing the Octagon complex with me, which is the most little
an immense block of sinter (c. 1.0 x 0.4 x 0.5m), which indicates a long term flow of water around the pipe even after it was no longer functional. Mangartz and Wefers concluded that the Terrace House and Octagon mills were all supplied by water from the Değirmendere aqueduct, carried down a mill-race from the top of Terrace House 2. However, this contradicts Wiplinger and Passchier, who surmised that the Değirmendere aqueduct was no longer functional after the later fourth century CE. A supply from the Marnas/Throessitica aqueduct is also possible at this elevation. Either way, because of the massive sinter accumulations around pipe #650, one might hypothesize that the mill was originally supplied by pipes like #650, carrying water east-west down the Embolos street from the Upper Agora, but that later its supply-line was modified so as to come from the north slopes of Bulbuldağ through Terrace House 2, after the area was re-leveled and other water-mills constructed there during the sixth century.

2) The second water-mill complex is related to another Big Red Pipe [#93], just east of the famous Celsus library façade. In Late Antiquity, the library was backfilled and its façade modified to function as the backdrop of a nymphaeum, whose front was closed by the rearranged panels of the Antonine Parthian

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521 Wefers and Mangartz 2010, 716.
522 Wiplinger 2013, 125 for the terminal dating of the Değirmendere aqueduct’s functionality, before CE 368.
523 Krinzinger 2001, 373.
Monument.\textsuperscript{524} A mosaic-paved audience hall was constructed at the library’s south and southeast.\textsuperscript{525} Just east of the audience hall’s stepped entrance are the remains of a watermill housing. Because the area was excavated early on by Heberdey (1898-1907), the precise phasing and chronology of this area remains poorly understood, even after Vetters’ reassessment in the 1970s.\textsuperscript{526} Vetters and Jobst dated the hall’s occupation between the fifth and seventh century, on the basis of a pavement mosaic.\textsuperscript{527} Big Red Pipe #93 is located on a straight line a few meters east of the mill race that was built just west of the monumental stairs for the audience hall. The pipe is heavily mortared and tilted up towards Celsus, contrary to the slope of the hill – water coming down the Embolos was thus carried under modest pressure to provide motive force that powered the mill.

3) The third mill complex was built into the west side of the so-called Fountain on the Upper Agora, and was supplied by Big Red Pipes [#20-23].\textsuperscript{528} This watermill was cleared and cleaned in 2014: in the southwest corner of the fountain, tracks from the wheel installation’s motion are visible in the accumulations of sinter that

\textsuperscript{524} For the late antique conversion of the Celsus library façade into a nymphaeum, with supply from the SE, see Heberdey 1905, 70.
\textsuperscript{525} See Vetters 1974, 215, where Vetters notes the discovery of a tenth or eleventh century lead seal here, which he (following Strocka) interpreted as a TPQ for the final occupation of the hall, and the destruction of the library façade in the Middle Ages. See also Vetters 1977, 198-9; Vetters 1978, 267; and Vetters 1979, 126 with plan at Abb. 3.
\textsuperscript{526} Without reference to the mill complex itself, whose water race and wheel supports are still visible, but rather to its context, including the fountain in front of the Bibliothek façade at Celsus Platz and the fifth - sixth century reception hall and mosaic excavated above the mill, on the south side of Celsus Platz, see Heberdey 1904, 49f; more recently see Vetters 1977, 198f with a plan published in Vetters 1979, Abb. 3.
\textsuperscript{527} Vetters 1976, 500.
\textsuperscript{528} For the original excavation at Der Fontane see Heberdey 1912, 173-177; for the inscriptions see \textit{IK} 12, 414 and \textit{IK} 12, 416 for inscribed architraves and enclosure slabs dated 92/93 CE from the original construction by Calvius Ruso; \textit{IK} 14, 1316 and 1317 for the restoration by proconsul Asiae L. Caelius Montius under emperors Constantius II and Constans, dating 340-350 CE.
cling to the fountain walls. Immediately above the wheel-housing may be seen a stack of heavily sintered Big Red pipes. Identical Big Red pipes were used as replacements for their heavily sintered predecessors – this situation raises the question of sinter accumulation rates and the longevity of the Big Red Pipe as a standard design.

We have already noted the “Big Red” pipe’s presence at the Scholastikia bath, thought to be an early or mid-fifth century re-foundation; the Octagon watermill has also been dated to the fifth century by Ladstätter and Mangartz. By extension, the presence of identical Big Red pipes at water-mills by the Upper Agora Fountain and Celsus Platz may also indicate a fifth century date for these complexes, which were excavated early in the history of the Austrian project and are less well understood. In this scenario, water-mills fed by Big Red pipes were highly visible components of the Late Antique city, during the period in which it was rebuilt after the destructive earthquakes of 363 CE, well before the better known water mills at the Terrace Houses, which are dated to the very late sixth or seventh centuries.

Close examination of Big Red Pipes in relation to these Late Antique industrial complexes thus underlines the point that water mills powered by intra-urban diversions from aqueducts were not symptoms of Late Antique encroachment, but rather were carefully coordinated by city managers and integrated into larger urban planning schemes, placed next to new administrative complexes. Late
Antique Ephesus was, by this account, less like imperial Rome, and more like Victorian London.

All of the aqueduct-fed, water-powered mills at Ephesus were secular industrial installations – that is, they were built into converted structures in secular public spaces, near administrative complexes, without any visible or piped connection to a church. Elsewhere we might postulate a relationship between churches and industry as indicated by their shared connections to water diverted from aqueducts.

Proximity of water-powered industrial installations to church complexes is hardly uncommon, though proximity alone cannot be an argument for the site-specific relation of church to industry, or for the maintenance of related water infrastructure by the church. The domestic-industrial complex that sprang up in Late Antiquity in front of the nymphaeum on the acropolis at Sparta was situated just 30 meters west of a mid-sixth to seventh-century church. The water mill in the nymphaeum at Messene was similarly about 20m north of a late seventh century basilica church, and 20m west of a Late Antique/Middle-Byzantine bath complex that is currently under excavation – at the very least, the three functioned simultaneously, in a high-traffic area of the Late Antique city (Fig. 3.19-20). At Lycian Xanthos, a fifth-sixth century industrial center flourished in

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529 The industrial complex at the nymphaeum was recently excavated and to my knowledge remains unpublished; for the church see Sweetman 2009. Sweetman prefers a mid-late sixth century date for the complex, which also includes a monumentalized well in a small cruciform structure immediately west of the narthex.
the former civic basilica, dismantled in the fifth century, in whose substructures a
large reservoir was installed, probably taking its feed from the south side of the
west-east aqueduct line that ran under the Decumanus, just north of the basilica.
This complex was right across the street from the East Church, which also had a
feed off the aqueduct that supplied complex fountain and baptistery
installations.\textsuperscript{530} At Lycian Andriake, Late Antique churches were sited in very
close proximity to dye production from murex shells, which required large
volumes of water carried in by the aqueduct.\textsuperscript{531} At Pisidian Kibyra, industrial
activities (including leather-working, pottery kilns, and metallurgy) supported by a
piped-in water supply around the stadium seem to have coincided with
construction and activity at an Early Christian basilica just to the south of the
production zone.\textsuperscript{532} The ceramic kilns and food preparation areas that invaded
the Large Baths III.2B at Cilician Anemurium were also in close proximity to the
Beach Basilica there.\textsuperscript{533} In these cases, the precise relationship between the
church and neighboring industrial activity is unclear, even if they share water
supplies – what is clear, however, is that the occupation of both the churches and
the industrial/commercial zones were contemporary, and thus that these spaces
together constituted busy Late Antique ‘neighborhoods,’ very different from the
monumental civic city cores that had preceded them.

\textsuperscript{530} See infra Appendix F. s.v. Lycia, Xanthos, at the Civil Basilica and East church for a full
description of these complicated remains; the basic reference for late antique date of reservoir
installation under the civil basilica comes from the 2004 report from Xanthos, for which see Des
\textsuperscript{531} Çevik and Bulut 2011, 64.
\textsuperscript{532} Ekinci et alii 2007, 24 and Ekinci et alii 2009, 33.
\textsuperscript{533} See Russell’s excavation report on encroaching structures from the area of Large Baths III.2B
The connection between churches and industry, powered by water diverted from aqueducts, is more obvious elsewhere: the episcopal complex attached to the south side of the fifth-/sixth-century cathedral in Byllis (Basilica B) contained an extensive and well-integrated system for the collection of rain-water and ground-water sources that supported various workshops, including a fuller, viticultural activities, and other food preparation/storage areas.\footnote{534 For industrial activities at the episcopal quarter in Byllis, see Beaudry et alii 2009 and 2013 with plans.} At Thessaloniki, an edict of the emperor Justin II gave the church of St. Demetrius privileges for the operation of a salt pan at Kitros, where salvage excavations in the 1980s revealed a fortified episcopal complex with a variety of water-powered installations for wine and oil processing, presses, mills, and storage areas.\footnote{535 For Kitros see Gerousi 2013, here at 35 n. 16-18 with fig. 23; and for the responsibility over a salt pan in the reign of Justin II, see Dolger 2009, 129 #258 and see Vasiliev 1943 with Gregoire 1944-1945.} At the Campanopetra church in Cypriot Salamis, the church’s courtyard phiale and small bath drew its supply from a bronze pipe coming in from the street (inscribed stone pipes were also found here); food preparation areas were set here onto the original level of the church’s atrium courtyard.\footnote{536 See Roux 1998, 149-150 and Argoud 1980, here at 333.} Domestic-industrial complexes also sprang up inside the Late Antique city walls at Phrygian Hierapolis, where their supply of water from the city’s north aqueduct flowed down from its primary destination, the extra muros bath, which had lately been converted (early sixth century) for use as a church.\footnote{537 D’Andria, Scardozzi, and Spanò 2008, 34-39 and Arthur 2006, 100-1.} Pottery production at Lycian Patara was located...
in close proximity to a cemetery church just north of the city, near a small spring that was adapted into the church; food preparation seems to have taken place near the ground-water source in a southern annex at Patara’s Strassenkirche. At Viranköy near Cilician Olba, recent surveys identified an industrial complex with water channels in close proximity to the terminus of the aqueduct, which had been repaired by the bishop Kosmas in the sixth century, during the reign of Justin II and Sophia. And at Meryemlik near Seleukeia in Cilicia, there is both textual evidence from the Life of Thekla (for soap-production) and archaeological evidence (for water-lifting devices between reservoirs 2 and 3, and for irrigation) that would indicate the dedication and strength of the church’s commitment to water-powered industry and regional agriculture.

The proximity of, or connection between, high-status secular or elite constructions to water-powered or –facilitated industrial areas which encroached on public spaces in Late Antique cities, suggests that these developments were not symptomatic of decline, but rather that such processes could be carefully controlled and organized by local authorities with careful water-planning. Baths were traditionally the prime reason for an aqueduct’s construction in Roman

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538 İşik 2011, 74-5 for pottery production at the extramural church; production activities at the Strassenkirche are without note in publication but seem to be indicated by the finds of millstones around the well and groundwater catchment pool at the church there, which is dated to the later fifth or early sixth century by ceramics, see KST 19.2 (1998), 65-8.
539 Erten 2009 and see Appendix E #95.
540 See Miracles of Thecla 26, trans. Dagron or Johnson for soap; my DSC02008.JPG for the square cutting in the bulwark between open reservoirs 2 and 3 that could correspond to a water lifting device, or the walls along the far side of the wadi at the complex’s E that are probably not circuit walls, but rather for channeling torrential water further downstream, away from the complex and the agricultural lands surrounding it.
cities. The introduction of such carefully coordinated industrial applications for water in Late Antique cities – either in addition to or at the expense of traditional display- or pleasure-oriented Roman spaces of consumption like baths – is a primary characteristic of the Roman to Late Antique shift in the ideologies and practices of water management in cities.

3.16 Intra-urban diversion: ecclesial water in the metropolitan cities

Baptisteries are the first thing that comes to mind when most people think of the church’s relationship to water, but the provision of running water from aqueducts to baptisteries in the Late Antique eastern Mediterranean was actually rather unusual and rare.

Baptisteries are not a good measure of a church’s integration into urban water systems. Eight baptisteries survive from our sample of the eastern empire’s metropolitan cities. Piped supplies for baptisteries account for half this number, with examples from Bosra, Salona, Stobi, and possibly Side – notably however, these are all cities where the church’s influence on the broader scheme of city water management was more restrained, and the churches acted as consumers only, without any more visible role in the supply or provision of water for the city as a whole (excepting Bosra, where a bishop intervened with Justinian to rebuild the aqueduct, attested by inscription, see E.101-2). A variant of piped-water

541 Compare also the piped baptistery supplies for Hagia Sophia in Constantinople, the Kourion episcopal complex, and at Amphissa in Boeotia.
supply for a baptistery appears at Corinth’s Lechaion basilica: in the octagonal baptismery north of the narthex, a marble-lined basin in the southeast corner provided an indirect supply of piped water to the font at center, which had neither a drain nor its own piped supply. This basin itself lacked a dedicated supply, and was likely filled by bucket from one of the pipe-fed fountains in the church’s atria; the combination of piped and unpiped points of supply and storage probably represents a fairly typical situation for the many churches with such fountains.

Sometimes the choice not to supply a baptistery with piped-in water was not for any lack of opportunity: at Ephesus, Pisidian Antioch, and Apamea, baptisteries did not have dedicated supplies from pipes, though the episcopal complexes were otherwise well integrated into municipal networks. The author’s experience looking at monolithic fonts in local museums across the eastern Mediterranean would suggest that this proportion – roughly half of baptisteries fed by piped-in supplies among metropolitan cities – cannot be reflective of the larger situation in the provinces, where drains are typical, but piped-in supplies for baptisteries are much rarer.

The lack of piped water supplies for baptisteries becomes especially interesting when we consider the contradiction of the archaeological evidence with the ancient prescription, recorded since the Didache of the second century, that

542 Of the remaining two examples, Tyr supplied its baptistery from a rock-cut cistern which may or may not have been connected to the city’s supply system, and there is no published evidence for the supply of the baptistery at Tyana despite its discovery, to my knowledge – for the Tyana baptistery see KST 26 (2005): 513-528.
baptisms should if at all possible be made in living water (ἐν ὕδατι ζῶντι). The Didache here use the same distinctions of language – living/flowing or dead/standing water – that were applied in Roman jurisprudence concerned with water rights, and which were also familiar to the Mishnah, where Jewish exegetes debated the relative value of different categories of water in similar terms. In fact, there are arguably Jewish precedents for the Christian re-evaluation of rain water’s relative goodness, and its potential sanctification, in comparison to the spring water sources traditionally favored by Romans. Miqva’ot for ritual ablutions were more ecumenical in their adaptation of rainwater sources: a good example comes from Lmyra, where a recently discovered synagogue built in the third century CE to abut the city’s eastern walls, adapted part of the circuit as a rainwater catchment, that supplied an elaborate miqva’ot with marble surrounds. Given the prevalence of baptisteries without access to living or running water, we might consider another alternative. Namely, if water taken from a well or cistern and poured out of a vessel onto a baptizand could be considered living water – at that instant when it was poured or aspersed, anyways – regardless of its actual source, this would constitute a striking evolution of the terms by which water sources and quality had forever been judged, according to classical and Roman writers.

544 On ‘living water’ in the Didache, see now the discussion of Ferguson 2009, 202-4.
545 The first century miqva’ot at Qumran were also all fed from a rainwater system, see Hirschfeld 2002, 259. For the Lmyra synagogue and its rainwater system, see Seyer and Lotz 2013, esp. 135. My gratitude is due to Martin Seyer for discussing this installation with me on-site in July 2013.
Blurred lines between traditional categories for water also become apparent upon consideration of hagiasmata, or holy water sources. The attribution of healing powers or divine presence to spring water is a well-known phenomenon from Late Antiquity and Byzantium. What is less well-known is how church builders could walk the line between natural and artificial holy water, providing artificial piped-in supplies for water sources venerated as holy, that at least appeared or were understood to be or be like natural spring sources. The clearest examples come from two related hagiasmata at Thessaloniki: a small fountain with frescoes of the Anargyroi was installed adjacent to the cisterns under the cryptoporticus of the Roman Agora, just south of the basilica of St Demetrius. In the crypt of the St Demetrius church itself, was the five niched nymphaeum which was so central to that saint’s cult. Crucially, both the cryptoporticus fountain and the St Demetrius nymphaeum were not supplied by springs on site, but rather were fed by piped-in water from the city’s aqueduct. Another striking example comes from Phrygia: the so-called hagiasma on the road leading up the Hierapolis hill to the shrine of St Philip, in addition to two marble-lined pools for immersion on the north side of the nave of St Philip’s tomb-basilica (recently

546 See recently Ousterhout 2015 on springs and healing in Constantinople, and Talbot 2014 on hagiographic sources for holy pools and springs in Constantinople.
547 Bakirtzis 1984, II: 5-19, here at 13 identifies an aqueduct supply for the Anargyroi fountain under the Agora cryptoporticus. Bakirtzis interpreted the frescoes of Cosmas and Damian, doctor saints, as an indication that the fountain’s water were venerated for healing, though we might also propose that they functioned as a marker of the water’s potability.
548 See Lemerle 1978-80, II: 205-6 for comments on the St Demetrius church’s relationship to the Roman baths on which it was built, and the supply of the nymphaeum/hagiasma in the crypt.
excavated, not the octagonal so-called martyrion above it), were also supplied by piped-in aqueduct water, rather than an immediately local spring source.\textsuperscript{549}

These contradictions – standing water in wells and cisterns could provide the living waters of baptisteries, the living holy waters of hagiasmata were potentially aqueduct-fed parts of a larger artificial municipal system – should alert us to the complexity of the church’s involvement with water in Late Antiquity. Upon careful inspection, we find that the relationship between churches and urban water systems was considerably thornier than the problem of supplying water to baptisteries might suggest, its contradictions included. A vast array of hydraulic features was involved in the water management of churches in Late Antiquity. Water installations at churches were hardly limited to specifically ecclesiastical features like baptisteries or hagiasmata, but also included the replication of domestic features like peristyle fountains; civil features like public baths or large terminal cisterns; and industrial installations requiring water, like mills or cisterns associated with glass or pottery production, metallurgy, and food processing.

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\textsuperscript{549} For the St Philip hagiasma, see D’Andria, Scardozzi, and Spanò 2006, 95 with fig. 70, for the accompanying details of its supply by aqueduct. The extraordinarily important installations around the St Philip tomb-church have been preliminarily published in D’Andria 2011-2.

\textsuperscript{550} This list is drawn from Jones 1964, 2: map VII “Ecclesiastical Organization Under Justinian.” The water systems of all these sites have been given more thorough descriptions in Appendix F, listed by province and city name.
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</tbody>
</table>

A survey of evidence from the fifty-eight archbishoprics of the eastern empire in the time of Justinian demonstrates that there was no overarching or monolithic model by which churches were integrated into municipal water networks. Rather,
we submit that churches interacted with water networks along a spectrum, in three dimensions. If imagined as a Cartesian plot, its $x$ axis might be defined as the measure of state control over water resources, as indicated especially by the relationship of water networks to fortifications and other strategic locations within cities. Its $y$ axis might be defined as the degree to which churches were integrated into municipal water networks (whether as suppliers or merely down-line consumers); its $z$ axis as a measure of the variety of hydraulic installations around churches (for liturgy, water-storage, industry, bathing, etc.). The construction of churches – especially episcopal complexes from the later fourth through sixth centuries – meant the implantation of these complexes into pre-existing systems for the supply, consumption, and drainage of water in Roman cities, balancing the maintenance of a system’s ‘bones’ with the effort required to impose new intentions that could be at odds with old Roman drainage-, display-, and pleasure-oriented modes of water consumption.

A quick comparison of Syrian Apamea and Phrygian Hierapolis might help explain this model, and demonstrate its broader applicability. At Apamea, state control over water *intra muros* was maintained by placing distribution equipment for an inner aqueduct (6th century) within the line of fortifications.\(^{551}\) Churches at Apamea offered little in the way of storage, and were integrated into water networks only as consumers with fountains, akin to elite residences.\(^{552}\) At

\(^{551}\) Vannesse et alii 2014 for the distribution complex in the fortifications at Apamea.

\(^{552}\) Balty and Lemaire 1969, 70 for the phiale and water installations at the “Atrium Church with Large Colonnade.”
Hierapolis, critical locations in the city’s water distribution network were usurped by new church constructions: a converted bath-church extra muros, where the city’s northern aqueduct crossed into the city; and on St Philip’s hill, where a large public bath supplied by a new inverted siphon-bridge was built adjacent to the eastern aqueduct’s entrance into the city.Industrialization spread through the old Roman city core: besides glass and textile workshops on the city’s north side, in the center, the city’s primary intra muros bath was converted into a church, with columns from the despoiled temple of Apollo (which itself became a den of water pipes and industry). Clearly, the church in Hierapolis was able to very effectively assert control over the city’s water resources through careful planning. Pisidian Antioch and Jarash compare well with Hierapolis in this sense, in terms of church-positions at the head of local water networks, the variety of hydraulic features incorporated into churches in these locations, as well as the relatively early dates (later fourth to fifth centuries) at which the church became involved in local water affairs. On the other hand, the church as consumer model appears more prevalent, with even traditionally strong church-centers like Corinth and Ephesus falling into this category.

Generally speaking, some churches featured new and large-scale elements like reservoirs or baths that made episcopal complexes both central consumers and

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553 See Caggia and Caldarola 2012 for the bath and bridge, with details of two strands of pipes crossing under the bridge in Scardozzi 2007, 78.
554 Recent excavations indicate that the apodyterion was converted into a church sometime before coins indicate the building burned between 612 and 620; see Sacchi and Bonzano 2012, 328.
nodes in maintained or modified water networks, if not also their some-time managers (e.g. Iustiniana Prima, Philippopolis, Resafa, Tyr, Jerusalem).

Some church complexes usurped and converted pre-existing hydraulic works to function as primary or first-degree water-consumers; churches in this role were more akin to Roman baths and nymphaea, which tended to exert a greater gravity or influence over water system development in the rest of the city, as did churches in these locations (e.g. Thessaloniki, Antioch in Pisidia, Hierapolis, Bosra).

Churches in other cities functioned merely as down-line or secondary consumers in ramified networks that were still closely controlled by state or secular elite interests (e.g. Stobi, Corinth, Ephesus, Side, St. Babylas at Antioch, Apamea). Churches in this role were more akin to elite houses, which consumed water (mostly for fountains) but did not organize or structure the networks themselves. Or, episcopal churches were not at all integrated into municipal networks, but provided water to consumers 'off-the-grid', entirely from cisterns and wells, or potentially from nearby rivers and lakes (e.g. at Nicopolis ad Istrum, where an older Roman aqueduct was not rebuilt for the sixth-century settlement). In this connection it should also be noted that more than half of the eastern empire’s metropolitan cities were sited on rivers or lakes, as

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555 Poulter 1995, 6 and 45-6.
indicated in Table 3.3.\textsuperscript{556} A tabular assessment of hydraulic infrastructure data for the metropolitan cities, provided in extenso in Appendix F, can help further demonstrate the variety and vitality of the church’s integration into municipal water schemes.

Taken as a whole, it is clear that there was no monolithic model for the church’s approach to water management in Roman cities. Justinian’s formalization of the church’s responsibility for water infrastructure in 530 CE was not innovation but only maturation, an edict promulgated in a highly variegated imperial space where responsibilities and expectations for municipal water supplies and consumption had begun to shift away from imperial Roman precedents at least two centuries earlier. The two centuries following Justinian’s edict, on the other hand, portended disasters for the Byzantine state – war, insecurity, and loss of territory to the Slavs and the Umayyads, plague and depopulation, principally – that had dire consequences for the empire and by extension, its surviving Roman water infrastructure, especially in border zones of Byzantium’s ‘no-man’s land’ policies on the Danube or in Cappadocia or Cilicia. By the time that a new military rather than civic administrative organization emerged after the later seventh century to deal with these crises, the tyranny of the aqueduct as an expensive, conspicuous necessity for the water supply of Roman cities of status had effectively ended.

\textsuperscript{556} We have already drawn attention to late antique notices of the acceptability of surface water for large scale municipal supplies, in our discussion of Procopius’s account of aqueducts at Dara, above, sec. 2.4 and 2.9.
3.17 Aqueducts after the seventh century: water in the military capitals

A quick review of water infrastructure in the military capitals underlines the point that, by the eighth or ninth centuries, the empire settled new administrative centers into locations that mostly lacked functioning aqueducts, though in many cases one might have previously existed, and could at least potentially have been repaired (see Table 3.4).

Table 3.4: Military Capitals After the Seventh Century

<table>
<thead>
<tr>
<th>Capital</th>
<th>ModName</th>
<th>Theme (Date By)</th>
<th>Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Adrianopolis</td>
<td>Edirne</td>
<td>Macedonia (802)</td>
<td>Ottoman aqueduct on Roman predecessor?</td>
</tr>
<tr>
<td>2 Amaseia</td>
<td>Amasya</td>
<td>Armeniakon (667/8)</td>
<td>Riperine + Hellenistic and Roman system, with inscription and evidence for medieval functionality</td>
</tr>
<tr>
<td>3 Amorium</td>
<td>Amorium</td>
<td>Anatolikōn (669/70)</td>
<td>No aqueduct, supplied only by wells?</td>
</tr>
<tr>
<td>4 Ancyra</td>
<td>Ankara</td>
<td>Boukellarion (767/8)</td>
<td>Roman – early Byzantine aqueduct with inverted siphon to citadel; TPQ non after construction of citadel with inverted siphon blocks, in seventh or eighth century.</td>
</tr>
<tr>
<td>5 Arkadiopolis / Bergoule</td>
<td>Lüleburgaz</td>
<td>Thrace (680)</td>
<td>Ottoman system on Roman predecessor?</td>
</tr>
<tr>
<td>6 Arsamosata</td>
<td>Kharput ['rocky fortress']/El a-zig or Haraba</td>
<td>Phasiane/Derzene (935)</td>
<td>Unknown</td>
</tr>
<tr>
<td>7 Barion</td>
<td>Bari</td>
<td>Longobardia (892)</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td><strong>Caesarea</strong></td>
<td><strong>Kayseri</strong></td>
<td><strong>Charsianou (863-873)</strong></td>
</tr>
<tr>
<td>---</td>
<td>--------------</td>
<td>-------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Cephalenina</td>
<td>Kephallenias (809)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Chandax</td>
<td>Heraklion</td>
<td>Kretes (767 or 961)</td>
</tr>
<tr>
<td>11</td>
<td>Cherson</td>
<td>Cherson</td>
<td>Chersonos/Klimata (833)</td>
</tr>
<tr>
<td>12</td>
<td>Chonai</td>
<td>Honaz</td>
<td>Thracesion (687)</td>
</tr>
<tr>
<td>13</td>
<td>Corinth</td>
<td>Corinth</td>
<td>Peloponnese (811)</td>
</tr>
<tr>
<td>14</td>
<td>Corinth, later Thebes after 809</td>
<td>Corinth / Thiva</td>
<td>Hellados (690)</td>
</tr>
<tr>
<td>15</td>
<td>Dyrrachium</td>
<td>Dürres</td>
<td>Dyrrachiou</td>
</tr>
</tbody>
</table>

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557 Strataridaki et alii 2009 for the Heraklion aqueduct  
558 Romančuk 2005, 50 for the medieval city gate at tower eight in Cherson, with two strands of pipes entering the city from the aqueduct and ibid., 102f for the primary use of this system, to fill cisterns that were used for salting fish. The system was also in use between the fifth and sixth centuries, though it appears to have been maintained in later centuries as well.  
559 See above sec. 3.8 for a discussion of water around Chonai.  
560 Symeonoglu 1985, 168 for the Thebes aqueduct with an arched bridge built by Bishop John Kaloktenes in the twelfth century, for the city’s silk industry, in use until the later nineteenth century.
<table>
<thead>
<tr>
<th>No.</th>
<th>Location</th>
<th>Province</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Gangra</td>
<td>Çankırı</td>
<td>Paphlagonia (826)</td>
<td>fifth century repairs; wells</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>unknown</td>
</tr>
<tr>
<td>17</td>
<td>Idassa/ladera</td>
<td>Zadar</td>
<td>Dalmatias (899)</td>
<td>wells + 41km aqueduct from Vrana cave spring/lake source – carried through marsh in stone pipeline. 105 CE construction; fifth or sixth century terminus?[^561]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>18</td>
<td>Kamacha</td>
<td>Kemah, Erzincan prov</td>
<td>Mesopotamia (899-911)</td>
<td>unknown</td>
</tr>
<tr>
<td>19</td>
<td>Koloneia</td>
<td>Aksaray</td>
<td>Koloneia (863, prob. 842)</td>
<td>Long-distance qanat supply?</td>
</tr>
<tr>
<td>20</td>
<td>Koron, later Tyana</td>
<td>Kappadokias (830)</td>
<td>Koron is set above a wadi valley with torrential flows: Tyana was supplied by a simple gravity flow aqueduct from close, abundant spring northeast of the city</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Lykandos</td>
<td>Lykandos (916)</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Mytilene [Lesbos]</td>
<td>Mytilene</td>
<td>Aigaiou Pelàgous (842/3)</td>
<td>26km Roman aqueduct of second or third century CE, including Roman bridge sections with repairs, as well as sections with evidence of Ottoman repairs and reinforcement[^562]</td>
</tr>
<tr>
<td>23</td>
<td>Naupaktos</td>
<td>Naupaktos</td>
<td>Nicopolis (899)</td>
<td>Roman aqueduct with Late Antique restoration; little studied.</td>
</tr>
<tr>
<td>24</td>
<td>Neapolis</td>
<td>Kavala</td>
<td>Strymon (899)</td>
<td>Roman aqueduct with Late Antique restoration: the Kamares aqueduct terminates at a coastal fortress. This system includes a 280m long bridge with 60 arches, at</td>
</tr>
</tbody>
</table>

[^561]: Ilakovac 1976 for the Iader/Zadar aqueduct.
maximum height 25m. The present structure is
Ottoman, though part of a
retaining wall carrying a
channel is not arched but
still related to the fortress,
and may be earlier in
date.

<p>| | | | |</p>
<table>
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<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td><strong>Nicaea</strong></td>
<td>Iznik</td>
<td>Opsikion (680)</td>
</tr>
</tbody>
</table>
|   |   |   | City supplied by a
Roman-Byzantine
aqueduct with substantial
Ottoman repairs, possibly
along a different line from
the same source to the
east city gate; little
studied |

| 26 | **Nicomedia** | Izmit | Optimaton (775) |
|    |   |   | Roman aqueduct; little
studied |

| 27 | **Samos, later** | Samos | Kibyrrhaiotōn (697 or 720) |
| **Attaleia** |   |   | Pre-Roman and Roman-
Byzantine aqueducts, in
use at least until later
seventh century +
bath/church conversion |

| 28 | **Sebasteia** | Sivas | Sebasteia (911) |
|    |   |   | Unknown |

| 29 | **Seleuceia** | Silifke | Seleukeia (934) |
|    |   |   | Roman aqueduct to
Silifke and Meryemlik in
use at least until fifth
century, unclear terminal
date. |

| 30 | **Smyrna** | Izmir | Samos (899) |
|    |   |   | Roman aqueduct with
inverted siphon
maintained in Byzantine
period to Kadifekale on
Mt Pagus? Ottoman
repairs. |

| 31 | **Syracuse** | Sicily (700) |
|    |   |   | 4 pre-Roman and Roman
aqueducts are known at
Syracuse; albeit with
unknown functionality
during the Byzantine
period, but note the
murder of Constans II in
bath in 668. Ottoman
repairs; one aqueduct is
still functioning today for |
<table>
<thead>
<tr>
<th>No.</th>
<th>City</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>Thessaloniki</td>
<td>Thessalonica (824)</td>
<td>Roman qanat / aqueduct with clear evidence for Transitional period and Middle Byzantine functionality; Ottoman repairs.</td>
</tr>
<tr>
<td>33</td>
<td>Trebizond</td>
<td>Trabzon</td>
<td>Chaldias (840) Roman / Byzantine aqueduct; little known apart from Justinianic inscription.</td>
</tr>
</tbody>
</table>

Twenty-three of thirty-three military capitals had older aqueducts, albeit mostly long-abandoned and dysfunctional by the time these cities were elevated in status. Certain exceptions – with still functioning aqueducts – included Thessaloniki and Cherson (by virtue of archaeological and/or textual evidence). Probable exceptions might have included Nicaea, Koloneia, Syracuse, or Amasya, on account of technological simplicity. Respectively these are a short aqueduct, two qanats and an open channel carried beside the river, all with some indications of post-Late Antique usage. Post-seventh century aqueducts might have continued to supply fortifications at Smyrna or Rhodes, though these systems are poorly documented or obscured by later Ottoman phases. Functioning or possibly functioning aqueducts in the military capitals are, with the exception of Amasya and Nicaea, united by their coastal locations, where external supplies of water that could be used to restock ships would have remained a strategic desideratum.

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For Syracuse see Crouch 1990, 271-278.
The remaining ten of these twenty-three military capitals with aqueducts had certainly lost the benefit of their older Roman aqueducts, by the time that these cities were elevated. Just two (Nicaea and Thebes) were the location of new aqueducts, in this case much later during the twelfth and thirteenth centuries, respectively. At least eight military capitals with Roman aqueducts were the sites of much later repairs, where at least portions of older aqueducts were returned to service after the Ottoman conquest.

The intentions of the Byzantine state by the seventh century are perhaps more visible in the ten of thirty-three military capitals that very likely never had an aqueduct to begin with – in these locations, rather, riperine and lacustrine sites (on rivers and lakes) predominated. Together with the evidence for unrepaired aqueducts in military capitals, I would argue that the hydraulic situation of the military capitals as a whole reflects the broader trajectory considered in this chapter, by which Byzantium progressively disinvested from aqueducts, as potential sources of strategic weakness instead of strength, and sought more secure alternative sources in ground-, surface-, and rain-water. Because the Byzantine state invested so heavily in labor and technology for the repair of the 500km long aqueduct in Constantinople, the failure to repair existing aqueducts in the military capitals should not be pinned on technical inability or lack of resources, but rather on a lack of administrative prerogative that extended these

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564 For the Thebes aqueduct, see Symeonoğlu 1985, 168.
potentialities into strategically important centers of the provinces after the
seventh century.

We will conclude this chapter by offering six models that can help explain the
variable afterlives of Roman aqueducts in cities of the eastern empire, between
c. 300 and 800 CE.

3.18 The afterlives of aqueducts, model 1: catastrophe and sudden abandonment

We noted in sec. 3.11 above that well-attested examples of aqueducts rendered
dysfunctional by earthquakes are, at this stage, comparatively rare given the
overall number of aqueducts in the eastern empire, and the seismic activity which
characterizes the eastern Mediterranean as a whole. It is important to stress,
however, that earthquakes which apparently brought down aqueduct systems in
these locations usually did not precede wider abandonment, if sometimes they
portended the beginnings of lower-intensity occupation with smaller populations
in greatly reduced settlements, organized around cisterns and wells (e.g.
Anemurion), or around smaller disaggregated spring sources (e.g. in seventh
century Hierapolis and Sagalassos, and see below, 3.20 for disaggregation).

Before the seventh century, damage to aqueducts from earthquakes seems

\[565\] Again see Appendix F, for examples of aqueduct systems with good evidence for
dysfunctionality caused by earthquake damage, for instance at Sagalassos, Phrygian
Hierapolis, Ephesus and Pergamon, Anemurion, Aspendos, Petra, perhaps Gadara and
Beth Shean.
normally to have been repaired (excepting e.g. Anemurion), if sometimes also complicated elements of water systems were eliminated and simplified (e.g. Pergamon or Petra). Or, damaged aqueducts were given up but without terrible effects for the city in question, because additional aqueducts were still functional and continued to supply the city (e.g. Ephesus, after the collapse of the Değirmendere aqueduct before the fourth century).

Catastrophic abandonment should be pinned instead on territorial insecurity, particularly the Avar-Slavic and Arabic invasions that resulted in the loss of Byzantine territories during the sixth and seventh centuries. Territorial insecurity that prevented the organized repair of aqueduct systems might also be considered, e.g. at Corinth. At Stobi in Macedonia, there is clear evidence that the aqueducts continued to function in the city until the time of its abandonment coincident with Slavic invasions in the later sixth century: this is indicated by the continuing functionality of the cathedral’s baptistery in the sixth century, supplied by a lead pipe, that was robbed out only well after a stratum of abandonment-refuse had settled on the baptistery’s floor in the later sixth century. Similarly, at Sirmium in Moesia, the city’s aqueduct continued to supply the area of the former imperial palace – covered since the fifth or sixth century with domestic

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567 Garbrecht 2003, 128 and Garbrecht 2004a, 193 for Pergamon’s replacement of a bridge system on the Madradağ line with pipes following topographic contours, instead.
568 Bellwald 2004, 81 for conversion of a pressurized system to an open-flow system, in pipes at Petra.
569 Wiplinger 2013, 108.
570 Wiseman 1978, here at 410-411 and Wiseman 1984, 309 with fig. 15.
installations and workshops – before a near total disruption and dispersal of the settlement in the seventh century.\footnote{571}

While cities captured by the Umayyads in Palestine and Syria almost universally retained functioning aqueducts (see below sec. 3.22 for continuities), locations just inside the new Byzantine-Arab borders seem to have widely suffered the loss of aqueduct systems: though detailed information pertaining to the abandonment of water systems in Cappadocia and Cilicia is largely lacking, it should not be surprising if many such urban water systems were in fact maintained until the cities were no longer inhabitable by Byzantine forces, for reasons of insecurity rather than water shortage. For instance, cities in Cilicia evidence fairly widespread sixth century restorations or improvements to urban water systems, before settlement abandonment or disaggregation began in the seventh or eighth century. At Anazarbos, a new aqueduct was built around 516 or 517 CE, not long before the apparent dislocation of the settlement in the seventh century,\footnote{572} while at Side, the aqueduct was still functional when the supply line was incorporated into a distribution complex and reservoirs set into the city's later seventh/eighth century city walls.\footnote{573}

### 3.19 The afterlives of aqueducts, model 2: gradual abandonment

\footnote{571} Ochsenschlager and Popovic 1973, here at 87.  
\footnote{572} TIB Neue Forschungen 129 and IK 56.1.#22-24.  
\footnote{573} On a later seventh or eighth century date for the walls, see Foss 1977c and see Gliwitsky 2005, here at 376 says that the later date is "seit Foss alle Bearbeiter annehmen." For the reservoirs H1 and H2 see Mansel 1963, 171.
Even in cities that fell into the danger zone, along border areas where Avaro-Slavic or Persian-Arab incursions were not uncommon after the fifth century, east Roman cities demonstrate a marked tendency towards the gradual rather than sudden abandonment of their aqueducts, due to a lack of repair and maintenance of the lines. Archaeologically, this is attested by the gradual deposition of sediments and ceramics in the channels of aqueducts which indicate their neglect, corresponding to a diminution of service as the flow-through of the aqueducts decreased with sedimentation or infilling. Gradual abandonment of aqueducts usually coincided with the expansion or development of alternative water sources around the same time.

For instance at Caesarea Maritima, the city’s Channel C aqueduct was slowly filled during Late Antiquity by a sinter build-up (25cm thick) that reduced its flow-through by 75%.

Notably, new Late Antique wells and cisterns were introduced into Caesarea Maritima after the fourth century, when problems with its other aqueducts (Channels A and B) are indicated by inscriptions commemorating repairs of these lines. At Beth Shean, where aqueducts had been repaired as late as the early sixth century if not later, gravelly washes speak to the gradual abandonment of drainage systems after the later sixth or early seventh

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574 Everman 1997, 161.
575 See the stratigraphic tables in Lenzen 1983, 22-30 and Everman 170 with references for new late antique cisterns and wells, with continued use into the Abbasid period. Holum 2004, 193-5 for new cisterns at the church on the Temple platform. See CII 1259 and Hamburger 1959, infra Appendix E #79 for the later fourth century repair, attested by inscription, for the aqueducts identified as channels A and B by Everman, 170.
576 For sixth century repair of one of the Beth Shean aqueduct, attested by inscription, see infra Appendix E #99.
century.\textsuperscript{577} As at Caesarea Maritima, there was a surprisingly lively investment in wells at Late Antique Beth Shean.\textsuperscript{578} At nearby Banias in Palestine, home to a once-flourishing cult of Pan, the city’s aqueduct gradually filled with shards of locally produced ceramic datable to the early or middle fifth century CE, when several villas just outside the city proper were also abandoned.\textsuperscript{579}

Such examples of gradual aqueduct abandonment are not limited to Palestine, but also extend into Anatolia. At Ephesus, unusually hard water and sinter formations from the Throessitica aqueduct probably encouraged abandonment of the source for consumption, though the aqueduct itself was maintained and its water employed for industrial purposes, at a mill installed in the converted nymphaeum of the Upper Agora (arguably in the fifth century).\textsuperscript{580} The other aqueducts at the service of Ephesus continued to function – excepting the Değirmendere aqueduct, collapsed before the fourth century\textsuperscript{581} – even as wells and cisterns were re-introduced across the city around the same time. At Troy in Asia, Aylward pointed to a 1.3m thick layer of sediments that built up in the aqueduct’s channel, which he related to a gradual demise of the city’s water

\textsuperscript{577} Gradual abandonment of drainage systems is also noted at Arabian Pella, where the forum area was entirely silted up by the early seventh century, see Smith 1973, 8 and 57-8. For Beth Shean see Hadashot 120 (2008), at http://www.hadashot-esi.org.il/report_detail_eng.aspx?id=757&mag_id=114..
\textsuperscript{578} Khamis 2001, 159–76 and Gil 1992, 101 for wells at Beth Shean with “water from Paradise” known from the Hadith; LeStrange 1890, 81 for a well mentioned by Muqadassi; and SEG 8.7 and 8.8 for inscriptions recording the construction of a well by one bishop Ioannes, perhaps of the mid-sixth century.
\textsuperscript{579} Berlin 1999, 42-3.
\textsuperscript{580} See Pickett, forthcoming for comments on the supply of the mill in the Upper Agora fountain at Ephesus, and above sec. 3.11.
\textsuperscript{581} Wiplinger 2013, 108.
system during Late Antiquity. 582 Perge appears to have been particularly aggrieved with problems related to water sinter, distinctly visible in a 3m wide and high sinter deposit covering a mass of vertical supply pipes in the city center (from above, see Fig. 3.11). Supplied by a Severan nymphaeum at the top of the cardo, the euripus or open channel that ran down the middle of the city’s main street was a highly visible manifestation of this system, whose Late Antique repair is indicated by spoliated inscriptions (including an honorific for Gordian III, r. 238-44 CE) reused as closure panels for the water channel, and in the repair of the fountain itself. 583 However, a small chapel implanted directly into the euripus on the south side of the cardo’s crossing with the decumanus indicates the continued occupation of the city even after the euripus (and perhaps with it, the aqueduct) was abandoned; the re-introduction of wells was a feature of life in Perge around roughly the same time. 584

3.20 The afterlives of aqueducts, model 3: settlement disaggregation

Well before the collapse or abandonment of many aqueduct systems in cities of the eastern Roman empire, Gregory of Nyssa asked in a letter sent to Nicomedia, from the later fourth century:

582 Aylward 2006, 113 for sediment deposits in the Troy aqueduct.
583 AE 2004.1474 and IK 61.2 #282 for the Gordian inscription, and #294 for another third century inscription honoring an official (named lamprotatos and synagogeos), reused in repair of the nymphaeum.
584 The chapel is not well published, though its remains survive to several meters in height, and are clearly visible for visitors to the ancient city. Wells were observed by the author in the agora area around the macellum (itself converted during late antiquity into a fish farm, with reused terracotta pipes lining the interior walls of the round building at its center), and in the late antique houses or shops on the east side of the cardo, south of the crossing with the decumanus.
“Of what benefit to the thirsty is a magnificent aqueduct if there is no water in it? However symmetrical the placement of columns, with all their variegated form bearing the pediment aloft, which would the thirsty prefer to supply his need: to see bare stones beautifully laid out, or to find a spring, even if it flowed from a wooden pipe, provided only that the stream it pours forth is clear and drinkable?”

That is, aqueducts were only useful insofar as they provided drinking water, a need which could be met with considerably less ostentation by simple springs, or by the wells and cisterns so insulted by Roman authors, whose Late Antique aggrandizement we examined in our discussion of Procopius, above in sec. 2.9.

Disaggregation to smaller springs, or the denucleation of settlements once centralized by external supplies of drinking water in preference for more widely-spread alternative sources in the hinterland, was another option for settlement resilience in Late Antiquity. We can examine several examples that are paradigmatic of this option for settlement resilience, after the abandonment or collapse of aqueducts.

Hierapolis for example, in western Anatolia, was characterized by the disaggregation or break-up of its settlement after the collapse of the city’s aqueducts, around smaller spring-sources in its hinterland that had previously fed into the supply of the system, after a devastating and well-recorded earthquake in the later seventh century. Three groups of pressurized ceramic-pipes had supplied the Roman city, which was dominated by mineral hot springs that

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586 Scardozzi 2012a, 116-7 on the earthquake and the end of functionality for the aqueduct at Hierapolis.
contemporaries called undrinkable, so fresh water was presumably at a premium in Hierapolis.\textsuperscript{587} After a reorganization of these supplies for the benefit of the church during the fifth century, a devastating earthquake in the mid-seventh century caused the city’s complex pipeline aqueducts to fail, and the old city core became a sediment trap, dominated thereafter by small-scale agricultural occupation.\textsuperscript{588} Hierapolis’s former inhabitants probably didn’t need to go far for water, though – four villages within 15 kilometers have names that include \textit{pinar}, or spring, while three more without –\textit{pinar} are similarly equipped.\textsuperscript{589} We do not have to rely here on Turkish Republican toponymy alone, because several such sites were originally sources for the aqueduct lines themselves – point being, they all had springs. With traces of lower-intensity Middle Byzantine occupation for agriculture spread throughout the old city and its hinterland, Hierapolis demonstrates how towns that had historically been overly-reliant on imported water could break up to resettle at extra muros water sources in a city’s hinterland.

Cypriot \textbf{Kourion}, a coastal city without springs or a river that wholly depended on its aqueduct, was also abandoned for more reliable extra muros supplies of water, after an earthquake devastated the city c. 680, and rendered its aqueduct disfunctional. Citizens abandoned the old Roman city core and their shattered

\textsuperscript{587} Strabo 13.4.14.  
\textsuperscript{588} D’Andria, Scardozzi, and Spanò 2008, 44-7 as well as Arthur 2006 and 2012 for Middle Byzantine Hierapolis.  
\textsuperscript{589} Scardozzi 2012b, 151 for regional toponymy and preliminary results from regional surv ey based on satellite imagery.
homes, and camped near the former site of Bronze Age Kourion, an area that had abundant wells tapping a high water table, as well as easy access to water for irrigation from the river Korusi. There, at the village called Episkopi, was a late medieval manor belonging to the Cornaro family of Venice, which contained a chapel that upon excavation, was revealed to have been constructed with material salvaged from the episcopal basilica at Kourion, such as opus sectile plaques and champlévé panels, an indication of the continuity between these settlements, despite the dislocation of the 680s.590

Settlement disaggregation could also be an intra-muros phenomenon, akin to the model of *citte ad isole*, city-islands or small nuclei of reduced-intensity occupation that developed within the circuits of older Roman cities, in this scenario towards smaller spring or well and cistern sources. Such a model applies to Corinth after the sixth century: Lolos noted a variety of repairs to the city’s Hadrianic aqueduct – primarily buttressed piers in opus incertum – that he associates, for lack of firm dating evidence, with repairs made before or after the fifth century, perhaps in association with earthquakes of CE 365 and 375.591 Lolos assumes that the aqueduct “fell into ruin during the course of the fifth century,” though more recent work has pointed to the continuity of baths in the city into the seventh century, which might also indicate some functionality for the aqueduct at this time.592 In any case, at least twenty-four springs are known within the classical walls of the

590 Megaw 2007, 560-1
592 Lolos 1997, 298.
city, with countless more in the hinterland, where recent surveys have identified more transitional period activity than was previously thought. Two springs inside the city, Lerna and Peirene, remained centers of activity during the Middle Byzantine period. Lerna’s spring house was adjacent to the Asklepeion, which was damaged and abandoned in the course of the fifth century, around the same time that the Lerna court below became a center for burial and night-time cult activity, attested by the deposit of more than 4,000 fifth-sixth century lamps at the so-called Fountain of the Lamps, immediately west of Lerna. The cemetery surrounding these springs included the Late Antique Kodratos basilica, which was maintained well into the Middle Byzantine period. Similarly, the area around the Peirene spring continued to be inhabited into the Middle Byzantine: besides functioning as a space for burial, water from the spring continued to be led off to destinations unknown, with a one-aisled chapel built into the court’s north narthex in the later tenth century. The city’s refugium, on the Acrocorinth, was also blessed with two springs – one just inside the west gate, another in the enclosure’s south (the so-called Upper Peirene spring) – within the circuit of its Late Antique fortifications.

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593 Landon 2003, 47 see the map Fig. 3.1.
594 Pettegrew 2008, 259 considers how, in the Roman and Late Roman periods, “ex-urban settlement [in the Eastern Corinthia] is both more continuous and complex than previously estimated. … some 9 of the 24 sites yielded late forms of narrow combed ware dated between the later 6th and 8th century.”
595 See principally Corinth XIV and Brown 2009, 237.
596 See K. S. Garnett 1975 for analysis of the lamps.
597 See Caraher 2003, 461 for description and references: “probably in use until the twelfth century.”
598 Robinson 2011, 293-301.
599 See Corinth III.1, 31-60 for Stillwell’s discussion of the Hellenistic spring house and its successor structures at Upper Peirene on Acrocorinth.
At Patara in Lycia, such intra-muros disaggregation focused early medieval activity onto perennial water sources associated with churches. Patara’s aqueduct dependent on a supremely sophisticated and fragile inverted siphon was probably no longer functional by the fourth or fifth century. Yet activity in and around Patara continued after disaggregation of its settlement to more proximal water supplies. The source of Patara’s aqueduct, at the abundant springs of Islamlar, was maintained as a focus for continued settlement, as indicated by the remains of rock-cut houses and a chapel with traces of fresco there that were identified as Middle Byzantine by the editors of the *TIB*. Inside the old Roman city, Patara was amply supplied by groundwater resources, including at least 16 wells, and an intra-muros sulphurous spring that supplied the Hafenthermen, which became a center for Late Antique industrial activity. Two churches in Patara are prominently located atop groundwater resources. The fifth-century Quellenkirche north of town – probably built on the remains of older Roman water channels and a temple, speculatively identified as Apollo’s – is surrounded by both an older Roman cemetery and two distinct areas with Late Antique kilns and industry. The so-called Strassenkirche near town center south of the Harbor Baths is a sixth-century church, which was never integrated into the city’s aqueduct system, but was instead supplied by a humble curbed well in a southern room off the narthex; while immediately south of the nave a c. 2x2m

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600 See *TIB*, 8.2.573 s.v. “Islamlar.”
601 See Baykan 2014 and forthcoming for wells.
602 Işik 2011, 74-5.
basin with marble surrounds was surrounded by a peristyle and filled by groundwater infiltration. Like the kilns around the Quellenkirche, millstones were found in both these rooms at the Strassenkirche, suggestive of continuing industrial activity that profited from the proximity of perennial water resources in these spaces, during a time when the low-lying Roman agora and colonnaded street by the theater had been abandoned due to drainage problems that continue to flood the former core of the old Roman town.

A comparable disaggregation towards smaller perennial water sources might be observed at Troy on the Dardanelles. After the eventual collapse of Troy’s aqueduct (fifth century?), there is evidence that the remaining inhabitants of the city disaggregated from the old city core, and shifted towards a smaller perennial water source at the Spring Cave near the old West Sanctuary, on the western side of the Roman residential district. Houses in this area were occupied until the fifth century; thereafter, there is no evidence for occupation until the thirteenth century when a graveyard covered the area. However, the excavators speculated that there may have been earlier Transitional Period or Middle Byzantine activity in this location, which is for whatever reason invisible.

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605 See also Rose 1999, 57 and 60 for the use of the area as a cemetery. The Spring Caves had earlier been used as fish pools in the Flavian period, set in an area used for quarrying.
606 Rose 1994, 274 compares activity at the Spring Cave in Troy with evidence of regional activity, namely inscriptions for Michael III’s construction of fortifications at Nicaea, Smyrna, and Ankara.
3.21 The afterlives of aqueducts, model 4: outright continuities

In the formerly Byzantine cities of the Umayyad caliphate, nearly all of the cities with Roman aqueducts retained their service (e.g. at Jerusalem, Caesarea Maritima, Tiberias, Palmyra, Damascus, and Antioch, with new aqueducts constructed for Umayyad Ramla and Hebron).\(^{607}\)

In the Byzantine territories, continuity of external water supply systems was considerably more uneven. In the longue durée, aqueducts most commonly survived in discontinuous sections as property boundaries,\(^{608}\) mill-races or components of irrigation systems,\(^{609}\) but in the short and moyen-durée past the seventh-century horizon, Byzantine aqueducts remained functional for cities only where large population densities were required for places of extraordinary state-level military/bureaucratic or supra-regional religious importance. These consistently included technically simple supply systems without sophisticated components like inverted siphons.

Cities meeting these conditions, with clear archaeological and/or literary evidence for the continuity of their aqueducts after the early seventh century,

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\(^{607}\) See Appendix F for detailed histories of these cities with reference to the Umayyad phases of their water systems; and see Gorzalczany and Amit 2014 for the new aqueducts at Hebron and Ramla, built on Roman principles with open channels and terracotta pipelines.

\(^{608}\) TIB 5.1.176-7 and RRH I.229 #859 for the Amuda aqueduct in Cilicia, which survived as a property boundary in the thirteenth century.

\(^{609}\) TIB 4.123 and TIB 5.1.296 for mills of unknown date at Kayaci, the source of the Elaiussa Sebaste and Korykos aqueducts. Water mills have also been discovered along the course of the Myra aqueduct, pers. communication with Fatih Önur in Antalya, July 2013. The Myra aqueduct was probably repaired in the Middle Byzantine period, see Morganstern et alii 1993, 90. For mills along the Thessaloniki aqueducts, see Siaxambani 1997, 338-341. See Blanc and Genequand 2007, 295-306 for mills set onto the Bosra aqueduct in the Byzantine and Umayyad period.
apart from Constantinople, include Thessaloniki, Cherson, Samos, Ephesus, Myra, Side, Salamis, and Gortyn; perhaps also Smyrna, Nicaea, Amaseia, and Rhodes.

Myra is an excellent example insofar as it demonstrates how these systems tended to be very simple, short-distance, open-channel and often pre-Roman gravity systems, rather than systems relying on the most sophisticated elements of Roman engineering prowess, such as inverted siphons. With evidence of Middle Byzantine building-techniques employed for repairs to Myra’s originally Lycian (fourth century BCE) and Neronian aqueduct line after the ninth-century CE, Myra was a provincial capital and supra-regional pilgrimage center for St Nicholas, as well as an international military pressure point that was repeatedly besieged by the Abbasids, around which time it became a port of departure for the Byzantine naval fleet. Besides Myra, cities where aqueducts probably retained their functionality after antiquity were predominantly ports in which resupply of water to outgoing ships continued to be a strategic priority included Thessaloniki, Samos, Constantinople, and perhaps Rhodes.

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610 Morganstern et alii 1993, 90.
611 TIB 8.1.346-7 for evidence of continuing state and military activities at Myra between the seventh and ninth centuries.
3.22 The afterlives of aqueducts, model 5: settlement nucleation

The nucleation or convergence of settlements around locations with maintained aqueducts, or around plentiful natural sources from springs and lakes or rivers, constitutes another model for settlement resilience after antiquity.

In the territories of the Umayyad Caliphate, settlement nucleation towards perennial water sources and maintained aqueducts is perhaps best exemplified by Tiberias, the famous bath town on the Sea of Galilee, and the capital of Jund al-Urdunn after the Islamic conquests of the 630s. The second century and Byzantine aqueduct here carried hot spring water to baths that had no need of fuel, and functioned well into the tenth century at least,\(^{612}\) while the Mishnah and later Arabic sources report that inhabitants obtained most of their drinking water from the lake, anyways.\(^{613}\) The Umayyad conquest in 636 had little effect on the town’s infrastructure, and after a devastating earthquake in 749, whose traces are seen all over the arid Northern Jordan valley, Tiberias retained its status as an Umayyad provincial capital. Walmsley has suggested that the populations of smaller ruined or demoted towns like Beth Shean, Jarash, and Gadara relocated to Tiberias, which experienced tremendous growth at this time.\(^{614}\) Tiberias thus grew leaps and bounds by settlement nucleation, not least because it was one of the very few nearby localities with basically unlimited amounts of easily

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\(^{612}\) See Stacey 2004, here at 3 for Islamic sources on the hot springs of Tiberias. The sources themselves may be found in translation in LeStrange 1890, 334-5.

\(^{613}\) On water resources at Tiberias, including Byzantine, Umayyad and Abbasid repairs to the reservoir and aqueduct, and the installation of penstock mills along the lines, see Winogradov 2002; for discussion of sources regarding consumption of lake water, see Hirschfeld 1991b, 34-5.

\(^{614}\) Walmsley 2007, 74-9
accessible fresh water – from the lake and a still functioning aqueduct – in addition to the attraction of hot springs for bathing.

Within the borders of Byzantium, the evidence for settlement nucleation during the transitional period is more circumstantial. With well defined evidence for the continuity of its aqueducts and baths into the seventh and eighth century, it might be argued that Thessaloniki’s population grew precisely when so many other towns and cities affected by the Avaro-Slavic invasions were being abandoned. Otherwise, the evidence for settlement nucleation in Byzantium was perhaps less conditioned by the maintenance of surviving aqueducts, than by the circumstances of cities that both retained administrative status, and were blessed by perennial water from rivers and lakes, such as Nicaea, Ancyra, and Dorylaion. Dorylaion, especially, is a prime example because – like Tiberias – the city was endowed with both a perennial water source (from the Tembros/Porsuk river) and important hot springs, that made it a natural choice for both state-directed military activity, and revolts.\footnote{For the emboldened cities, refer to their detailed entries in Appendix F; for transitional period activity at Dorylaion, see e.g. \textit{TIB} 7.238-242 and the detailed discussion below in sec. 4.9 concerning towns with hot-springs.} In this sense, then, we might argue that while the Roman state was “artificially-centered,” onto cities developed in places of religious or strategic importance that potentially lacked natural defenses or guaranteed access to perennial water, the Byzantine state gradually re-centered itself onto places that were more forgiving, with easily defensible locations situated near perennial surface or ground-water resources, earlier eschewed or
overlooked by imperial Roman city planners in preference for locations at lower elevations on the plains with spring water imported via aqueducts.

3.23 The afterlives of aqueducts, model 6: outright rejection

Where spring water had long reigned at the top of hierarchies for potable water during the imperial Roman period, the diversification and pursuit of alternative water sources during Late Antiquity is nowhere more visible than in those cities which retained administrative status and continued to function as poleis, without aqueducts at all.

The Roman city of Nicopolis ad Istrum had been sacked and mostly destroyed in the 450s, though it was reoccupied with the status of metropolis in province Epirus Vetus after the sixth century. The city performed its functions as an ecclesiastical and military center at this later time without the benefit of municipal buildings, or the restored functionality of any of the four aqueducts that had supplied Nicopolis in previous centuries.\(^{616}\) Nicopolis was not unique among Late Antique metropolitan cities for its lack of an aqueduct. Larisa, metropolitan of well-watered Thessaly, also seems to have lacked an aqueduct or a functioning drainage system by the sixth century: salvage excavations near the episcopal cathedral uncovered a sizeable cistern, and a bath that drained not into a sewer, but into a soakaway pit that had filled with ceramics, bones, iron slag, and

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\(^{616}\) Poulter 1995, 6 and 45-6.
At Mokissos, metropolitan capital of Cappadocia Secunda after its elevation by Justinian, there were no active springs, and no indications that the city was ever supplied by an aqueduct. Cisterns (and probably also wells) were the primary supplies for the city’s water, with several set in proximity to churches. At Church 2, a masonry built cistern (=90m³) is set back from the church by several meters, it was presumably filled from rainwater carried over the sloping ground or from channels set into the walls of the church’s auxiliary buildings. Berger reports two other cisterns with similar construction in Mokissos, one in association with Church 1, and another on the northeast hill top that could be associated with Church 4. Amorium also seems to have lacked an aqueduct, though it maintained a bath into the later seventh or eighth century from a well-supply.

In section 2.9 above, we discussed the role of aqueducts and springs alongside the aggrandizement of cisterns in Late Antique literature, through the lens of Procopius. The literary elevation of cisterns in Late Antiquity finds wide parallels in the archaeological and epigraphic evidence. The town of Madaba, for instance, in southern province Arabia, had no aqueduct system. Nevertheless, the area around today’s Madaba Archaeological Park encompasses churches

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619 An aqueduct was reported by Karatza 1985, 66 though Berger 1998, 366 after a thorough survey disagreed.
620 Author, pers. observation 2013
622 Lightfoot and Ivison 2012, 23 for the bath, and on Amorium’s water see also Lightfoot 2007; and Katsari et alii 2012, 52.
and streets with a centralized sewer system, as well as numerous cisterns and reservoirs, some with inscriptions.\textsuperscript{623} An inscription in an arched and vaulted cistern was noted by scholars in the 19\textsuperscript{th} century, and published by Piccirillo, indicating that the cistern was renovated by Justinian for the people of Madaba.\textsuperscript{624} Another inscription, found in a cistern in the mosaic courtyard of the church of St Theodore, is dated to 575-76 CE, set in a large mosaic cartouche. Some of its lines are poorly preserved, due to later work on the mosaics, but it may be restored as follows: “All, in glorifying, say ‘cistern in cistern, o the marvel [θαύμα]. Lord, remember your servant the bishop Sergios, under whom was made this beautiful work with the pure fountain…”\textsuperscript{625} The cistern here is glorified as a \textit{thauma}, a miracle or marvel: this term was normally reserved for monumental imperial constructions, not cisterns, though as here it became applied to smaller scale hydraulic constructions in Late Antiquity, noted otherwise by Robert\textsuperscript{626} and Piccirillo.\textsuperscript{627} Harrison’s survey recorded more than 100 cisterns in the modern city of Madaba. Bikai speculates that Madaba actually had 500 or so cisterns in total, which included not only small residential cisterns on the Roman model, but also larger, publicly accessible cisterns in church atria, as became so typical in Late Antiquity.\textsuperscript{628}

\begin{footnotes}
\item[623] Piccirillo 1981.
\item[624] Bikai 2004, 232 and Piccirillo and Denton 1996, 43.
\item[625] Piccirillo 1981, 310-1.
\item[626] Robert 1948, 64-6.
\item[627] Piccirillo 1981, 310-1.
\item[628] Harrison 1997.
\end{footnotes}
An improvement in attitudes towards water drawn from cisterns may be responsible for expansions of settlement during Late Antiquity, into areas previously deemed uninhabitable, both as refugia or centers of refuge, and as stopovers for trade or centers of pilgrimage at strategic locations that simply lacked good alternatives for water supply. According to Procopius, rainwater collection systems that attracted Justinian’s oversight or patronage were predominantly constructed at fortified refugia (e.g. Rhabdios or Hemerium, see above sec. 2.9). This particular class of settlement grew by necessity during the insecurity of the fifth to seventh centuries. Such refugia relied on both domestic-scale cistern installations where there were permanent populations, but also on large-scale rainwater collection schemes that were associated with churches in locations that lacked other indications of residual occupation, as at Tigani in the Maniote Peloponnese, or at Phrygian Kırk İn / Kırkinler.

Exemplary of the class of refugia towns generally, Monemvasia for instance, is totally dependent on rainwater collection, dotted by cisterns at all scales.\textsuperscript{629} Monemvasia was semi-legendarily built as a refuge in response to the Slavic incursions into the Peloponnese during the 580s: the archaeological evidence such as it is seems to confirm that occupation began here in the later sixth or

\textsuperscript{629} The larger cisterns, in the upper part of Monemvasia, were inaccessible to me when I visited in June 2014. They are difficult to contextualize (presumably with either large houses or with churches) owing to the Ottoman clearance of this area. For these installations see e.g. Kalligas 2010, 125; for the double-barrel vaulted cistern at the Hodigitria church of the twelfth century (220m$^3$) ibid., 118; for the two-aisled Palazzo cistern (680m$^3$) ibid., 116; and for the Middle Byzantine cistern at the Katechoumena church, see ibid., 144.
seventh century, though the elaborate rainwater collection schemes, cisterns, and fortifications would suggest more careful and long-term planning for occupation of the site, which remained as a resilient bastion of Byzantine trade and influence until 1460. Comparable to Monemvasia in date, location, and total dependence on rainwater is the peninsular refugium at Tigani, off the western coast of Mani in the Peloponnese, whose focus is a Late Antique – early medieval basilica with ~100m³ capacity cisterns.

Motivations for rainwater dependence were not always defensive, however: they may have been inspired simply by the desire to expand city-like settlements into areas previously considered uninhabitable by anything other than small farms or military outposts, for want of the springs that made proper Roman urban settlements possible. The former temple-estate of Lyrboton Kome near Antalya, for instance, had in Roman times been a small farming village that grew during Late Antiquity into a sizeable town, organized around large-scale and publicly sited cisterns for rainwater collection, many of which were adjacent to new church basilicas. Similarly, the island of St Nicholas / Gemiler Adası near Ölüdeniz in Lycia, was a thriving Late Antique trading settlement, and probably

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630 Kalligas 2010, 204 for settlement of the site, and the earliest evidence for its occupation from the sixth or seventh century; note the agreement on this point by Dunn 2011.
631 Caraher 2003, 484 for references to Tigani, excavated by Pelekanidis and dated to the 6th century and/or Transitional Period.
632 The classic late antique precedent for settlement expansion dependent on rainwater, as noted in the first chapter, are the sophisticated runoff collections systems found in monastic contexts in the Judean desert, which begin to be built in the later fourth century; see Hirschfeld 1992. These arguably have Nabatean and Judaic precedents, as at Humeima or Qumran, for which see respectively Oleson 2010 and Hirschfeld 2002.
633 For Lyrboton Kome, see its description in Appendix F, with primary reports in Keil 1926b, Broughton 1934, 226; Çevik 1997; Güçlü 1998, and Çevik, unpublished.
the center of a cult for St Nicholas. At the highest point of the island (50m ASL) stands a 30m long three aisled basilica (Church 3) with probably later fifth century mosaics. At the church’s north is a long east-west wall, more than 250m long and >1m thick. On the long wall’s north side is a massive cistern (~1200m$^3$), with multiple phases of repair, that was originally covered by barrel vaults supported on buttresses set into the north and south walls, about 5m apart. The cistern was probably filled by rain water channeled along the long wall, which in this scenario was built for water retention rather than any defensive purpose (a suggestion reinforced by the lack of a wall on the opposite south side, or east and west for that matter), and facilitated by the construction of the church on the summit. Church 4, connected to Church 3 by a long vaulted passageway, also had a sizeable if smaller masonry-built cistern to its northeast (~50m$^3$). While the excavators concluded that it “may have been used to distribute holy water to the faithful,” we should not overlook the potential of both these church-related cisterns at Churches 3 and 4 on Gemiler Adası, to contribute to a wider decentralized supply of rainwater to inhabitants and sea-faring visitors on the island.

3.24 Conclusions

This chapter has adopted aqueducts as a vista or platform from which to observe larger changes and shifts in the culture and society of the Late Antique eastern

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634 36°33'12.74"N  29° 4'8.28"E.
635 See Asano 2010, 131-3 for the long wall and large cistern at Gemiler Adası.
636 Quote from Tsuji 1995, see 79-84 for Church 4.
Mediterranean. We began this chapter by considering the unique relationship between imperium and the artificial supply of spring water to cities, a quintessentially Hellenistic and Roman phenomenon that continues to characterize life in modern cities. For Gibbon’s Rome and the American ideal alike, the state-directed supply of water to cities has been perceived as a desideratum for the survival of urban culture. It was argued that originally, the θαῦμα or wonder of producing water in great quantities where it did not naturally belong was deeply linked to kingship and the divine across the ancient Mediterranean. Aqueducts developed first for elevated temple-sanctuaries and palatial / elite residences, and only much later for broader distribution in non-elite communities, beginning in the Hellenistic period in the city states of western Anatolia like Priene, before they proliferated across the Roman world. It was argued that the most technologically sophisticated Roman systems for urban water supply – inverted siphons – were especially fragile and sensitive to disaster, and that such systems were widely abandoned by the fourth century CE, though they persisted in use for second and third degree distribution systems during Late Antiquity in cities like Ephesus and Hierapolis.

Late Antique awareness of the fragility of aqueduct systems was highlighted in an examination of primary sources – like Theophanes, Procopius, and Choricius of Gaza – as a corollary to the wider awareness of meteorological phenomena like droughts and floods, as well as the intentional creation of drought as a strategy in war or politics. Despite these well-attested markers of the insecurity of
artificial water supply systems in Late Antiquity, in addition to evidence for the
tremendous cost of aqueduct construction (perhaps 50 times the cost of a
contemporary church), the continuing ideological value of a link between
imperium, emperors, civilization and spring water was maintained, as
demonstrated by Roman and Late Antique panegyrics, as well as inscriptions
that recorded the construction of aqueducts, motivated by a lack of spring water
for urban consumption.

An examination of the epigraphic evidence for aqueduct construction and
maintenance in Late Antiquity revealed a diversification, heretofore unnoted, of
local interest in water-system patronage from all ranks from the later fourth to
early sixth centuries, before a sharp sixth-century increase in the number of
bishops investing or intervening with imperial authorities on behalf of aqueduct
construction and maintenance in their communities. Churchmen appeared as
patrons of urban water systems conspicuously early, well before the Justinianic
formalization of episcopal management of urban water systems in 530 CE.

Conflicts and disputes pertaining to the spring sources of aqueducts were also
considered, with a detailed examination of the legends surrounding the
development of the Archangel Michael's cult at Chonai. There, the crux of the
story centered on 5,000 men from neighboring Laodikeia coming into the territory
of another city to build a dam that would have flooded the archangel's sanctuary
– miraculously prevented by the archangel himself – in an allegory for the
defense of locally controlled resources and water management that would resonate throughout the Mediterranean for centuries to come.

Despite the concern of the state for the preservation of aqueducts, and their safe-keeping from illicit diversions as evidenced by the legal literature – visible archaeologically as the tendency to confine water distribution apparatuses for cities within the lines of fortifications, even into the seventh or eighth century as at Side – a range of scenarios for aqueduct repair and diversion were considered. Diversions were typical of aqueduct systems, both inside and outside cities – extra or intra muros – for purposes of irrigation and industry, with water diverted not only from the lines themselves (contrary to the dictates of Roman law), but also from water supplies formerly controlled by temples. It was argued that such diversions, especially for industry, should not be considered as symptoms of decline or ‘squatter occupation,’ but that careful consideration of the relationships between such industrial installations and ecclesial or secular administrative centers through their water supplies would indicate that these were instead organized or directed with the express approval of local authorities. Many such diversions were made for the benefit of the episcopal complexes which sprang up in cities across the Mediterranean after the later fourth and fifth centuries, well before the Justinianic formalization of their responsibility for water infrastructure in an edict of 530 CE.
Episcopal complexes were revealed to be particularly interesting, and diverse, with regard to the manners in which they inserted themselves into local water supply networks, most commonly as consumers, but also occasionally – and thereby setting important precedents for later developments in the sixth century – as managers of local water networks. This was most commonly achieved by carefully inserting church complexes into critical points in water networks, such as points along the walls where aqueducts entered into cities, or in baths converted for church use, or near new and large-scale water storage complexes. While baptisteries ostensibly required supply from ‘living waters,’ and hagiasmata or holy springs should have been naturally-fed, we saw that the inverse was actually true, and that baptisteries were in fact most commonly supplied by bucket from a cistern or phiale, and that hagiasmata could in fact be part of larger, artificial urban water networks.

It was argued, through an examination of the military capitals that emerged during and after the seventh century, that by this point in time the Roman state had largely disinvested from aqueducts as a mode of urban supply, in favor of proximal lake and river sources; twenty-three of thirty-three military capitals had formerly been supplied by aqueducts, but perhaps only five or six of these remained in use, though a considerable number were later repaired during the period of Ottoman hegemony (e.g. at least eight of twenty-three military capitals with Roman aqueducts). Rather than any sudden catastrophe in the seventh century that destroyed aqueducts or rendered them disfunctional, the gradualist
and progressive nature of the replacement of aqueducts with ground-, surface- and rain-water sources was stressed. Crucially, the continued investment of the Byzantine state in aqueducts at other locations (like Constantinople, Antioch, and Thessaloniki) demonstrates that the repair of these systems was not beyond the technical reach of Byzantine engineers, but was instead the consequence of an administration that was incapable or chose not to extend the potentiality of repair into the provinces from the capital, where Constantine V hoarded both technical prowess and capital resources following the restoration of Constantinople’s aqueduct in 765. This moment in the later eighth century, quite interestingly, also marks the point when aqueducts emerge as ideologically and pragmatically valued components of court-life in neighboring polities, like early medieval Italy, Carolingian Francia, Abbasid Iraq at Samarra, and the nascent Bulgarian state at Pliska and Preslav. As a conclusion, and as a replacement for heretofore current and simplistic notions of the ‘continuity or collapse’ of Roman aqueducts after antiquity, six models were offered for the afterlives of aqueducts: (1) catastrophe and sudden abandonment, (2) neglect and gradual abandonment, (3) disaggregation of cities to proximal water resources, (4) nucleation of cities towards locations naturally blessed with abundant water resources, (5) outright continuity of aqueducts in select locations of especial value, and (6) an outright rejection of aqueducts as supplies for cities of status as metropolitan or military capitals.
4.1 Introduction: Penn Station and baths after antiquity

We might begin the story of how baths and bathing changed in Late Antiquity with a look at the most storied bath building in the world: the old Pennsylvania Station in New York City (1910-1963), designed by Charles Follen McKim, of the architectural firm McKim, Mead, and White.

The façade of Penn Station took a temple’s muscular Doric order, and the concourse for boarding trains was an expanse of modern steel-and-glass vaults above the tracks that would not have looked out of place in Haussmann’s Paris. For the spacious waiting room, McKim looked to the tradition of imperial Roman baths, fixing the coffered cross-vaults of the Basilica of Maxentius into the scale and plan of the tepidarium from the Baths of Caracalla (compare figs. 4.1 and 4.2). One critic in 1962 questioned “whether the Baths of Caracalla have ever been appropriate as a railroad ticketing center,” but the building was widely hailed throughout its brief life as a “magnificent adaptation” of “royal Roman baths, with rich detail in solid stone, [and] architectural quality in precious materials that set the stamp of excellence on a city.” Charles Moore was with McKim when he visited Rome in the summer of 1901, long before the Penn Station project, and he describes how they all sat there together, “in the shadow

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637 “Penn Station To Give Way To Madison Square Garden; Great Space in Peril; RR To Go Underground” in Progressive Architecture, September (1962).
of the Baths of Caracalla...[where] it seem[ed] as if the very spirit of Rome – its ordered bigness, its grandeur, its essence of the eternal – stole into their souls, lifting and transforming the men and giving them insight and power to compass achievements that belong to the ages." Desirous of these formal and spatial qualities for his buildings, Jonnes tells in Conquering Gotham how “McKim was convinced that the rising American modern empire was more ‘nearly akin to the life of the Roman empire than that of any other known civilization’ so he turned to that ancient imperial scale to create for Cassatt [founder of the Pennsylvania Railroad] a modern edifice of comparable magnificence.”

It may be no accident that McKim turned to the genre of the bath, which apart from temples and churches such as the Pantheon or Hagia Sophia, created the most magnificent vaulted interior spaces of the ancient world. Such spatial arrangements, like the dome on pendentives, were directly subsumed from baths into Late Antique church architecture. The spatial and formal qualities so often recalled in praises or descriptions of Roman baths – of light and airiness contained by columnar orders and vaults, details compelling the eye forward across space – were central not just to the Christian basilica, but also to the conceptualization of McKim’s Penn Station in New York City, and to railway terminals like Washington D.C. or Chicago’s very own Penn Stations, where

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640 Jonnes 2007, 147.
641 Ibid. 165.
642 A point acknowledged by Ward-Perkins 1966; and lately, more forcefully, by Brandt 2011.
643 As prominently in Lucian’s ekphrasis for a bath, *Hippias*.
Roman baths became a significant component of early twentieth century America’s architectural legacy and cultural identity. We might go one step further than structure, and compare the decline of New York’s Penn Station with the end of the imperial public bath building in Late Antiquity.

Between the third and the seventh centuries CE, the Roman public bath became a locus for cultural transformation and social conflict that ultimately preceded its own demise, with the intersection of functional, cultural, and economic developments investigated in this chapter. New York’s Baths of Caracalla became increasingly obsolete, so the story goes, because cars proliferated and transportation downsized after World War II. Trains and their stations became less sustainable as investments, at the same time as Penn Station’s four-by-four block of real estate and air-rights became some of the most valuable on the island of Manhattan. Formally too, urban planners and the public weighed the value of modernism and new, industrial materials against Roman-style monumental stone architecture. Critics sneered at Penn Station in New York, decreeing that its “majesty [was sought on false terms with] the bastardization of a Greek or Roman temple.” Its designers – McKim, Mead, and White – picked up an occasionally pejorative Roman epithet, Triumvirate. Penn Station became mere “residue from a Caligulan invasion,” since “today we know that a

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645 Editorial, “Penn Station To Give Way To Madison Square Garden; Great Space in Peril; RR To Go Underground.” Progressive Architecture, September (1962).
railroad station need not look like a Roman bath in order to be good architecture.\textsuperscript{646}

In 1957, Penn Station’s columns were covered with plastic. Neon-lit advertisements and partitioned-off commercial spaces encroached on the open interior. A futuristic, curvilinear ticket counter with bright lights was installed under the waiting room’s soaring vaults, with hopes that the change might spur ticket sales and improve the station’s image. The result further isolated and anachronized McKim, Mead and White’s neoclassical creation, with its columns, entablatures, and vaults.

Lewis Mumford foresaw the end of old Penn Station in 1958,\textsuperscript{647} though its demolition and conversion came rather later, after the air rights had been sold and new plans were finalized to replace the old baths with an amphitheater, Madison Square Garden, set above a new subterranean Penn Station, in 1961. The vestigial guts of the old Penn Station – its tunnels – were reused, because they were valued for their ability to disgorge a steady stream of subway-riders up into the new arena. Promoters argued that only in the most well-connected place in the city could the new amphitheater work for city-living spectators.

\textsuperscript{646} “Penn Station’s Value Queried.” \textit{New York Times} (letter), 18 August (1962).
\textsuperscript{647} Mumford 1958.
Preservationists cunningly parried against accusations that the old station reeked of Roman opulence by reframing the building’s “Caligulean residue” into a narrative straight from Late Antiquity: “The great hall will go, the great concourse will fall, the traveler will be mashed into subterranean passageways like ancient Christians while the wrestler and the fight promoter will be elevated to the vast arena. The Decline and Fall of the American Empire — sic transit gloria mundi.”\(^648\) Interestingly, the catacomb label has stuck on the underground Penn Station, appearing in print as recently as 2007.\(^649\) On July 25, 1961, planners promised preservationists that “the main waiting room of Penn Station will be left as is,”\(^650\) but by July 27 their true intentions to destroy the entire complex became public.\(^651\) Suggestions were quickly floated as to how the train station’s columns and sculpture might be most fittingly despoiled and re-used. After failed measures to re-install the columns in Flushing Meadows or Battery Park,\(^652\) demolition began in 1964, and in the end they were all unceremoniously dumped in New Jersey.\(^653\) The sculpture was more carefully removed: the large eagles from the façade all survived as spolia, for instance, with four finding their way to the Market Street bridge over the Schuylkill River in Philadelphia, among other places. Madison Square Garden and the new subterranean Penn Station were

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\(^649\) Rasmussen 2007.


\(^651\) “‘62 Start is Set for New Garden; Penn Station to be Razed to Street Level in Project” in \textit{New York Times} 27 July (1961).


completed in 1968. Vincent Scully wrote that, in the old Penn Station, “one entered the city like a god,” but in the new, “one scuttles in…like a rat.”

4.2 The transformation of Penn Station as a lens for viewing the so-called decline of the public bathing habit after antiquity

The challenges faced by this rail station, arguably the most important Roman bath in the modern world, neatly encapsulate the evolution of the Roman bath in Late Antiquity. Emergent financial considerations – in Penn Station’s case, the densification and commercialization of lower Manhattan, skyrocketing real estate prices alongside lowered revenues and soaring maintenance costs, changing cultural attitudes to rail travel, new ideas about historic preservation – circulated together as the original social and financial agreements that had formerly guaranteed Penn Station’s continuity fell apart. The conversion to amphitheater went ahead, the station moved underground to become the ‘catacomb’ it is today. Rail transportation never became entirely obsolete of course, but its monumental expression became less obligatory in the modern city. Encroachment and new functionality crept into Penn Station’s cavernous waiting room / tepidarium, as independent points of sale and advertisement dismembered the space. After the building was scheduled for demolition, community interests triangulated between formal preservation, programmatic new intentions for the space, and maintenance of the vestiges. Many jumped at the prospect of salvage, and suggested where to put the spolia, and how it

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Scully 1969.
should be treated. All these events were components of a fundamental reassessment of monumental architecture’s value in urban environments, as a setting for rail-transportation, and as a part of the renegotiation of American urban identity in the post-World War II period.

The transformation of baths in Late Antiquity may not be so different than the evolution of Penn Station: a confluence of factors contributed to a reassessment of the architectural, financial, and cultural investments that provided an ideologically valuable genre of monumental architecture (imperial style thermae-bath buildings/train stations) for a distinctive social behavior (public bathing/railroad travel). Over time, these spaces progressed from encroachment and interior redefinitions of space and form, to conclusive demolition and abandonment, or functional conversion. Penn Station’s bath was turned into Madison Square Garden’s amphitheater, but elsewhere one encounters old train stations repurposed wholly or in part as museums (Musée d’Orsay), office or commercial districts (Dearborn Michigan [orig. 1883, converted 1980s]), casinos (Adelaide, Australia [orig. 1856, converted 1985]), churches (Northwest Argentina), and luxury apartments (Interurban Station, Dallas [1916] or Union Station, Indianapolis). In the same way, Roman bath buildings were subject to numerous forms of conversion: houses, churches, and industrial centers were installed there sometimes during, but mostly after, the baths themselves had ceased to operate.
In the final analysis, Penn Station was not merely an index for cultural change and social conflict, but a locus in which these larger changes occurred. I propose that Late Antique baths were much the same. In what follows, I suggest four factors whereby we can explain the diminution and introversion of the bath after antiquity: 1) the declining value of baths as a public space for elite self-representation through statues and inscriptions; 2) the vulnerability of the bath as locus politicus, a space for public assembly and a seat of government, but also an epicenter for urban riots, violence and stasis; 3) the lingering value of baths as an object of envy for Rome’s neighbors; and 4) the immense costs and challenges of providing artificial water supplies to baths (examined in the previous chapter on aqueducts), which predicated the expansion of natural thermal bath sites that took on new importance as Late Antique administrative centers, loci for architectural patronage, and hot spots for both internal rebellions and cross-border conflicts with neighboring polities.

### 4.3 Christianity and baths after antiquity: a red herring

Christianity is still a popular explanation for the demise of the urban Roman bathing – or the diminution of grandiose public Roman baths into smaller facilities under private or church management – because churchmen quite vocally expressed their disdain for mixed-gender public nudity and the vice or sexual immorality it could promote, besides the presence of pagan statues and ritual
there, too. Churchmen were also concerned for excessive public expressions of private wealth in baths, like long retinues of slaves and attendants or elaborate and expensive bath accessories. All these concerns find visual and material expression in the Projecta Casket, from the fourth century, which depicts female nudity, mythical bath attendants, and lavish bathing accessories, pointing back to objects like the silver casket itself (fig. 4.3).

However, as Dunbabin has explained, these attitudes were not so distinctive of Christianity, but were also expressed by traditionalist or conservative pagan authors like Cato. Indeed, many churchmen were not shy to express their deep enjoyment of the bath, or to extol its value for health, wellbeing, and discourse among friends. And, from an early date, Roman churches included balneae and pribata among their investment portfolios, according to the Liber Pontificalis. The wide exchangeability of conservative Roman and conservative Christian perceptions of bathing undermines the utility of a strictly pagan versus Christian dialectic with which to explain the transformation of the Roman bath. To the contrary, Roman-style public bathing never truly ‘died’ –

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656 The casket was probably used for the toilette of a well to do Roman woman, likely in the service of her bath routine in the company of slaves; in this sense the object points back towards itself.
659 Poccardi 2009.
the spaces that enabled this particular behavior were merely transformed and relocated.

4.4 The architecture of bathing after antiquity

As Lavan recently noted, “a detailed synthesis focused on bathing in Late Antiquity has not been undertaken.”\(^{661}\) Most of the work to date is focused on particular regions and individual sites. A brief survey of recent scholarship concerned with Late Antique baths might be useful.

The Levant has received especially good attention: Kamash’s dissertation dealt with water in the imperial Roman Near East and considered a number of baths for analysis and in appendices for reference;\(^{662}\) Stefanie Hoss’s dissertation focused explicitly on bathing culture in Palestine from the Hasmoneans to the Roman Conquest, also with useful appendices;\(^{663}\) while Reeve’s MA Thesis (written for Oleson as part of the Humayma project) included an appendix with brief descriptions and bibliography, unfortunately without plans, for nearly a hundred baths across Jordan and Palestine.\(^{664}\) The work of the French in Syria has been a watershed; and formally its importance cannot be stressed enough. To a large extent this depends on the hands and mind of the artist and scholar Fournet of the IFPAO in Beirut, whose pioneering work in the baths of Bostra was followed by a synthesis of baths in south Syria, fortunately completed before

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\(^{661}\) Lavan 2007, here at 137.
\(^{662}\) Kamash 2006.
\(^{663}\) Hoss 2004.
\(^{664}\) Reeve 1996.
the outbreak of serious hostilities there in 2011. Fournet’s work provides an ideal template for future work on baths elsewhere in the Roman world (especially for standards of illustration); a meeting of the Bahnèorient project in Istanbul Dec 2010 promised the extension of Fournet’s methods in the context of a larger synthesis of Late Antique-Byzantine baths in the Eastern Mediterranean.

However, the author is unaware of that project’s progress, which has apparently continued its focus on individual sites without much of a synthetic or comparative component.

In Anatolia, work has been much more provincially-focused. Farrington surveyed the imperial period baths of Lycia (drawing well-deserved attention to the use terracotta spacer-pins in the earliest imperial baths but asserting, perhaps incorrectly, that the row-type of Lycian baths constitute an especial type which evolved separately from the imperial type imported from Italy), while Huber has published extensive descriptions and drawings from predominantly Late Antique baths in Cilicia for over fifty years. Uyterhoveen has recently published an admirable synthesis of domestic and private bathing in Roman and Late Antique Anatolia.

665 Fournet 2012.
666 Farrington 1995.
667 Huber 2005, 7-55 includes plans and typological descriptions of nearly all the surviving bath complexes in Cilicia, composed over the course of his career; see also Hoff 2013.
668 Uyterhoveen 2011.
In Greece, the only synthetic account thus far derives from Wassenhoven’s dissertation, which was concerned with the public baths of the classical Peloponnese, and which appeared in 2012.\textsuperscript{669} For Bulgaria, there is a short annotated and now outdated bibliography, with reference to the numerous short descriptions from various archaeological publications, predominantly in Bulgarian and Russian.\textsuperscript{670}

For North Africa, the historical and architectural scholarship of Leone\textsuperscript{671} and Thébert\textsuperscript{672} stand out for their inclusion of baths from Late Antiquity; these areas are outside the purview of the present project. Notable too is the important but under-cited study by Stasolla for Late Antique Italy, which charts the church’s concern for baths beginning with the implantation of churches into domestic complexes after the later third and fourth century.\textsuperscript{673}

Otherwise, while individual cities have been surveyed in monographs or review articles, the baths of the Late Antique eastern Mediterranean remain basically unsynthesized since Berger’s MA thesis, *Der Byzantinisches Bad*, or the short chapter in Yegül’s magisterial *Baths and Bathing in Classical Antiquity*.\textsuperscript{674} The latter provides an interpretation of the architectural development of baths in Late Antiquity that I take no qualms with: the replacement of a tripartite pattern of bath

\textsuperscript{669} Wassenhoven 2012.
\textsuperscript{670} Vačeva 2010.
\textsuperscript{671} Leone 2007.
\textsuperscript{672} Thébert 2003.
\textsuperscript{673} Stasolla 2002 with extensive appendices.
\textsuperscript{674} Berger 1982 and Yegül 1992, 314-349.
visits (frigidarium – tepidarium – caldarium) with a bipartite scheme focused on
the hot rooms (tepidarium – caldarium); the abandonment of large bath
complexes for smaller ones; the tendency towards hip-tubs instead of open
pools. What remains for further examination, however, are the causes for these
evolutions, which I would locate not (only) in new Christian attitudes to the body
and public nudity or pleasure, but in the bath’s role as a locus for segregation
rather than congregation; for forms of elite self-representation that were
increasingly obsolescent and vulnerable; and in the trend away from aqueducts
carrying artificial supplies of water to urban baths, towards locations blessed with
natural hot springs, instead. Further, there is an apparent contradiction of Yegül’s
thesis, to be found in the expansion of dry areas used for public assembly rather
than bathing, in many Late Antique bath complexes. We examine these factors in
the following sections with more detail.

4.5 Social factors: segregation, xaris, and envy at the baths
Scholarship has overwhelmingly treated baths as public buildings for
entertainment or medical treatment, a benefit of empire. The congregational
aspect of the Roman bath should not be separated from its segregational aspect,
however. The boundaries of the bath became liminal when baths were the
meeting place of dead spirits with the living: common are tales of encounters with
demons or the evidence of deposited defixiones and cast spells in Roman

675 Typical of this attitude is Dodge 1999.
baths.\textsuperscript{676} Among the living, segregation in baths was enacted interpersonally by virtue of social status (including allegiance to circus factions,\textsuperscript{677} administrative rank,\textsuperscript{678} but also slave versus free\textsuperscript{679}), gender,\textsuperscript{680} religious/confessional differences,\textsuperscript{681} ethnic background (Roman versus other, especially barbarians and/or Semitic peoples).\textsuperscript{682}

\textsuperscript{676} For instance, in the later fifth or sixth century \textit{Life of Caesarius of Arles}, ghosts were exorcised from a popular local bath (Klingshirn trans., 73). For other similar instances, see the studies of Dölger 1909 and Bonner 1932, and compare with similar tales recorded by Hasluck among the Greek populations of pre-Republican Turkey, Hasluck 1929/1973, 38-40 and 107-112.

\textsuperscript{677} The circus at \textit{Tyr} was outfitted with separate baths for the blues and the greens, as identified by inscriptions there; see Kahwagi-Janho 2014 and Chéhab 1973.

\textsuperscript{678} Difference of rank was most obviously performed by conspicuous consumption and public displays of wealth in baths: Ammianus Marcellinus (28.4.6) casts disdain on those men who, when they enter the vaulted rooms of a bath, “each attended by fifty servants, shout in threatening tones ‘where on earth are our attendants?'”

\textsuperscript{679} Chrysostom’s \textit{Homily} 15 tells of a slave woman, beaten by her Christian mistress, who reveals marks of scourging and bruises on her back when she goes to the public bath.

\textsuperscript{680} Gender-segregated bathing was enforced under the reign of Hadrian according to the SHA; it was also recommended by the Council of Laodicea in 365 CE (Canon 30), in the later fourth century \textit{Apostolic Constitutions} (1.6 and 1.9), and by the Council of Trullo in 692 (Canon 77). At the Council of Chalcedon, see Third Session sec. 51, trans.Price and Gaddis, 446. Bishop Dioscurus of Alexandria was excoriated for allowing women of questionable reputation into the episcopal baths. Gender-segregated bathing was also a trope in the Lives of the Holy Fools, in which the Fools would enter into women-only baths to provoke unrest; this is commented on by Evagrius Scholasticus 31; see also Syrkin 1982 or for Symeon the Fool, Krueger 1995, 153.

\textsuperscript{681} Accounts of religious/confessional differences playing out in baths are numerous. Heretics were a frequent target, whether from a pagan/traditionalist Roman or Christian perspective. Malalas 11.9, Jeffreys and Scott trans., 145-6 describes how Trajan martyred a group of Christians at \textit{Antioch}, burned their bodies, and had the ashes mixed into bronze hot-water vessels for the bath; whoever used these became dizzy and had to be carried out of the baths, leading Trajan to admit of his error, and melt down the vessels to erect statues of the martyrs (he thereby claimed to have resurrected them personally, rather than giving the credit to Christ). During the persecutions in the reign of Maximian, 303 CE, Eusebius (\textit{HE} 8.9.2) tells us that soldiers were posted outside of baths to indiscriminantly defile customers with the entrails of sacrificed animals. Arianism plays an occasional role: an Arian bishop imposed on Samosata was thought to pollute the bath water, leading locals to refuse to bathe with him (Theodoret \textit{HE} 4.13 = Socrates \textit{HE} 2.16).The Arian Olympios died in the Helenianae bath in Constantinople after uttering his blasphemies there (Theophanes AM 5991 = Theodore Lector 465, PG 81.1 cols. 131.24-8). Bishop Aaphrates of Antioch charged Valens with Arian impiety to his face, which drove Valens’ eunuch servant to madness, leading him to commit suicide in a hot bath (Theophanes AM 5867). Bathing with Jews was prohibited by the Trullo Council in 692 (Canon 11). Baptism in baths was another frequent trope: Hormisdas, father of Sassanid king Chosroes, was reportedly baptized in a bath (John of Nikiu, 95.23). Malalas 12.50, Jeffreys and Scott trans., 171 describes the martyrdom of St Gelasinos at Heliopolis in Phoence: Gelasinos was a mime performing in a festival during the reign of Diocletian, who was thrown into a bath’s pool by the
There were several responses to the tension of segregation in Roman baths: one was violence and bodily harm, described in more detail below. The other response was to reinforce segregation architecturally, by withdrawing the activity of bathing out of public and into the private baths of large residences that proliferated after the third century, especially. One dimension of this segregation was socioeconomic: inscriptions from privately funded public baths sought to ward off a visitor’s envy of wealth, invidia or πθόνος, by reminding them of the patron’s benevolence and wealth expended on the bath. This is an implicit acknowledgement of begrudged danger to the bath’s ktistes or founder, who had become especially important in the visual culture of the Late Antique bath, represented in sculpture and inscriptions.

4.6 Baths as a locus for elite self representation in sculpture and inscriptions

Apart from the considerable role of bath sculpture in the formation of the canon of Roman art history – witness the Farnese or Palazzo Reale collections culled from statuary found at the Baths of Caracalla after the fifteenth century – scholarly interest in bath statues and inscriptions in context has been more limited. Baths

crowd; he emerged and refused to perform on account of his faith, and was subsequently murdered.
682 John of Nikiu 90.24 distinguishes one of Antioch’s many baths as belonging to ‘the Syrian nation’.
683 Uyterhoeven 2011.
684 Dunbabin 1983.
685 For instance at Dunbabin 1989, 33.
686 See Barkan 1999.
discovered with sculpture are actually rather rare, known almost entirely from western Asia Minor, North Africa, Cyprus, and Italy. Baths with sculpture are basically unknown to archaeology in Spain, the Northern Provinces (excepting Trier), and the Levant (excepting four of nearly 200 known baths).687

I would like to make four brief points about sculpture and inscriptions in baths after antiquity, with some important consequences for this chapter’s interest in the factors that influenced the eventual abandonment of many urban Roman baths:

1) Epigraphy has been vastly under-utilized in the study of sculpture in bath complexes, with important consequences for visibility of evidence in the record, especially for private Late Antique representations of individuals and families.688

2) Defining the nature of restoration in baths is an important, related problem. Fagan has demonstrated that there is no economy of scale in inscriptions that commemorate bath restorations: a big inscription does not necessarily equal a big gift, and in any case relating specific structural changes in buildings to honorands in inscriptions is difficult. Like churches, Late Antique bath inscriptions will not infrequently commemorate a construction in vague terms [e.g. ἐκ θεμελίων or, from the foundations], that should not literally be taken to mean that

687 For sculptural environments in Palestine at Philippopolis, Gerasa, Palmyra, and Beth Shean, see the discussion and references in Tsafir 2008.
688 On this issue, see most recently, see Stirling 2014.
the bath was literally built anew, from the ground up. A roof repair might very well have garnered the same praise in inscription. The converse is also true – we should be careful not to confuse a lack of commemorative inscriptions with a lack of maintenance or modification. At the Hadrianic Baths of Libyan Lepcis Magna, the last datable inscription for a restoration on site belongs to the Severan period, as do the famous arch and forum in town, though the presence of structural changes to the building, barely-mentioned reworked portraits and a cross and Christian invocation inscribed on one of the frigidarium’s cipollino columns alert us to the continued use of the site throughout Late Antiquity.

3) Published collections of inscriptions or sculpture whose assemblages can be convincingly dated to before the fourth century are comparatively rare, especially outside of Italy. The set of second or third century inscriptions from the public baths at Kremna in Pisidia are one example.

4) The final excavated states of baths and their sculptural or epigraphic collections are often not original, but are instead the product of Late Antique interventions and restorations in bath buildings, no matter the antiquity of the objects found inside. This was dramatically demonstrated at the Vedius Baths in Ephesus. Here, thousands of sculptural fragments were used as preparation for an opus sectile floor, dated by coins to the late fifth century, which provided an

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689 IRT 396.
690 Bartoccini 1929, figs. 178-180 and 195-6, and Manderscheid 1981, cat. n. 326.
691 IRT 832.
692 See IK 57, 63f.
unexpected terminus post quem for the otherwise-undated curation of classical
and imperial sculpture found above that opus sectile pavement. Careful
excavation and record-keeping facilitated Marvin’s famous reconstruction of the
Late Antique spatial organization of sculpture at the Baths of Caracalla, on
whose model contextually sensitive studies of sculpture’s find-spots have been
produced for baths at Aphrodisias, Ephesus, and Miletos.

Scholars in the earlier twentieth century favored bath-sculpture for exercises in
Kopienkritik or the attribution of build-dates to baths without inscriptions. This
orientation culminated with Manderscheid’s magisterial catalogue of mythological
sculpture from imperial Roman baths – spolia, portraits and Late Antiquity were
unfortunately not within his scope, however. Mythological and cultural
sculpture is arguably overrepresented in publications of excavated baths
because of this orientation or bias (as at Side or Perge), according to which
private portraits (especially Late Antique ones) were less valuable for museum
collections. This orientation has probably skewed our conception of the typical
bath’s sculptural content, while scholarship exaggerates the effect by

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693 Auinger and Rathmayr 2007, 245.
694 Marvin 1983 for sculpture in the Baths of Caracalla.
695 Smith 2007 for sculpture in Hadrian’s Bath at Aphrodisias.
696 Auinger and Rathmayr 2011, Auinger 2011, and Aurenhammer and Sokolicek 2011 for
sculpture in Ephesian baths.
697 For the Faustina Baths in Miletos, see Maischberger 2007 and Schneider 2009.
698 Even newer catalogues, whatever their thoroughness, can emphasize Kopienkritik at the
expense of context in the analysis of sculpture from Roman baths. See for instance the catalogue
for Cherchel, Landwehr 1993-2012, where Porträtplastik was added only in the most recent fourth
volume (2012). For the debate on “heirloom pieces” and “new productions” in late antique
collections of statuary, see for example the opposing positions of Stirling 2007 and Hannestad
2007.
concentrating on the reception of pagan sculpture in baths of the Christian empire. Accordingly, scholars have generally been satisfied with the idea of Late Antique baths as museums, “a collective reflection of the city’s wealth if not pure decoration,” part and parcel of the Christianization of the Roman city, and the aestheticization of desacralized Roman sculpture.

Smith, on the other hand, working at Hadrian’s Bath in Aphrodisias, has noted that the Late Antique portraits found there formed less a “museum” than “a vivid example of continuing ancient statue life” (see fig. 4.4 for a plan of statue bases at Hadrian’s baths, in their Late Antique display positions). From this perspective, baths were not mere ‘repositories’ of sculpture and inscriptions, but were instead important venues for the curation of Late Antique urban identities, especially after the clearance of forums and agoras in favor of imperial monuments, after the Tetrarchy.

We can expand Smith’s point by emphasizing how Late Antique baths were especially critical venues for the representation not only of individuals, but of...

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699 e.g. Lepelley 1994 argued from statue bases for Hercules and Juno found at baths in Cherchel -- inscribed translata de sordentibus locis -- that baths functioned as repositories of desacralized temple sculpture, largely in response to the laws of 384 and 399 which closed the old places of sacrifice. Bassett 2004, worked with the Zeuxippos bath collections, the textual evidence for which suggests sculpture there was entirely mythological and cultural (philosophers, dramatists, etc.) in character.

700 Leone 2007, 86-87.

701 Smith 2007, 220.

702 Thébert’s study of inscribed bases found in the fourth century portico of the Memmian Baths in Bulla Regia revealed that it had served as a collection and redisplay point for older portrait statues culled from the forum, see Thébert 2003, 446f. On the late antique removal of statues from agoras and forums in Spain and North Africa, see Witschel 2007.
corporate family and group identities, fictive or by blood. Bauer has described
how private portraits retreated from Roman public spaces into the church\textsuperscript{703} and
domus\textsuperscript{704} in Late Antiquity.\textsuperscript{705} Baths were a late hold-over in this process, even if
the date and mode by which private portraits (especially in related groups)
entered into baths is unclear, and worthy of further comment.

The introduction of family groups into baths was arguably a relatively late
development, which is securely attested only after the beginning of the third
century CE. Standard Roman statuary practice after the Republican period
included individual portraits, or the creation of mythical statue groups – like
Apollo and the Muses or the Virtues and the Graces – but comparable visual
constructions of families in public are rarely attested during the early Empire
outside of the imperial house, where they of course flourished.\textsuperscript{706} Private families
stayed private – in the tomb (where reliefs\textsuperscript{707} or grouped busts in family
columbaria\textsuperscript{708} were especially popular media), and in the domus. There, Pliny the
Elder tells us that “genealogical lines of descent, in fact, used to be indicated,

\textsuperscript{703} For the representation of corporate and family identity in churches and church cemeteries, see
Yasin 2009.
\textsuperscript{704} See Coates-Stephens 2001, and Stirling 2005 and 2007 for late antique sculpture collections
in the domus.
\textsuperscript{705} Bauer 1996.
\textsuperscript{706} Augustan and Hellenistic imperial dynastic groups – in coins, on relief, in sculpture -- are all of
course important precedents for the later-Roman tendency for private families to create their own
portrait groups. The question here is really the acceptability of different public contexts in which
these private groups could be displayed. For the Augustan material, see especially Zanker 1990,
193.
\textsuperscript{707} Boatwright 2005.
\textsuperscript{708} A function of rooms or sections of rooms being purchased for use by families, see for instance
the columbaria of Rome or the mausolea of the Vatican necropolis. See Fejfer 2006, 119-120.
running back and forth between painted portraits” in the domus. We have little in the way of statue groups with which to compare these family trees in the domus, however. The Barberini Togatus is a striking exception – wherever it was originally displayed – but in the way of family groups from public spaces like baths, there are only a few examples to which we might refer.

Indeed, the closest early parallels for the creation of private family groups in public spaces were not in baths at all: Two monumental installations dedicated by women under the Antonines are especially relevant. At Perge, Plancia Magna rebuilt the old city gates to make room for a court fronted by a scaenae frons, whose niches held statues of Plancia Magna’s family, including her father and brother. On the other side of the gate and facing the city was a group of portraits of the emperors and their wives, from Nerva to Hadrian. In Olympia, Regilla included her husband Herodes Atticus and children below members of the imperial house in the niches of a two-storeyed nymphaea, a rare step on a private monument - this may have been more permissible because the imperial family was given the superior space in the upper row, and because it was located in a cultic rather than civic space. In both instances, the private family group was represented publicly only in proximity to a larger imperial family group.

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709 Pliny, NH 35.5-6.
710 Fejfer 2006, 363-66 with references for Perge and Plancia Magna. For the inscriptions and identifications of statues from the gate at Perge, see /K 61. For Roman family groups generally, and the potential for visual resemblance rather than inscriptions to inform the viewer of family ties (e.g. the Tetrarchs), see the thoughtful chapter in Kampfen 2009, 104-122.
The early Roman baths excavated at Pompeii and Herculaneum contain only minimal statuary, for instance, other locations in cities being much preferred for sculptural displays. A near miss, Balbus (whose portrait statues were ubiquitous in the early empire anyways) was granted a funerary monument outside of the Herculaneum bath, a large altar and statue with base.\textsuperscript{712} There is little to nothing surviving of family groups from first to later second century CE Roman baths, private or imperial. Second century privately-owned baths occasionally had individual spousal or parental inscriptions: the Varius Baths in Ephesus, for instance, contained a statue base dedicated to "Quintilia Varilla, priestess of Artemis, wife of Pu. Quint. Valens Varius, who built this place from his own for his people."\textsuperscript{713} We should be careful to distinguish these single inscription dedications to spouses and relatives from larger, interrelated groups of individuals. Goodchilde and Ward-Perkins’s catalogue of Tripolitanian inscriptions revealed that, at the Hadrianic Baths in Lepcis Magna, several \textit{pairs} of second or third century” inscriptions were set up by a close relation to honor “a good son” or “a good brother.”\textsuperscript{714}

Family groups in baths become visible during the third century: this is arguably an imperial innovation that was then imitated by private families. Two excavated baths are known to have contained imperial family groups; another is implied in literature. The bath at Philippopolis/Shahba in southeast Syria is the only Roman

\textsuperscript{712} Fejfer 2006, 224-226.
\textsuperscript{713} \textit{IvE} 986.
\textsuperscript{714} \textit{IRT} 263, 361, 396, 580.
bath in the Near East known to have contained multiple portraits. These included Philip the Arab (244-249), his wife Otacilia, their son Philip II (aug. 247-249), as well as the lower portions of a similar female figure.\textsuperscript{715} Kleiner points to contemporary coins and medallions that also represent Philip the Arab with his wife and son in profile as a group. Kleiner explains that Philip "sought to found a dynasty based on those of the Antonines and Severans."\textsuperscript{716} The dynasty was short-lived, however: little Philip II was slain at age 11 by the Praetorian Guard, after his father was defeated and killed by Trajan Decius in CE 249. The second excavated imperial family group comes from the *basilica thermarum* of the East Baths in Timgad, a three aisled basilican room divided by two rows of piers, before each of which stood a pedestal with an honorific statue. These included Valerian and the wife of Gallienus, Cornelia Salonina, as well as the two sons of Gallienus and Cornelia. Gallienus was there too, found alongside semicircular water basins in the frigidaria, accompanied by Crispina, the wife of Commodus, and a prominent local lawyer, as well as several mythical and idealizing pieces. That the inscription of Gallienus (dated 255/6) is identical to Valerian's means, for reasons of titulature, that they could not have been erected at the same date.\textsuperscript{717} The *Scriptores Historia Augusta* records a comparable installation: Caracalla built for *pietas*, at his eponymous baths in Rome, "a portico, named after his father and intended to contain a record of his achievements, both his triumphs and his

\textsuperscript{715} Balty 1990.  
\textsuperscript{716} Kleiner 1992, 368.  
\textsuperscript{717} Ballu, Cagnac, and Boeswillwald 1909, 226-245.
Additional examples of imperial family groups in baths could probably be inferred from Yegül’s postulated Kaisersaal, a space for celebration of the imperial cult he identified at Ephesus, Sardis, Aphrodisias, and Pergamon. Later, but arguably also related to this tendency towards the glorification of family in baths, Maurice is attributed with the construction of a portico at the public bath he built in Blachernae, in which “painters [depicted] … all his deeds from childhood until his reign.”

Private family groups are first securely attested in Roman baths around the same time, in the third century CE. The first example to my knowledge (after scouring the IK and other corpora) comes from a private group at the baths of Pisidian Kremna, where a family-group for the gens Ulpia was erected between niches on either side of a basilical entrance hall adjoining the bath proper, TAQ c. 220 CE (fig. 4.5). This may be the structure referred to as oecobasilicum in one of the inscriptions – such a space is also referred to in the inscriptions of Thyatira, Aphrodisias, and Sardis. Here, the editors of the IK volume from Kremna studied these inscribed bases to conclude that “Ulpia Eumeliana was doubtless related to Ulpia Rutiliana Longilla, to M. Ulp. Tertullianus Aquila, 

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718 SHA Caracalla 9.
719 Yegül 1982.
720 Theophanes AM 6079.
721 Thus we see that the family group may be connected to the creation of new public spaces in the bath after the third century, a phenomenon discussed below in the section on apodyteria/bath basilicas, see 4.7.
722 IK 57.43.
723 IK 57.38.
724 IK 57.44.
and probably to an anonymous femina consularis\textsuperscript{725} ‘who left 12,000 denarii for the completion of the oecobasilicum.’ The statues in the bath house were designed to honor this prominent family as well as the gods. The anonymous inscription uses an abbreviation, C.M.F or clarissimae memoriae femina – not attested before the third century – which persuaded the editors to date these texts to sometime after 220 CE.\textsuperscript{726} After the third century, family groups become more visible in the record for sculptural installations in baths.

We can suggest three models for the function of family groups installed in baths, operational between the third and the sixth centuries, after which time many baths outside of Constantinople were seemingly cleared of their older sculpture collections:

1) imperial groups. These parallel the creation of dynastic groups in other media and urban locations from the preceding centuries, after Augustan and Hellenistic precedents.

2) private family groups set into proximity to the emperor, following the model established for the family of Herodes Atticus in proximity to the Antonines, at the Olympia fountain. The major example here is Hadrian’s Baths at Aphrodisias,

\footnotesize\textsuperscript{725} IK 57.45.  
\footnotesize\textsuperscript{726} See IK 57.45.
where new groups of proconsular families were set near to the emperor in the later fourth and fifth centuries.\textsuperscript{727}

3) private family groups in baths without imperial proximity, a) newly commissioned like Kremna or b) curated with spolia like the Scholastikia and Odeion baths in Ephesus.\textsuperscript{728} This strategy of using spolia to create new family groups was not limited to baths, but extended also to another genre of water architecture, namely fountains: besides recently published examples from Ephesus,\textsuperscript{729} another example comes from the forum at Philippi, where a sixth-century fountain was ennobled with a curated group of reused imperial-period funerary inscriptions and statues (with their own, separate bases) for the ancient lineages of the Mucia and Decimia families, probably in the sixth century.\textsuperscript{730} And, the Antonine Nymphaeum at Sagalassos was similarly rebuilt after the early sixth century with a family group of spoliated second and third century bases. Whether the creation of these family groups with spoliated bases portend the survival of senatorial families in these locations during the fifth and sixth centuries, or merely an attempt by local notables to 	extit{simulate} a hereditary connection to past magnates, will probably remain unclear.\textsuperscript{731}

\footnotesize
\textsuperscript{727} Smith 2007.
\textsuperscript{728} Auiunger and Rathmayer 2007.
\textsuperscript{729} Note especially the Nymphaeum Traiani: the fountain’s sculpture may have been reorganized in late antiquity as a monument to the Theodosian house. See Roueché 2009 for the proposal that the Embolos had by c. 400 turned into a giant monument to the Theodosian family; the particular connection between Theodosius and Trajan was disseminated in official propaganda. Note also the fragmentary inscription IvE 600a for a late fourth or early fifth century restoration here.
\textsuperscript{730} \emph{AE} 2004.1335.
\textsuperscript{731} On the creation of \textit{fictive families} in Roman and late antique art generally, see Kampfen 2009.

The Scholastikia baths in Ephesus contain a very interesting and little noticed set of multiple family groups, curated in Late Antiquity with spoliated statues and bases gathered from around the city. Dividing the baths from the residential units to the west, the north-south running Akademiegasse was a 3m wide cryptoporticus (figs. 4.6-7). The vaults of the cryptoporticus were supported by eighteen legibly reused statue bases forming the pillars of the so-called Pfeilergang, which together represent the members of three senatorial families,\textsuperscript{732} two married couples,\textsuperscript{733} two sets of fathers and sons,\textsuperscript{734} and a few apparently unaccompanied individuals, but only two emperors (Antoninus Pius and an irradiated Domitian, from an inscription celebrating the first neokorate of Ephesus).\textsuperscript{735} Vaults over the cryptoporticus, set on these reused statue bases, rested on the southwest walls of the bath, as supports for the apodyterion basilicas above that are associated with the c.400 restorations: thus the porticus is necessarily contemporary or posterior to this date, despite the antiquity of the

\textsuperscript{732} Most prominent is the gens Vedii. Dating to the mid second century, Publius Vedius Antoninus and Publius Vedius Papianus Antoninus, father and son were both present together along the corridor, though only Publius Vedius Antoninus’s base remains in-situ (\textit{IvE} 728 and 730). A Severan-period descendant, Aurunceius Vedius, was also present somewhere in the corridor (\textit{IvE} 724). Publius Vedius Antoninus’s name as benefactor also graces the immediately adjacent Temple of Hadrian, in addition to the Vedius Baths (which retained its name and function until the end of the fifth century at least). For the Vedius family see \textit{IvE} 429, Kalinowski 2002 and \textit{ÖJh} 44 (1959), Beibl. 258f; \textit{ÖJh} 45 (1960), Beibl. 78 and 94. For the operational dates of the Vedius baths see Auinger and Rathmayr 2007. The other gens represented are the Severi (\textit{IvE} 635c, 639, 648, and 892) and the Pollioi (with bases probably taken from their nearby memorial at the head of the Embolos by the Upper Agora, see \textit{IvE} 407 and \textit{ÖJh} 50 [1972] Beibl. 267f); these inscriptions also record the names of an impressive number of women, several of whom were asiararchs / high priestesses independent of their husbands, as Friesen 2006 points out.

\textsuperscript{733} Including husband and wife of procuratorial standing called \textit{philosophoi}, from the early third century, see \textit{IvE} 616 and 617.

\textsuperscript{734} The Proculi, in Latin and bilingual inscriptions, \textit{IvE} 718 and 1103; and the Castricii \textit{IvE} 634 and 634a.

\textsuperscript{735} \textit{IvE} 282.
reused bases. Coin finds here indicated use deep into the Byzantine period, with a firm TPQ set by the probably fifth- or sixth-century pavement mosaic.\footnote{\textit{ÖJh} 42 (1955): Beibl. 30.} The self-consciousness and intentional nature of the reuse is indicated by several factors, not least of them that the buildings from which these inscriptions were taken (including the Vedius Gymnasium), were demonstrably still in use.\footnote{Three arguments can be adduced in favor of the position that these bases were self-consciously recycled. First, precisely because this manner of legible recycling is not standard practice – the recreation of a blank face noted in church pavements and fortification walls is much more standard in late antique construction, as it is in fortification walls, or here on the interior of the baths, as well as in lode bearing positions along the \textit{Pfeilergang} itself. Second, the construction of pillars and vaults with very differently sized statue bases (from .8 – 2m in height) required the creative and careful work of masons to set regular vaults on top. Third, one reading of the evidence would suggest that these bases came from monuments which were still functioning in the early fifth century. Compare for instance Jones’s (2000) discussion of the difficulty of reuse.} The bases of the \textit{Pfeilergang} directed the viewer’s attention both to individuals and their families (whether celebrated or less famous), no longer with statues, but through the written commemoration of their offices in the \textit{cursus honorum}, their deeds and virtues: the language of \textit{pietas}, \textit{amicitia}, \textit{paideia}, and \textit{euergetism} is frequent. These inscribed bases also recorded the relationships in which individuals and families were implicated or connected, and cemented these relationships into architectural connection with one another, spaced at intervals down the length of the Akademiegasse to support the vaults of the western porticus, at a time when such bases were otherwise especially mobile in transit around the city as spolia.

With these three models for the introduction of family groups in Late Antique baths, we might better understand how baths became an especially critical space
for self representation of private persons and families in Late Antique cities, particularly after imperial displays began to dominate traditional spaces, like agoras and colonnaded streets. Such display may have been a liability for baths, however.

We should dovetail the observations above concerning the comparatively late introduction and display of family portraits in baths and fountains with the argument recently propounded by Anderson, that an important factor in the decline of the 'statue habit' in antiquity was sculpture’s vulnerability as an anchor or focus point for social unrest.\(^{738}\) Social disorder in antiquity was characterized by the vandalism and injury of statues, arguably as substitutes for authority figures and imperial persons themselves, as so famously occurred during Antioch’s so-called Statue Riot of 387, when statues of Theodosius and his family were mutilated and dragged through the streets in protest of high taxes. Portraiture and Idealplastik in baths is often found with facial damage, thrown into drainage channels and hypocausts in such a way that suggests their violent removal from the public spaces of the bath proper. We should separate social violence to portraits from the arguably religious-in-nature vandalism enacted upon mythological sculpture, for instance castration.\(^{739}\) The portraits of the Scholastikia and Odeion baths at Ephesus, for instance, were almost uniformly found with considerable facial damage, stashed and broken in the latrines and

\(^{738}\) Anderson, forthcoming.
\(^{739}\) Hannestad 2001 for castration of statues in bath sculpture from Ephesus and Perge
hypocausts at unknown date, rather than in situ in positions of display; nevertheless these baths continued to function well into the seventh if not eighth centuries, without their former sculpture collections.  

In such fashion then, we might ascribe especial value to Late Antique baths as venues for self-representation when the streets and agoras were progressively cleared of private monuments in favor of imperial displays. At the same time, we should not fail to implicate the sculptural collections of baths in the eventual obsolescence of baths generally, owing to the bath’s well-documented role in stasis and social disorder in Late Antique cities, a consequence of the bath’s increasingly prominent role as locus politicus, a place for public assembly. We examine this role in the following section.

4.7 Late Antique baths and the architecture of public assembly

Like hippodromes and theaters, the architecture of public baths – spacious, vaulted, light-filled, and often heated – facilitated their use for large public assemblies, albeit with mostly standing room only. Alison Frantz noted that “[the proliferation of large vaulted dry rooms] at a time when actual bathing facilities were so curtailed seems illogical.” An explanation might be sought in an account of personal encounters at baths during Late Antiquity, which includes the adoption of baths as spaces for public or political assemblies.

740 Aurenhammer and Sokolicek 2011, see 55 fig. 8 for a map of sculptures and findspots from the Odeion bath at Ephesus, found in the hypocausts and latrine drains.
Celebration of the imperial cult is perhaps the most well-publicized component of the bath’s contribution to public life: In an oft-cited article published in the *Art Bulletin* in 1976, Yegül argued that a room in some of Asia Minor’s imperial baths, the so-called *Kaisersaal*, was important for the practice of the imperial cult between the second and the late fourth century. Yegül posited an Antonine origin for the rooms identified as *Kaisersaal*, which – at baths in *Ephesus*, *Sardis*, *Aphrodisias*, *Hierapolis*, *Pergamon*, and *Ankara* – share central locations, framed by niched columnar facades topped by arcuated pediments, and often altars or inscriptions connecting the space to the imperial cult. Yegül sought the demise of the Kaisersaal in the enactment of Theodosius’s edict that ended sacrifice, and with it the imperial cult.\footnote{Yegül 1982 and CTh 16.10.}

But imperial cult was only one dimension of the bath’s social and administrative function under the Empire. In Late Antiquity, we might observe the increasing importance of public assembly in baths by reflecting on changes made to baths that are attested by archaeological evidence and the primary sources.\footnote{The purposes of these assemblies are detailed below in the following section, see 4.8.} Besides the fact that Δημόσιον, a common appellation for baths, meant most simply “public building,” three kinds of rooms in baths were especially important for public assembly: *palaestrae*, *frigidaria*, and *apodyteria*. These spaces were the most common locations for display of sculptural installations or commemorative
inscriptions. They were also adopted for official or political functions not related to bathing. And they were the most common choice for explicit conversions of bath space to other functions, namely for praetoria (the governor’s headquarters or audience hall and court), and churches, the latter numbering more than fifty buildings from around the Mediterranean.

**Palaestrae** are outdoor areas surrounded by colonnades that were used for exercise and athletic competitions. Their use, transformation, and demise as a component of baths in Late Antiquity remains understudied. Late Antique baths were normally built without palestrae. Yegül argues that “the disappearance of the palestrae...concurred with the disappearance sportive functions from the program of bathing,” phenomena which were “undoubtedly a reflection of the strong Christian opposition to nudity and gymnastics.” The palestra's terminus might on the other hand be sought as a corollary of the epigraphic habit, when dedications made by the alytarchs who traditionally oversaw athletic contests drop off the radar, due to changes in civic organization

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743 As at Syrian Antioch and Caesarea Maritima, see discussion below.
744 Vaes 1984-6, here at 317-318 lists 19 examples of bath-church conversions, mostly in west European provinces. A fuller list would also include: Samos, Ballsh (Epirus), Assos and Ephesus (Asia), Labraunda (Caria), Elaiussa Sebaste (Cilicia); Nice and Cimiez/Cemenulum (Gaul); Boppard am Rhein, Trier, and Metz (Germany), Thessaloniki (4 examples) and Palaiopolis (Corfu) in Greece; Berroia (Macedonia); four examples in Rome with additional examples in Albano, Cassino, and Ostia (Italy); Dikitanaura, Kaunos, and Olympos (Lycia); Sabratha, Jebel Oust, Mactaris, and Bulla Regia [North Africa]; Hierapolis (Phrygia); Antioch (Pisidia); Sinop (Pontus); Villa Speciosa (Sardinia); and Kalendarhane in Constantinople.
745 See Steskal 2003 on the function of the palestra in the baths of Ephesus.
746 See Remijsen 2012 on the status of athletes and athletic competitions in late antiquity.
747 Yegül 326-8.
and a decrease in the number of *agones* or athletic competitions after the third century.

Athletic contests continued in cities like Antioch into the sixth century,\(^748\) however, while elsewhere palestra porticoes continued to be maintained at such a late date, as indicated by new dedications and inscriptions made on the occasion of repairs, as at **Beth Shean**.\(^749\) There are a few new Late Antique examples, too. At Peloponnesian Argos, Gordian III added two large palestreæ to the Serapeion/Asklepeion baths there.\(^750\) At **Antioch**, a 350 x 72m enclosure with brick arcades and a semi-circular end was adjacent at the north to Bath C: the space, dated perhaps to the fifth or sixth century, appears to have originally been a palestra that was later converted into a private exercise or riding track.\(^751\)

At **Caesarea Maritima** in Palestine, a public bath with palaestra was erected in the southern part of Insula W2S3, above a third-century Roman mansion.\(^752\)

In any case, palaestrae do not seem to have been used as places of significant public assembly in Late Antiquity, to judge from the silence of the sources on the matter. More typical was encroachment on palaestrae in the form of industry.\(^753\)

\(^{748}\) Malalas 16.6, Jeffreys and Scott trans., 222; the games at Antioch were held in the stadium at Daphne, though training or exercise might well have continued in the palaestrae of the city’s baths.

\(^{749}\) *ESI* 6 (1987/8), 17 for the inscription.

\(^{750}\) Aupert 1992, 361f, his phase 3.

\(^{751}\) Humphrey 1986, 458.

\(^{752}\) *NEAHL* 5: 1660, s.v. Caesarea.

\(^{753}\) Çevik, Kizgut, and Bulut 2009, 237 for industrial installations at the palestra of the baths Rhodiapolis;
burials or churches, or housing for elites and non-elites facilitated by their enclosure of large and open, unbuilt spaces in otherwise crowded cities.

Modified frigidaria and existing or new apodyteria offered perhaps better options for public gathering indoors.

The primary function of the frigidarium, given its name, was 'to be cold' (Lat. frigeo): it contained cold-water pools called piscina, baptisterium, kolumbethra, or dexamene. As Nielsen notes, the frigidarium was often the largest room in the baths, long and rectangular in shape with vaults – especially in the imperially funded, highly axial and symmetrical-style bath complexes. It is in such larger frigidaria, rather than in the smaller polygonal frigidaria encountered at Pompeii's Stabian baths or Antioch's Bath E, that we find evidence for their conversion to

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754 Palaestrae of baths at Pisidian Antioch and Syrian Bosra were subject to encroachment by churches; for these buildings s.v. by province and city-name below in Appendix F. The bath-church at Pisidian Antioch was under excavation until recently, only short reports have been published, see ANMED 4 (2006), 149 for a brief overview and a sixth-century date on the basis of architectural sculpture. The Cornutus palestra at Perge was the site of an aisled tetraconch church's construction at its center, in the later fourth or early fifth century (Kleinbauer 1987); the palestra of the Ostgymnasion at Ephesus was also the site of church construction, in its southeast porticos sometime in the fifth century, with use until destruction by fire in the first third of the seventh century. There were numerous burials in the area around the Ostgymnasion. See most recently, Quatember 2008 and Auinger 2011, 76-79.

755 As for instance at the Verulanus Halls in Ephesus, the palestra of the Harbor Bath: contra Yëgul 1995, 313 who calls Verulanus in late antiquity "a small and shabby residential district," see the marvelous results of the recent Austrian excavations directed by Ladstätter 2012, 23–27 with ground–plan and photographs. These were prestigious residences at the time of their construction, sometime after the end of the fourth century.

756 Russell 1987, 21-2 for the construction of houses and industrial installations at Anemurium's Bath III 2 B.

use for various forms of public assembly, coincident with the suppression of the natationes or pools that previously existed in these spaces.\textsuperscript{758}

At Frigidarium 1 in Sagalassos’s Antonine Baths, for instance, there are indications of a major functional change in the later fourth century CE that created more room for public assembly, apart from bathing. In the south arm, a mosaic panel refers to the use of this refurbished space as a public banqueting hall.\textsuperscript{759} The use of the banquet hall coincided with another important change: Colossal monumental statues of the Antonine emperors and their wives were introduced into niches in the northern arm of the frigidarium, gathered from locations in the city external to the baths. Waelkens argues that this occurred when the statues had become detached from the emperor cult celebrated at the Temple of Hadrian, at the time of the imperial cult’s official, ostensible termination in the late fourth century. Better dated is the frigidarium’s collapse – earthquake damage was dated c. 590 CE with the help of C-14 analysis performed on owl pellets found in the collapse.\textsuperscript{760} A rather later parallel for bath-dining at Sagalassos comes from Theophanes, writing for the year 712/13 CE, in which he describes how Philippikos dined at the Zeuxippos baths in Constantinople “with citizens of ancient lineage.”\textsuperscript{761}

\textsuperscript{758} Frigidaria that retained their use for cold water-bathing sometimes saw their large pools filled in and replaced with smaller tubs, as at Kom el-Dikka in Alexandria: see Kolataj 1992, here at 114-117.
\textsuperscript{759} My thanks to Julian Richard from the Sagalassos project for this information.
\textsuperscript{760} Waelkens 2008.
\textsuperscript{761} Theophanes AM 6205 for Philippikos dining at Zeuxippon.
At the Antonine Baths in Carthage, following abandonment in the period of the Vandal occupation and rebuilding sometime c. 530 CE, only the frigidarium was put back into use for a brief period, before the whole complex became a quarry for building materials. At baths in Syrian Androna, the richly decorated frigidarium (with Proconnesian marble and opus sectile) saw its cold water pools suppressed at the same time as it was converted into a colonnaded forehall.

At Antioch’s Bath F, a large rectangular pool was replaced by a 12m wide basilican forehall paved in opus sectile: this action is dated by an inscribed mosaic to before 537/8 CE.

Frigidaria were susceptible to conversion for another form of public assembly: namely, as churches. At the Roman Bath-Gymnasium on Aegean Samos, the frigidarium became a baptistery for the church-monastery that encroached on the bath in the mid-sixth century. The bath’s aqueduct-fed supply of water continued to function in this secondary phase (until 659/665 CE) not only for the baptistery, but also for a latrine, fountain, and various agricultural activities. This compares with Aezanoi / Çavdarhisar in Phrygia, where the city bath’s tepidaria became the naos of a church, though the natatio in the frigidarium/narthex was apparently maintained after the church was implanted, because it was never back-filled, but rather collapsed vaults were found on its clean floor, from the

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762 Leone 2013, 159-168 for changes made to the frigidarium at Carthage’s Antonine baths.
763 This change coincided with the repaving of the entrance court, see Mango 2002.
764 Stillwell 1941, 8-9 for Bath F at Antioch.
765 Martini and Steckner 1993, here at 162-4 for the conversion of the Samos and Aezanoi baths.
same earthquake that eventually felled the church. This bath-church conversion is dated by excavators to the fifth- and sixth-century.

The Lat. *Apodyterium* / Grk. *Apodyterion* is derived from the Greek word 

\[\alphaποδύω\], meaning to undress. It was adopted from the Classical gymnasium: Plato describes the apodyterion in *Lysis* (206e) as a room for socializing and assembly, and “originally [it was] used as an assembly room, whereas in the Hellenistic period it as used exclusively as a changing room.” In Late Antiquity, the use of the apodyterium was more flexible – the term is applied to contexts where the space was used as an elaborately decorated hall for audiences, assemblies, or banquets; instead of just a room for changing clothes.

Apodyteria were frequently added to pre-existing baths in a basilica-type format – and indeed their form bears close comparison with contemporary basilican churches. The apodyterion at Karm Abu Mena in Egypt was similarly modified, with a double-apsed forehall erected in its place at the end of the sixth century. Indeed, the building was initially mistaken by its excavator as a church. The confusion is certainly forgivable, because *basilicas* were part of bath buildings, too, as they were in a place called *basilica Constantiniarum* in the Harbor Baths at Ephesus. Disagreement lingers around the identification of a vaulted basilica-

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766 Naumann 1984, 474.
769 *CIL* VIII 23964=828: *apodyterium novum in dextra cellis exeuntibus a solo constructum piscinas duas cetera restaurata adq statuis marmoribus tabulis pictis columnis ingressu…*
770 Berger 1982, 90, citing Krause 1966 in *RBK* 3, here at 1145.
type room in a bath at Carthage, “probably of the fourth century,” which has been identified as the basilica Gargiliarum, part of a bath complex where the Council of Carthage tackled the Donatist controversy in 411 CE.

Without inscriptions or literature, archaeology is simply left with basilicas attached to baths, whether or not we call them apodyteria.

At the Southwest Bath in Athens, the late fourth century reconstruction of a ruined second century bath entailed the creation of an “imposing…vaulted west hall, created by throwing together two rooms and covering them with a marble-chip mosaic floor,” terminated in a large exedra at the south, with benches lining the interior walls. At the Scholastikia Baths in Ephesus, an L-shaped double-basilican apodyterium was added to the core of a mostly second century bathing complex in the late fourth or early fifth century. In the southeast niche of the east basilica, an inscribed statue base and statue commemorated the ostensible patron of the restoration, Scholastikia, flanked by two conspicuously exposed water pipes. The addition of the basilicas at the Scholastikia baths also coincided with the construction of a spacious new caldarium space with a three-by-three arrangement of vaults in a quincunx pattern – oddly reminiscent of the cross-in-square type church, though without the characteristic dome in the center bay (and recalling in this way the later Khirbet el Mafjar). The former caldarium, at the

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771 Frantz 1988, 32-3 where the author also notes, quite interestingly for our purposes, that “although commonly associated with apodyteria, their [large vaulted dry rooms’] proliferation at a time when actual bathing facilities were so curtailed seems illogical. Another explanation is…that they were used as places of instruction by teachers.”
furthest northeast corner of the Scholastikia bath complex (just north of the ‘new caldarium’), had its immersion pools suppressed in favor of expansive hypocaust-heated floors. In this way, the space was presumably preserved for large assemblies in a dry, heated space that could be accessed fairly directly from the Embolos, straight through the new basilica. A series of inscriptions from the Scholastikia Baths reveal that it was frequently gifted with spoliated family groups of dedications (described above, from the cryptoporticus), as well as marble decoration and other donations by local notables from the early fifth to the late sixth or seventh century, when the last repairs to the bath’s water supply can be inferred from other sources. In Phrygian Hierapolis, the so-called Terme Grandi (presently the Archaeological Museum) was gravely damaged by an earthquake in the fourth century; in the course of successive restructurings in the fifth century, the apodyterion was expanded (perhaps coincident with conversion for ecclesial purposes), and its stone vaults replaced by new brick ones, their arches supported on ten spoliated columns brought from the dismantled Temple of Apollo. At Tlos in Lycia, two first and second century Roman baths were set

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772 For the Scholastikia bath and its phased changes, see primarily Miltner 1955, 1956-1958, 1959, and 1960, though the author here is also relying on personal observations from his time on site.
773 Foss 1979, 70 on the fragmentary and still unpublished archivolt inscription from the basilica, for one Ioannes, possibly a governor or a dedication to St John, who obviously had considerable local importance in Ephesus. And, see Pickett, forthcoming on pipes; the visibility of exposed pipes flanking Scholastikia’s statues might indicate that she was responsible for an overhaul of the bath’s water system, and/or the construction of the apodyteria basilicas in which her portrait was located.
774 Recent excavations indicate that the apodyterion was converted into a church sometime before coins indicate the building burned between 612 and 620; its shell was later used for housing in the twelfth and thirteenth century. See Sacchi and Bonzano 2012, 328. For the medieval use of the space for housing, discovered by earlier excavations, see Kiriliova-Kirova 1972.
on the south and west sides of an open area containing a temple. In late Roman times they were joined by an apodyterion constructed of spolia from the temple after its obsolescence, all of which may be related to the neighboring church complex built of related temple spoils on the north side of the palestra. \footnote{775}{Personal observation, July 2013.}

Whatever the general tendencies towards the architectural diminution of Late Antique baths as outlined by Yegül, we should not fail to note the enlargement and restoration of areas in Late Antique baths not for bathing, but for public assembly. This fact underlines the importance of the bath as \textit{locus publicus} and \textit{locus politicus}, to whose purposes we turn now in the following section.

\section*{4.8 The bath as locus politicus: a seat of government and a place of judgment}

This section considers the bath as \textit{locus politicus}, a place of public assembly and judgment, and a seat for representatives of the imperial and provincial government. From the very early years of the Principate in the first century CE, city baths were more than a place of entertainment and hygiene. Baths were important civic components of the ideal urban image, as well as a prime location for political activity, along with the forum and the temple. \footnote{776}{See Zanker 1994 for the political triumvirate of temples, forums, and baths in early Roman cities.} A place of judgment, called \textit{dikasterion}, is attested already in the first century CE at the gymnasium of Alexandria, which served as the occasional seat of the Praetorian Praefect, and
whose stoa was a place for the public affixture of legal notices, petitions (*libellos*), and subscriptions (*hypographai*).\(^{777}\) The use of baths for imperial business seems to have intensified after the third century, as centrally-appointed regional governors began to displace locally-elected curial authorities: the large and vaulted, ostentatiously decorated, and often heated spaces made for convenient places of business for governors who traveled between a province’s cities.

In 245 CE, a subscription preserved as *Papyrus Euphratensis* 1 was addressed to Mesopotamia’s governor Julius Priscus, who sat in audience at the baths of Hadrian in Antioch.\(^ {778}\) One might attribute the itinerant judge’s choice of venue to the lack of a praetorium, which was remedied only in 370 CE by the emperor Valentinian, according to Malalas, when Valentinian converted the city’s Commodian baths to function full-time as a praetorium, a testament to the bath’s suitability for such purposes.\(^ {779}\) Archaeological evidence attests to a similar conversion at Caesarea Maritima in Palestine, where a Late Antique praetorium was built atop a pre-existing bath complex.\(^ {780}\)

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\(^{778}\) ἐπὶ ὑπά(των) Αὐτοκρά(τορος) Καίσαρος Μάρκου ᾿Ιουλίου Φιλίππου Σεβ(αστοῦ) καὶ Μεσσίου Τιττιανοῦ πρὸ πέντε καλ(ανσῶν) Σεπτεμβρ(ίων) ἔτους τρίτου ἐν Ἀντιοχ(είᾳ) κολ(ωνίᾳ) μητροπόλει ἐν ταῖς Ἁδριαναῖς Θερμε͂ς . , from Feissel and Gascou 1989, here at 547 and Feissel and Gascou, 1995, at 79.

\(^{779}\) Malalas 13.30, Jeffreys and Scott trans., 184.

\(^{780}\) The precise date of this conversion remains unclear, though it certainly post-dated the second and third century phases of the bath; see Patrich 2011, 18.
Non-imperial political organizations also met in baths. The Church Council of Carthage in 411 convened in the basilica of that city's baths,\textsuperscript{781} and an inscription from the Great Baths of Sardis indicates that its Marble Court or so-called Kaisersaal of the palaestra was maintained at least into the sixth century, probably no longer as a space for athletics, but as the occasional \textit{topos} or meeting place of the town's elders, the \textit{gerousia}.\textsuperscript{782}

The practice of adopting baths as seats of government extended from the capital into the provinces. The Praetorian Praefect was known to sit in judgment at the Zeuxippos Baths in Constantinople around the same time: two incidents are especially revealing. The context of the first is an incident described by Socrates and Sozomen concerning the Chalcedonian Patriarch of Constantinople Paul I, during the Arian controversy. After Constans died in 350, his Arian successor Constantius ordered his praefect Philip to remove Paul from the city and replace him with Macedonius.

Socrates gives the following details:

\begin{quote}
“The prefect Philip, dreading an insurrectionary movement among the people, used artifice to entrap the bishop: keeping, therefore, the emperor's mandate secret, he went to the public bath called Zeuxippus, and on pretense of attending to some public affairs, sent to Bishop Paul with every demonstration of respect, requesting his attendance there, on the ground that his presence was indispensable. The bishop came; and as he came in obedience to this summons, the prefect immediately showed him the emperor's
\end{quote}

\textsuperscript{781} Leone 2007, 86-87.
\textsuperscript{782} SEG 36.1100 and Yegül 1986, 49.
order; the bishop patiently submitted condemnation without a hearing. But as Philip was afraid of the violence of the multitude—for great numbers had gathered around the building to see what would take place, for their suspicions had been aroused by current reports—he commanded one of the bath doors to be opened which communicated with the imperial palace, and through that Paul was carried off, put on board a vessel provided for the purpose, and so sent into exile immediately."\(^{783}\)

Violence threatens in this anecdote on three levels: the deception of Philip luring a bishop to the baths for business as normal; the crowds swarming in and around the baths periling the “violence of the multitude”; and the possibility of being kidnapped by the authorities through a door directly into the Great Palace itself.\(^{784}\)

Another revealing incident is recorded by Malalas, dated 457-459 CE:

“In the reign of Leo, Isokasios, the quaestor and philosopher, was accused of being a Hellene. He was originally from Aigai in Cilicia, but he was a landowner in Antioch the Great… (370) He held many offices with honour, for he was a very learned man. He was arrested at the emperor's command, living as he then was in Constantinople, and he was dismissed from his office. Then he was led into the Zeuxippon and was examined by the praetorian prefect Pousaios. Pousaios reproached him as he came before the tribunal, stripped and with his arms tied behind his back, "Do you see, Isokasios, the state to which you have reduced yourself?"

Isokasios replied, "I see, but I am not shocked, for I am a human being who has met with human calamities. But pass an honest judgment in my case, as you used to when you sat in judgment with me." When the people of Byzantion who were standing by and watching (371) heard Isokasios, they shouted many acclamations in favour of the emperor Leo, then they freed Isokasios and took

\(^{783}\) Socrates \textit{HE} 2.16.

\(^{784}\) Compare also with Theophanes AM 5971, in which, during Marcian’s revolt against Zeno in CE 478/9, Zeno’s brothers were arrested by Illos on behalf of Marcian while bathing at the Zeuxippon.
him from the Zeuxippon to the Great Church. He gave his name, was instructed and baptised, and then sent to his own country.”

Both incidents are evocative. Spaces for assembly in imperial-type bath architecture facilitated a combination of crowds, power-play, and exposure that could devolve into violence – and, given the proliferation of Late Antique references to murder and bodily harm taking place in baths – we might begin to understand how the especial qualities of confrontation in baths could potentially work to the detriment of authorities sitting in judgment there.

Even more than the theater or hippodrome, which attempted to distance elites from the ruckus with a *kathisma* or viewing stand\(^7\), baths were spaces of intensely personal, face-to-face encounters. Socrates describes how the episode at the baths did not go according to the praefect’s plan, but resolved otherwise after the crowd threatened violence: “Philip was afraid of the violence of the multitude.” The unruly crowd forced the praefect’s guards to seize the bishop and carry him away from the crowded baths through a back door. The account of Malalas is also curious for its inconsistency: the author incongruously indicates that the crowd was both shouting acclamations in favor of emperor Leo, while simultaneously defying his will. Where the account of Socrates threatens with the possibility of kidnapping under false pretenses into imperial custody, in the account of Malalas, rioters successfully removed the arrested man from imperial custody.

\(^7\) Malalas 14.38, Jeffreys and Scott trans., 203-4 from 459 CE.

\(^7\) But see also Malalas 16.4, Jeffreys and Scott trans., 221 from 494/5 CE, when “supporters [of the Greens] advanced against the excubitores, and approached the kathisma and they threw stones at the emperor Anastasius...the crowd set fire to the Chalke, and the colonnade was burned as far as the imperial kathisma.”
custody while he stood under the gaze of his judge. The crowd settled the
dispute on their own terms, and possibly saved Isokasios’s life by baptizing and
exiling him themselves.

Emperors also used baths as places of audience. The *Scriptores Historiae
Augustae* record that the emperor Valerian sat for audience at baths in
Constantinople in the later third century, surrounded by military and civic officials,
where he gave gifts and conferred titles on those who had served him well. 787

Rather later, an imperial rescript dated 365 CE was issued by Valens and
Valentinian *in basilica Thermarum Commodianarum* from an unspecified city,
possibly Antioch.788 These patterns of imperial audience in baths became
institutionalized in the Early and Middle Byzantine state, during which time
emperors quite commonly sat for audiences in the bath complexes that grew up
after the fifth century in Constantinople at the Great Palace, Blachernae, and
Pythia. References to the murder of Roman and Byzantine emperors in (usually
palace) baths should be mentioned here, but pertinent to our discussion is the
simple fact that conspiracies rather than spontaneous crowd violence appear to
be responsible for these regicides.789 Such conspiracies could however play out
in public baths: during the reign of Valens, Ammianus Marcellinus tells us, a

787 *SHA* Aurelian 10 and 13, ed. and trans. Magie, 213 and 217-8 for Valerian Augustus holding
court with officials in the public baths of Byzantium.
788 Antioch’s Commodian baths were converted to use as a praetorium in 370 CE by Valentinian
(Malalas 13.30, Jeffreys and Scott trans., 184); if so, the issue of this law from the Commodian
Baths probably means it was being used as a praetorium before the final, formal conversion took
place. For the reference, see Baviera 1940, 2: 610.
789 For instance, Constantine famously killed Fausta by shutting her up in the praefurnium of a
bath (Evagrius Scholasticus 139); while Constans II was murdered by an attendant in palace
baths at Syracuse, see Theophanes AM 6160.
young man “in the bath…was seen to touch alternately with the fingers of either
hand first the marble then his breast, and to count the seven vowels, thinking it a
helpful remedy for a stomach trouble. He was haled into court, tortured, and
beheaded.”

The Late Antique tendency to subsume baths into both palace architecture and
elite housing, and to diminish their scale from the monumental norms of imperial
bath buildings, should be understood as the reflection of a desire not only for
social intimacy and perhaps bodily modesty, but safety from political
manifestations and violence, too.

4.9 The bath as a locus for political manifestation

Closely related to the place of baths as a seat of imperial power and provincial
governance, Late Antique sources also reveal that baths were – along with
hippodromes and theaters – a primary setting for public assemblies and political
manifestations that occasionally devolved into stasis, manifested by riots and
public disturbances. “Scholarship has tended to focus on the role of the theatre”
during these events because of the role of the so-called Circus factions or
Theater Claques, even if an examination of bath-riots in Antioch, for example,
reveal that baths also played an important part both for the factions and the

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790 Ammianus Marcellinus 19.2.28.
topographic context of the riots generally. We can recount bath-related riots at Antioch as follows, to make the point:

1) The so-called Statue Riot of 387 CE is one of the most famous riots of antiquity, a bloody retaliation against tax hikes on the curial class that culminated in the abuse and mutilation of statues of the emperor and his family, dismembered and dragged through the streets of Antioch. Before the attack on the imperial statues that marked the culmination of the riots, Libanius writes that the rioters “trooped out to the colonnade in front of the courtroom, raised their clamour anew, and stripped off their jackets. That section of the populace which was as yet unaffected began to stir into action…they proceeded to the bath nearby, and used their knives to cut the ropes, from which were suspended the lamps that give us our light at night time.” R. Browning puzzled over the meaning of this vandalism: were these lamps inside or outside the bath? If the lights were outside, then they were part of the famous scheme of Antiochene street lighting described by Libanius and Ammianus Marcellinus. These lamps were paid for by a levy of oil from working citizens, jostled out of their beds and made to relight the lamps in front of their houses with oil they couldn’t afford. On the other hand, if these lamps were inside the baths, then they were either paid for by the

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792 On violence towards imperial statues at Antioch in 387 CE, see especially Anderson, forthcoming. For the relevant sources see Orations 20-22 by Libanius [= Libanius, Selected Works: Selected Orations, trans. Norman, vol. 2], and Chrysostom's twenty-one Lenten Homilies, for which see John Chrysostom, Homiliae XXI de Statuis ad populum Antiochenum habitae, PG 49 cols. 15-223.
793 Libanius, Or. 16.41.
794 Amm. Marc. 14.1.19.
795 Libanius, Or. 33.34-37.
imperial government as a remittance for urban bath costs, or they were covered by a tax or duty/liturgy on the curiales themselves. Browning sagely suggested that “we can only guess just what this act meant to those who took part in it, but we need not guess blindly.”\footnote{Browning 1952, quote from 15 n. 37.}

2) A riot that took place sometime at the end of Zeno’s reign, perhaps in 498 CE, featured a starring role for a bath attendant named Olympius. After being hit in the head with a rock, the consularis Syriae Thalassius identified Olympius as the stone-thrower. Either Thalassius frequented the baths where Olympius worked – the Slavonic version of Malalas says that the bath was named for one Urbicius – or as Glanville Downey suggested, Olympius was “a well known ring-leader [of the Greens].”\footnote{For this account with the bath-attendant Olympius, see Downey 1961, 498. The relevant texts are Malalas 15.15, Jeffreys and Scott trans., 218 and the fragments from Excerpta de insidiis, 166-167.} The two roles are not mutually exclusive. Thalassius fled back to the Praetorium where he ordered his guards to seize Olympius and bring him back for interrogation. Olympius was found and retrieved, flogged and examined. When the Greens heard of his arrest, they attacked the Praetorium, rescued the prisoner from custody, and set the building on fire. We should remember at this point, of course, that the Praetorium at Antioch was itself a converted bath building, the former Thermae Commodianarum.\footnote{Malalas 13.30, Jeffreys and Scott trans., 184.}
3) The last riot on record from Antioch transpired in 507 CE. The charioteer Porphyrius Calliopas arrived at Antioch to ‘take over the stable of the Greens,’ and after some victories on the track, violence broke out during the celebration of the Olympics, beginning with an assault on Jews who were attacked for their association with the rival Blues. The chief of police (praefectus vigilum) and his entourage of Gothic toughs killed one of the rioters near the altar inside the Church of St John, and when the Greens found their comrade’s body, they rushed to confront his attackers: “at the bath known as the Bath of Olbia…they were met and joined battle,” recounts Malalas. The episode ended with the praefectus vigilum’s disemboweled body draped over a bronze statue in the antiforum.

Antioch’s baths thus provided settings and actors for the city’s riots during Late Antiquity. Baths were subsequently shut down by the authorities after riots, either to dampen unrest by preventing conspirators from congregating in public places, and/or to punish cities as a whole by depriving them of metropolitan status and their symbols and privileges of imperial favor, like theaters and baths. Similar events are recorded by Evagrius Scholasticus at Alexandria in 451-3 CE. When the baths at Antioch were closed as punishment in 387 CE, Libanius and Chrysostom spoke of it as the cause of much consternation and pain among the

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799 See Malalas 16.6, Jeffreys and Scott trans., 222-3 with discussion by Downey 1961, 504.
800 Vasiliev 1948.
801 French 1998, 484.
802 Evagrius Scholasticus 51.
citizens of Antioch. Both authors, however, recognized that such punishment was mild compared to the much-feared descent of imperial troops on the town.  

This brings us back to the circus factions: rather than simply linking the narrative of the Antioch riots to the theater and hippodrome, we can also consider how the factions were connected with city baths all over the empire. Indeed, at the heart of imperial power in Constantinople, the Zeuxippos baths were constructed immediately adjacent to the Hippodrome, separated by the open area called Dihipion, but joined together by celebrations for the factions. As late as 713 CE, Theophanes records how the emperor Philippikos, on the august occasion of his birthday, celebrated the victory of the Greens by banqueting and bathing “with citizens of ancient lineage” in the Zeuxippos baths.

Acclamations for the factions may also be found inscribed inside or by the entrances of baths, presumably carved by customers. At Ephesus, an inscription for the Greens was reported outside the Scholastikia Baths. At Tyr, home to one of the best preserved hippodromes from the Roman world, baths for the blues and the greens flanked each side of the hippodrome, as identified by mosaic inscriptions. At Alexandria, the Kom el-Dikka bath is connected by a corridor to two auditoria, in which a large series of factional inscriptions were discovered inscribed on the backs of stone seats. Their date – 608-610 CE –

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804 Theophanes AM 6205 for CE 712/13.  
805 See IvE 1192, for the Greens “beim Variusbad.”  
may be shared by additional inscriptions in the Kom el-Dikka baths themselves, set on green marble slabs and reading [τόπος] πρασήνον, place of the Greens, simultaneously an acclamation and a pun on the color of the marble employed.\textsuperscript{807}

This is tantalizing evidence for the involvement of the circus factions in bath management and patronage, which adds yet another layer to the existing gender, ethnic, or religious segregation dynamics that are known to have played out in Late Antique baths.\textsuperscript{808}

\textbf{4.10 Baths, sedentarization, and technology transfer}

We have seen how baths helped constitute power and social distance, and also how commemorative inscriptions in baths responded to \textit{xaris}, or envy, with best wishes for the health of a building patron or the bathers themselves. The idea with \textit{xaris} inscriptions was that visitors might enjoy the baths and be healthy, rather than envy the bath’s patron for his or her wealth that was invested in its construction. Yet baths \textit{were envied}, not only by Romans (which partially explains their role as settings for urban stasis, as discussed above), but by neighboring cultures, too.

\footnotesize\textsuperscript{807} For the auditoria inscriptions, see Borkowski 1981 with the discussion in \textit{SEG} 31.1485-1510. For the factional inscription in the Kom el-Dikka bath, see \Lukaszewicz 2006, 127-134 = \textit{SEG} 56.1975.

\footnotesize\textsuperscript{808} On segregation, see above sec. 4.5.
Outside the empire’s borders – in Sasanian Persia, Ghassanid Arabia, the Hunnic or Slav Balkans, and Gotho-Lombard Italy – Late Antique sources reveal how baths were the objects of desire and envy. Coveting this architecture successfully from outside the Roman empire meant acquiring skilled labor and new technologies from within. Baths were bundles of advanced technologies – expansive vaults, large glass windows, water-proof cement equally useful for bridge and dam construction, hypocaust arrangements for heating rooms, distributing water in pipes or raising it mechanically, and so forth. All of these devices were crucial in both utilitarian and display-oriented water management practices, as for instance prevailed in palace contexts, not only for the emperor but also for caliphs, khans, bishops, and governors. Consequently, baths were a locus for desire and diplomacy, envied by foreign rulers that came from cultures lacking these specific technologies and capacities for architectural production. Baths were thus diplomatically useful as exports, along with the rest of Late Roman and Byzantine water management expertise.

In a famous passage describing the palace of Attila the Hun, the historian Priscus relates how baths on the site were built by a Roman taken hostage during a battle at Sirmium:

“[The palace] was constructed of timbers and smoothly planed boards and was surrounded by a wooden wall which was built with an eye not to security but to elegance. The buildings of Onegesius

Note the story (Wars 7.1.39–42) of a conflict between the wives of two Gothic commanders, initiated by undue display of wealth and conflicts over social status in a bath.
were second only to those of the king in magnificence, and they too had a circuit wall made of timbers but not embellished with towers, as was Attila’s. Not far from this wall was a bath which Onegesius, whose power amongst the Scythians was second only to that which Attila had built, fetching stones from Pannonia. For there is neither stone nor timber amongst the barbarians who inhabit this area, but the wood that they use is imported. The builder of the bath had been taken prisoner at Sirmium, and he hoped to gain his freedom as a reward for his inventive work. But he was disappointed and fell into greater distress than slavery amongst the Scythians. For Onegesius made him bath attendant (prībatos), and he waited upon him and his followers when they bathed.”

Hunnic culture lacked baths not because stone, ceramic, and timber were unknown as building materials, but because the Huns lacked the specific combination of components made from these materials that were required for bath construction – like glass, lead pipes, hypocaust and flue tiles, vaulted architecture, or water-mills and lifting devices.

Sasanian culture, on the other hand, forwent baths because of the purificatory difficulties created by using fire to heat water. While Priscus suggests that Attila’s palace was only equipped with a bath because an engineer had been taken prisoner, and that this prisoner allegedly wished to better his circumstances by lending his abilities to the project, Pseudo-Joshua is more straight-forward: the Persian king Kavad built baths in the Roman style because he had ‘experienced the benefit of bathing’ personally, and presumably enjoyed it.

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810 Fragmentary Classicising Historians, 265.
Joshua the Stylite provides two related anecdotes concerning the export of bath technology to the Sasanians: the first describes how Balash, who reigned over the Sasanians between 484 and 488 CE, was despised by his soldiers “because he did not have the money to support them, and [by] the magi … because he was annulling their laws and wanted to build municipal baths for bathing.” As Pseudo-Joshua’s translator Frank Trombley noted for this passage, Sasanian religious texts like the *Vision of Arday Viraz* considered taking hot baths to be a sin, because it polluted fire, a manifestation of the divinity Ahura Mazda. Another Pahlavi text, the *Denkard*, specifies that bathing was permitted so long as the fire was ritually protected.811 Pseudo-Joshua also reports that, a bit later, in the early sixth century, since Kavad "had gone into the bath-house (demosion) of Amid when he captured (the city), and experienced the benefit of bathing, the moment he went down into his own country he gave orders that baths should be built in all the towns within the Persian domain."812

Procopius gives us another example of technology export for Late Roman baths, in this case to North Africa, describing how Leptis Magna was graced by Justinian with “baths and all the other improvements [that] gave it the character of a city. The barbarians who live close by, those called Gadabitani…he has now made Christians” (*De Aed.* VI.iv.11). In this sense then, bath construction on the

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811 *Chronicle of Pseudo-Joshua the Stylite* 19, Trombley trans. 17, n. 77 with references.
812 Idem, 91, sec. 75.
borders with an antagonistic tribe becomes an explicit component in Procopius’s process of converting, acculturating, and pacifying non-Romans.

A section of Constantine VII’s *de Ceremoniis* may reflect skilful Late Antique diplomatic practice when it advocates that, when preparing for the visit of important Persian diplomats, “the bath of the house, in which he is to live, has to be made ready…in order that whenever he wants, he himself and those with him can take a bath, and the bath is at their disposal alone.” To make such uniquely Roman pleasures available to diplomats was likely a good strategy in the quest to win friends and influence people, which could be enacted on the level of Roman state service for foreign diplomats in palaces or embassies, or with the construction of public baths for demographically diverse border towns like Leptis Magna.

Surely the widespread construction of baths in fortresses on the Limes Arabicus was part of a similar effort, particularly when these baths were located extra muros outside of the fortifications, not just for fire-protection, but probably also so that they could be used by visiting Lakhmids, Salihids, or Ghassanids. The transfer of hydraulic technology was an ongoing feature of Roman-Persian relations, of which baths are just one part. When Chosroes sacked Antioch in

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813 *De ceremoniis aulae byzantinae* 89 = Reiske ed. 398-410, cited from Dignas and Winter 2007, 245.
814 Tabari, *Ta’rih* I. 827-8 describes how Shapur captured the emperor Valerian near Antioch and forced the emperor and his companions to build a bridge-dam at Sostar/Shushtar “one thousand cubits” wide, which survives today in Huzistan province, Iran. It is sometimes called Band-e
541, and famously removed its citizens to a “New Antioch” that he had constructed complete with hippodrome and baths, he may have been doing more than making them comfortable – he was importing technical skills to replicate institutions and architectural features of the Roman world that were in demand in Sasanian cities and towns.\textsuperscript{815}

The preceding examples shed light on how bath buildings were not merely an indispensable component of Roman urban identity; they were sought-after bundles of technological prowess and products that served as enticements and sources of envy in diplomacy outside the Roman world. The reputation of Byzantine hydraulic engineers and technology abroad survived into the Middle Ages. A chapter entitled “Rare Imported Merchandise, Products, Slaves, Stones, etc.” from the ninth century Baghdadi merchant’s handbook by Pseudo-Jahiz records that hydraulic specialists were still listed, at that time, among the most coveted skilled laborers arriving from Byzantium (in addition to agronomists, marble workers, and eunuchs).\textsuperscript{816}

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\textsuperscript{815} Kaisar. See Ghirshman 1962, 137; and O’Connor 1993, 130. Roman experts in irrigation systems were also engaged in the area, in addition to the mosaicists, sculptors, and architects whose distinctly Roman work famously survives from Bishapur and Ctesiphon. For Sasanian importation of skilled Roman workers generally see Dignas and Winter 2007, 254-6 and on irrigation, Rahimi-Laridjani 1988.

\textsuperscript{816} See Pellat 1954, 159, cited by Cutler 2001, 255.
4.11 Thermal baths after antiquity

Thermal baths in antiquity have long been a topic of scholarly interest. Most recently, Dvorjetski\(^{817}\) has dominated the subject, addressing the viability of thermal baths in the Levant with more than twenty articles and a monograph over the last two decades, in which she was concerned chiefly for the following: to consider the appeal of thermal baths as places of healing in classical antiquity, frequently associated with the divine; to establish the frequency of women’s presence in thermal baths, together or separately from men; to establish the frequency of military presence in sites associated with thermal baths; and to investigate the survival of thermal baths from antiquity into the medieval period, as a consequence of their Christianization.

Dvorjetski’s moralizing approach – which largely follows Yegul’s example\(^{818}\) – looks for inconsistencies in the testimony of church fathers and rabbis, who simultaneously decried the (sexual or idolatrous) dangers and pleasures of bathing, but also participated themselves, and recognized the salutary benefits of baths for cures and healing. Though it is not my intention to discard Dvorjetski’s conclusions, the weakness of the moralizing or religious approach to thermal bathing after antiquity can be quickly recognized and re-considered even in the area of her focus, the Levant, with a look at archaeological evidence for hot spring baths at Pella, Hammat Gader, and Tiberias. In these locations, we should

\(^{817}\) Dvorjetski 2007, a summation and expansion of her earlier articles, with references.

\(^{818}\) Yegul 1992.
pin the continuity or discontinuity of thermal spring baths not on pagan versus Christian dialectics, but rather on external factors, such as environmental degradation and the administrative priorities of the Umayyads after the early Islamic conquests.\textsuperscript{819}

At Pella, the city’s forum and baths were constructed around a significant warm thermal spring, which is still used today for local supplies by a pump facility.\textsuperscript{820} Thermal baths here were multi-phase, early Roman and Byzantine, but because of problems with elevated water levels, only a small portion of the Roman phase was recovered in excavation.\textsuperscript{821} Talmudic texts indicate the continuity of the baths at least into the third or fourth century,\textsuperscript{822} even while the expansion of agriculture in the surrounding valley during Late Antiquity led to the acceleration of siltation processes and the gradual elevation of the water table. These processes were detrimental to the forum area of Pella, which was no longer usable by the early seventh century.\textsuperscript{823} The last use of the thermal baths here cannot be dated precisely by archaeological evidence, but given the widespread continuity of nearby baths in the seventh century (e.g. at Beth Shean, Tiberias, and Hammat Gader), the Pella bath’s abandonment should probably be related to these larger environmental changes that flooded the forum area with alluvium,

\begin{itemize}
\item \textsuperscript{819} On Umayyad bathing see most recently Tohme 2011.
\item \textsuperscript{820} Smith 1973, 88-91.
\item \textsuperscript{821} Smith and Day 1989, 4.
\item \textsuperscript{822} Smith 1973, 57-58, citing the Jerusalem Talmud 6.1.
\item \textsuperscript{823} Ibid., 8.
\end{itemize}
rather than any direct consequences of the Islamic conquests or any perceived concerns about the morality of hot-spring bathing.

On the other hand, the continuity and aggrandizement of hot-spring bathing at Tiberias and Hammat Gader should be related to continued investments by the Umayyads in bathing, coincident with the elevation of nearby Tiberias to the status of capital of Jund al-Urdunn after the Islamic conquests. Generally, it is agreed that the continued maintenance of hot spring and artificial baths in the Umayyad period was a consequence both of the Islamic interest in bodily cleanliness and ablutions, in addition to their investments in the especially Hellenic value of baths in palace contexts (as in the Byzantine world), as a marker of sophistication and technological prowess. Probably most famous, for instance, are the baths at Qusayr Amra, where the bath could only be accessed through a reception hall; its water was supplied from a well, raised by a monumental gear-driven saqiyah, to which the caliph was compared in contemporary court poetry.824

The 4800 m² Roman thermal bath at Hammat Gader (also called Hammat Tabariyeh) was excavated by Hirschfeld between 1979 and 1982.825 Hirschfeld’s

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824 See Tohme 2011 for a recent re-assessment of Qusayr Amra.
825 We should note here too that Eusebius describes the elevation of Hammat Gader to the status of bishopric (Onomastikon 74.10.), and that the city attracted the attention of Empress Eudokia in the fifth century, who visited sometime between 438 and 455, and left behind an epigram inscribed in stone that praised the clibanus, the source of the bath’s hot spring, for which see Di Segni 1997, 228-33, #49.
final report concluded that the Umayyad phases\textsuperscript{826} at Hammat Gader were characterized by “a systematic blocking of passages and narrowing of architectural spaces,” “inferior quality of the walls,” and “crude” constructions, before the complex was entirely destroyed by the earthquake of 749.\textsuperscript{827} However, a finely-detailed reassessment of the site’s history by Magness pushed Hirschfeld’s chronology forward, concluding that structural changes in the bath that Hirschfeld had associated with the Byzantine period (his Phase II), should instead be reassigned to the Umayyad period.\textsuperscript{828} These changes, which included the infilling of large pools and small hip-tubs (e.g. in Areas C, D, and E), nevertheless preserved the functionality of the pools in the so-called Hot Spring Complex (focused on Areas A and G). At least some of these changes may be associated with the extraordinary Greek-language inscription commemorating repairs ordered by the caliph Mu’awiya, dated to 662 CE.\textsuperscript{829}

At the capital of Jund al-Urdunn – Tiberias – hot springs are mentioned by Ya’qubi (c. 891) and Istakhri (c. 951), the latter describing how hot spring water was piped in for ablutions at the mosques. Maqdisi (c. 985) describes “boiling springs, which supply most of the hot baths of the town. A conduit goes to each

\textsuperscript{826} Hirschfeld 1997, 11-13 for the site chronology in overview.  
\textsuperscript{827} Hirschfeld 1997, 147-8 for Hirschfeld’s Umayyad phase 3.  
\textsuperscript{828} Magness 2011, 153-162.  
\textsuperscript{829} For the inscription see Di Segni 1997, 238-240 #54; note also the inscription dated to 740 CE from the same phase, Hirschfeld 1997, 270-2, #3. The former reads “In the days of Abdallah Mu’awiya, the commander of the faithful, the clibanus of the (baths) here was cleared and renewed by Abdallah son of Abu Hashim (or Abu ‘ASim), the governor, in the month of December, on the fifth day, Monday, in the 6th (year) of the indiction in the year 726 of the colony, according to the Arabs the 42nd year, for the healing of the sick, under the care of John the Gadarene, the steward.”
from the springs, and the steam of the water heats the whole building, *whereby they have no need of artificial firing.*" The more pragmatic advantages of a capital built on hot springs were hard to miss. Excavations at Tiberias have not located any of the hot spring baths reported by the literary sources, though they have recorded the Umayyad maintenance of Roman and Byzantine drainage systems and pipes in town.

Despite Dvorjetski’s title (which includes ‘Eastern Mediterranean’) her work entirely excludes Anatolia, which is rich in thermal springs. Thermal tourism is today a big business in the Republic of Turkey, and consequently commercial development in many locations blessed with natural hot springs has almost entirely obliterated the remains of older Late Antique or medieval Byzantine baths. Berger has the last word on this topic: in a recent publication, he stated simply that “the continuous use of a number of hot springs in Anatolia…is quite well documented throughout the Byzantine period,” before referring in more detail to hot springs with recorded use in the medieval period, at Dorylaion/Eskisehir, Basilika Therma/Sarikaya in Cappadocia, and at Pythion/Yalova.

I would like to move the discussion beyond the subject of dis/continuity, and in the following section explore how thermal baths might have contributed to a redefinition of settlement hierarchies and patterns in the early Byzantine period.

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830 See Stacey 2004, here at 3 for Islamic sources on the hot springs of Tiberias. The sources themselves may be found in translation in LeStrange 1890, 334-5.
832 Berger 2011, 59, and see also Berger 1982, 72-85 on hot springs.
From the fragmentary but evocative evidence of archaeology and the accounts written by nineteenth century travelers, the general picture is that Roman bathing at artificially supplied baths in cities was supplanted not only by monastic baths, but by thermal spring sites, which grew from small sanctuaries into cities with bishops and significant military activity. Such sites may have been exceptions to the otherwise hard and fast rule that exclusively associated baths with monasteries and palace contexts after the eighth century.833

Several phenomena should be introduced for consideration:

1) There is bountiful evidence for the aggrandizement of previously small, isolated hot spring sites into proper towns with bishops after the fourth or fifth centuries. Allianoi is perhaps the most famous and best recorded example, after the recent salvage excavations and conservation campaign that nevertheless failed to save the site from inundation after the construction of the Yortanlı Dam was completed in 2011. A 9000m² thermal complex was built over hot springs after the second century CE, roughly coincident with the construction of the Asklepeion in neighboring Pergamon. The bath was maintained into Late Antiquity and the Byzantine period with surprisingly few alterations, to judge from what has been published thus far (the ceramics are due a proper examination, in their depot at the Bergama Museum). The surrounding settlement, however, grew and changed in character significantly during Late Antiquity, with the

833 On which see Berger 2011.
addition of a basilican church, middling residences, and workshops for ceramics, glass, and metal production.\textsuperscript{834} Apart from a significant collection of sixth century coins,\textsuperscript{835} occupation deep into the seventh century is indicated by coin finds from the basilica, issued in the reigns of Phocas (r. 602-610), Heraclius (r. 610-641), and Constans II (r. 641-668), before an apparent resumption of activity under Isaac II (r. 1185-1195 and 1203-1204) in the Komnenian period, that continued steadily until the 1950s.\textsuperscript{836}

Elsewhere, examples of previously isolated hot springs growing into proper towns are hardly lacking. For instance, ancient Eudoxias / modern Hamamkarahisar – close to Germia at the north foot of Arayit Dağı/Mt. Dindymon in Galatia – was a hot spring town named after the daughter of Theodosios II, the later wife of Valentinian III. A bishop representing Eudoxias (subordinate to nearby Pessinus) appeared first as a signatory at church councils after Chalcedon in 451, which suggests the town’s elevation to city status at the time it was renamed, during the reign of Theodosios II. Bishops were maintained, according to the \textit{Notitia}, until the 9\textsuperscript{th} century.\textsuperscript{837} Southwest of the town is a

\textsuperscript{834} See excavation reports in Yaraş 2005 and 2006, the latter with plan of the baths on 304, and a site plan in \textit{KST} 29.2 (2007), 80.
\textsuperscript{835} Tekin and Erol-Özdibay 2012, here at 349. Generally, the Roman period material is rather poorly represented, while coins issued between the reigns of Constantine and Justin II make up the majority of the coins published so far, which in total number over 7000.
\textsuperscript{836} See \textit{KST} 29.2 (2007), 77.
\textsuperscript{837} See \textit{TIB} 4.163 for references.
modern Turkish thermal bath, whose 8 sided monolithic pool is almost undoubtedly a spolium, likely of an earlier bath in the same area.  

Another hot spring town in Galatia, at Myrikion, was probably elevated to city status in the first half of the fifth century, entitling the thermal spring town to a bishop, who with his successors appeared at councils between 451 and 879/80. Myrikion’s spring is in the headwaters of a stream that flows northwest to join the river Ankara. Ainsworth visited the site, and estimated its temperature at 125 degrees Fahrenheit. Around an early Turkish bath, “inclosed [sic] in the usual Mohammedan style,” Ainsworth reported “numerous Byzantine tombstones, cornices, pillars and other fragments” (ibid), while Anderson “saw no end of stones suitable for Christian architecture, moulded blocks, and short pillars of the characteristic Byzantine shape with capitals to match.” These reports were confirmed by Perrot, Guillaume, and Delbet, who also described a walled enclosure with spolia and ruins, but added evocative details of elaborate, carefully cut masonry, including two large basins under a dome on four pendentives.

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838 Hamilton 1842, I: 436f and Waelkens 1979. Just south of the bath is an early Ottoman mosque which also contains extensive Roman and Byzantine spolia.  
839 TIB 4.208.  
840 Ainsworth 1842, I: 144-5; Ainsworth calls the site Haimaneh.  
841 Anderson and Crowfoot 1899, 95.  
842 Perrot, Guillaume, and Delbet 1872, I: 275 as follows: “Le basin lui-même est au centre d’une enceinte carrée et, sous la muraille du moyen âge en mauvais blocage, on aperçoit en plusieurs endroits, et notamment à l’angle nord-est et à l’angle sud-ouest, les restes d’une enceinte d’un bel appareil hellénique. À peu de distance de là, on distingue à terre le périmètre d’un grand bâtiment rectangulaire qui pourrait avoir été une église. Les basins, tous les deux rectangulaires, sont du bas-empire ou tout au moins du temps des sultans seljoukides; la construction en est
This last description raises the second point, namely that 2) a number of hot spring locations contain or contained Late Antique and Byzantine architectural sculpture. We have already discussed, following Brandt, the exchangeability of architectural and linguistic vocabularies for church and bath architecture. Architectural sculpture should be considered as an extension of this relationship, particularly after churches and baths became increasingly intertwined after the fourth century, by virtue of church investments in baths for real estate portfolios, bath-church conversions, and presumably artisans and builders that worked on both baths and churches. That churches and baths should have contained indistinguishable capitals and columns, mosaics and opus sectile, or even massive monolithic basins, should therefore come as no surprise. The marbles though, being mobile, are as spolia the more difficult to relate to one genre of architecture or another. While Roman or Byzantine architectural spolia alone, embedded in an Ottoman bath, is by no means a guarantee that an Ottoman bath replaced a Byzantine predecessor – for instance the Eski Kapıçası in Bursa, with its Byzantine capitals, is most certainly not a modified Byzantine bath – the combination of architectural sculpture and historical sources indicating a Byzantine bath are at least reasonable indicators of long-term occupation on a hot spring site. Furthermore, the widespread notices of a variety of architectural sculpture at hot-springs – including tombstones – should be evidence enough of

**belle et soignée. Les degrés par lesquels on y descend sont en pierre de taille ou en marbre...La coupole, en briques épaisse, est portée par quatre pendentifs.”**

843 See again Brandt 2011 on the synonymous architectural and linguistic vocabularies of baths and churches, especially but not exclusively baptisteries.
the phenomenon argued here, that previously isolated hot-spring sites became the centers of larger settlements in Late Antiquity.

3) Military activity is consistently associated with thermal sites. Dvorjetski related the presence of military largely to wounded veterans seeking healing treatments, but – especially in the Byzantine period – we might do better to simply relate the presence of military to natural abundance, which made for cheap places to bathe, without need of the complicated mechanisms of civic support that had previously financed artificially supplied baths in Roman cities. One example, from the period of the ‘third century crisis’, comes from the reign of Gordian III at Skaptopara in Thrace, where an inscription records a third-century petition sent by villagers to the emperor: the village was situated near thermal springs with a regular market, between two military camps, and was subjected to unpaid and forced requisitions, as well as the quartering of soldiers: “because of the thermal springs the provincial governors but also your procurators come here to stay.”

In the Byzantine period, Dorylaion / modern Eskişehir is perhaps the best example of the relation of the military to thermal baths in Anatolia. Located on the Tembros / Porsuk river, Dorylaion has been an important settlement since the Hellenistic period, well known for its thermal baths since Roman times. In the early Byzantine period Dorylaion belonged to province Phrygia Salutaris, and

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844 See Hauken 1998, #5.
was a garrison for a division of the scholae (until Justinian moved them to Thrace),\textsuperscript{846} besides serving as a transit point on the Pilgrim’s Road from Constantinople to Ankara and thence to the Holy Land. The city was repeatedly attacked by Arab invaders after Mu’awiya’s first incursions in 651/2, and the city’s baths are explicitly mentioned in connection with an account of another such attack in 779.\textsuperscript{847} Dorylaion served as the heart of Artabasdos’s revolt against Constantine V in the 740/1.\textsuperscript{848} The city continued to have importance in the Middle Byzantine period for military operations as an aplekton, and presumably also for its hot-spring baths in the town center, an Ottoman incarnation of which was destroyed in the Greek-Turkish war.\textsuperscript{849} Humann-Puchstein observed an incredibly large monolithic basin in these baths, which reportedly held 50 men simultaneously (so large that he was unable to measure it, on account of the bathers occupying the basin when he visited, much to his disappointment), in addition to columns and decoration that he thought were of Byzantine origin.\textsuperscript{850}

\textsuperscript{846} Hoffman 1969/70, 280 and 298.
\textsuperscript{847} On the baths connection to the 779 raids see Tabari II.1197, trans. in Brooks 1900, here at 735: “Al Hasan the son of Kahtaba made a summer raid with 80,000 regulars…and he reached the hot springs of Adhruliya (Dorylaion).” This account is paralleled by Theophanes AM 6271, see also Lilié 1976, 65, 118, and 171f.
\textsuperscript{848} Theophanes AM 6233
\textsuperscript{849} Radet 1895, here at 496-7 for the destruction of these baths.
\textsuperscript{850} Humann-Puchstein 1890, 18: “Der antiken Stadt ist nichts mehr erhalten; nur das heisse Bad in der Unterstadt mit seinem kolossalen Wasserbecken und seinen Säulen scheint abgesehen von der türkischen Bedachung byzantinisch zu sein. Wir fanden wohl fünfzig Menschen in dem dampfenden Bassin badend, so dass wir, zudem bei der im Raume herrschenden Dunkelheit, den Bau nicht näher untersuchen konnten.”
Another Byzantine thermal spring with significant medieval military activity can be found at modern Sarıkaya, in Cappadocia. Basilika Therma was also aggrandized as a city in Late Antiquity, with its first bishop recorded as late as the council of 451, when *Firminus Thermis* attended the Council of Chalcedon – several other bishops are known from the later fifth and sixth centuries, around which time Hierokles called Basilika Therma the third city of Cappadocia Prima. Signatory bishops continued to attend councils between the seventh and thirteenth centuries. Apart from the insecurity of the conciliar lists, other Middle Byzantine activity can be securely placed at the site: a lead seal of Theodoros ἀπὸ ἐπάρχων is illustrated by Chantre; and the fields near town were the scene of a major battle between Bardas Skleros and Bardas Phokas in 978. In town, what little remains of the hot spring bath itself are the remains of a two-storeyed Roman façade, conceivably Antonine in date, with alternating round and square blind niches. The façade is set behind a large catchment basin for the hot spring. The site has recently reopened to excavation, though the author at the time of writing had not seen resulting publications.

All this is not to overlook how, to return to Dvorjetski’s concerns, Christianization may have affected formerly pagan sanctuary sites with thermal springs. In particular, the Anatolian evidence provides several examples of how Christian aetiologies grew up around formerly pagan sanctuaries, imbueing them with new

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851 See *TIB* 2.157.
852 Chantre 1898, 118.
meanings and histories that explained their presence and origins in a Christianized landscape.

Agros Thermon / Hüdai Kaplicas, for example, is today a vast center for modern commercial bathing resorts, outside of Afyonkarahisar in Phrygia. After antiquity, however, an unusual primary source for ancient and late ancient bathing at the site comes from the Life of Abercios, a late fourth or fifth century compilation of an earlier imperial epitaph belonging to the Bishop Abercios of Hierapolis, and an epistle from Marcus Aurelius of 177-8 CE to one Pollio of Hierapolis, which thanked Pollio for his help in reconstruction after an earthquake. The emperor asked Pollio to send Bishop Abercios, called “a pious man with the ability both to drive out demons and perform other acts of healing,” to Rome to treat his daughter Lucilla, who was ill. The vita then records how Abercius was disturbed by the lack of a place for bathing that could be used by inhabitants of the Pentapolitan plain, at Agros Thermon, and so he knelt in one place and prayed for the creation of a thermal spring, which subsequently appeared. The holy man then instructed the locals to build deep pools around the place where the waters welled up. Thönemann convincingly interprets the life of Abercios as a Christian aetiology to explain features of local hydrogeology, as well as the donation of the thermal spring bath at Agros Thermon, which

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854 Pococke 1745, 81-2 saw three Turkish baths fed with hot springs here, with “a strong chalybeate taste, [which] seem to be very good, and are greedily drank by the people of the caravan who pass by.”
855 For the inscription transcribed with commentary see Wischmeyer 1980.
856 Quoted from Thonemann 2011, 85.
Thönemann speculates had been originally donated by the empress Faustina.\footnote{\cite{Thonenmann 2011, paraphrasing here from 86-8, an eco-critical discussion of the text as Christianizing aetiology of landscape; note also Dölger 1922, 454-507.}} Travelers and the \textit{TIB} have consistently reported Roman, Early Byzantine, and Middle Byzantine architectural sculpture in or near an old Turkish bath in town, which unfortunately could not be located when the author visited in 2012 – the town today is positively overrun by new touristic development.\footnote{\textit{TIB} 7.172-3.}

Additional examples of Anatolian hot spring sites with Christianized characters can be gleaned from Hasluck’s rich ethnographic investigations in early twentieth century Anatolia. For instance, Hasluck investigated a hot spring in the village of Armutlu, on the Bos Burun peninsula in Bithynia.\footnote{\cite{Hasluck 1929/1973, 466 and on other spring sites see 107-112.}} The Armutlu hot spring bath was dedicated to three female saints, an unusual combination owing to their similarity to the three Graces who were common figures around Roman springs and baths: Nymphodora, Metrodora, and Menodora. Their cult is quite early in date, found in the \textit{Acta Sanctorum} and Constantinopolitan Synaxarion for September 10, a date when their tomb was shown “near the hot springs,” and the saints were attributed with the more efficacious execution of miracles at the site. Hasluck recalls that, at the Armutlu springs, he was shown the tombs of the saints in “amorphous rubble ruins of Roman or Byzantine date,” from which earth was used medicinally. Hasluck also makes reference to an ancient relief of the three saints, though he had no luck finding it during his visit in 1913.
Such Christianized hot springs, if sufficiently famous, could aspire to high places in the hierarchy of the Byzantine state. Germia, for example, was a thermal spring associated with the cult of Mên, on which was built the Church of St Michael the Archangel, the seat of an autocephalous bishopric after the seventh century.\footnote{Niewöhner\footnote{TIB 4.166–168 and 247 s. v. Germia.} 2010 and 2011a/b.}\footnote{Mango 1986.}\footnote{Niewöhner 2011b: 98-101.} Niewöhner\footnote{Niewöhner 2011b, 100-1.} has surveyed the remains of the church, completing the work suggested by Mango.\footnote{Niewöhner 2010 and 2011a/b.} The healing bath itself has not been identified as such, though Niewöhner includes hydrochemical analysis identifying unusually high values of hydrogen sulfide at the nearby Kurtluca and Ayvali springs.\footnote{Niewöhner 2011b, 100-1.} Hydrogen sulfide is typically thought to be of use for skin ailments and arthritis. In this regard, Niewöhner quotes Michael Featherstone’s translation of the Miracles of St Michael (\textit{BHG} 1288e) as follows:

“For he who is ill descends with fervent faith and admission of his sins into those miraculous waters and, submerging himself up to his beard, stands there wholly entreating almighty God and His holy archangel Michael; and forthwith by God’s command the fishes in the waters there come together and lick all round the entire body of him who is ill; and straightway he comes up healthy in soul and body, cured of chronic and recent diseases, both hidden and obvious, glorifying God and His commander Michael. For many lepers and sufferers of elephantiasis have been cleansed, and those with withered hands and feet healed, and a great many other illnesses of all sorts cured contrary to expectation.”

Elsewhere, the evidence for Christianized, formerly pagan hot springs is more fragmentary if nevertheless evocative. Just off the southwest coast of the

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\textit{TIB} 4.166–168 and 247 s. v. Germia.

Niewöhner 2010 and 2011a/b.

Mango 1986.


Niewöhner 2011b, 100-1.
peninsula of Cyzicus on the Marmara, there is a small island formerly called Panagia, which was blessed with famous hot and cold water springs, where Hasluck saw ruins of a large Byzantine church, baths, and hagiasma.\textsuperscript{865} Paul Lucas had earlier seen glass mosaic on the site of the church.\textsuperscript{866} At Sebaste / modern Selçikler in Phrygia, there existed a church built on a converted thermal bath site, originally built in perhaps the first or second century and maintained as such until 6\textsuperscript{th} century according to Fıratlı, its excavator, before it was converted for use as a church between the sixth to tenth or eleventh centuries, to judge from its architectural sculpture and other finds. Sebaste was a riperine city, focused on the plain of the Senaros / Banaz Çayı, which appeared prominently in the city's coinage. The city was founded by Augustus in 20 BCE on the site of older Anatolian settlements, at the suggestion of an oracle of Apollo.\textsuperscript{867} Southeast of Selçikler are two church complexes, the first so-called North church (with evidence for occupation from the sixth to tenth centuries, including an Early Byzantine ambo, colored glass inlays, and Middle Byzantine iconostasis fragments),\textsuperscript{868} and the second being the converted bath-church, called the South Church (with a three aisled pier/cross-dome basilica measuring 36 x 19m, an Early Byzantine ambo and grave-goods including coins of Michael VII Doukas, r. 1071-1078, all suggestive of occupation between the sixth and eleventh centuries).\textsuperscript{869} The South Church reused the walls and foundations and many of

\textsuperscript{865} Hasluck 1910, 18. \\
\textsuperscript{866} Lucas 1714, 1: 27. \\
\textsuperscript{867} TIB 7.366-368. \\
\textsuperscript{868} Fıratlı 1969. \\
\textsuperscript{869} Fıratlı 1979, 19-20.
the building materials of the earlier thermal complex, especially its large blocks. Whether or not the bath continued to operate after the construction of the church, or precisely which part of the bath the church was implanted into, both remain unclear. Fıratlı provides excellent plans which nevertheless, unfortunately give few clues. The original disposition of the Roman bath complex is not certain; just a few small pieces remain to the south of the church.

Several such thermal complexes remained in use or resumed operation after the turn of the millennium. A letter of Michael Psellos (early eleventh century) is addressed to one bishop Synetos, in which Psellos reports having bathed in hot springs at Luliopolis in Galatia, whose bishops had otherwise ceased attending councils after the Synod of 869/70. A bridge of unclear date, but suggestive of further (and perhaps Middle) Byzantine water management around Luliopolis, is located nearby: it consists of seven hexagonal masonry piers laid in the river bed, that were used as substructures for a wooden bridge that was built and laid on top. At Tyraion/Ilgin in modern Konya province, a hot thermal spring witnessed activity between at least the eleventh and eighteenth centuries, but likely there was also earlier Roman-Byzantine activity, as indicated by abundant architectural sculpture visible on the site in the nineteenth century. The TIB gives primary sources and other indications for a hot spring and baths known not only

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870 Idem.
871 Fıratlı 1970, 125; note also the plan in Mellink 1976, 288.
872 TIB 4.181-2 and Michael Psellos, Ep. 49.
873 Anderson and Crowfoot 1899, 66-7.
to early Modern visitors, but also to Crusader travelers.\textsuperscript{874} Albert of Aquitaine, for instance, noted \textit{ad lacus calidorum fontium, qui ibidem iuxta Finimis} (Philomelion, formerly Tyraion) \textit{fumabant}.\textsuperscript{875} Tyraion was known to Turkish sources as ‘Awgarm’ (or “hot water”), and also garnered mentioned from Arab geographers.\textsuperscript{876} Tyraion/Ilgin became an important regional center with a caravansaray later in the Seljuk period, its main baths domed (1219-1237) and restored (1267/8), as noticed by inscriptions.\textsuperscript{877} This bath, and another supplied by a cold water spring, were both built with a variety of Byzantine architectural fragments as spolia,\textsuperscript{878} though the town is today so overrun by five-star touristic development of the springs, that the author could not locate any historical remains whatsoever during a visit in 2012.

\textbf{4.12 Conclusion}

Baths were the primary motivation for the construction of aqueducts in Roman cities. Late Antique baths have historically been analyzed as a locus for the process of Christianization in pagan Roman cities, an environment in which competing notions of nudity, pleasure, and pagan sculpture came head-to-head. According to this argument, the church’s hostility to public bathing became a

\textsuperscript{874} TIB 7.410.
\textsuperscript{875} RHC occ. 4, 265-713, here at 376-7.
\textsuperscript{876} See again in the TIB, 7.410 for sources.
\textsuperscript{877} See the TIB entry for these dates; note also Huart 1896, 121f who records that “nous trouvons l’établissement thermal d’Ilidja, qui remonte à l’antiquité et a été réparé sous les Seldjoukides et les Ottomanes. … Dans Ilghin même…un ancient bain, en ruines, servant aujourd’hui d’atelier de potier.”
\textsuperscript{878} Sarre 1896, 23 notes longingly that “Umgeben von einem Wäldchen von Trauerweiden liegen westlich von der Stadt heisse Schwefelquellen; in dem alten Gebäude, das die Badebassins umschliesst und wohl seldjukischen Ursprungs ist, finden sich viele eingemauerte Architekturfragmente aus byzantinischer Zeit. Leider konnten wir das Innere nicht betreten…”
prime factor in the church’s eventual takeover of bath building patronage, leaving the majority of baths after the seventh or eighth century to be found only in association with churches and palace contexts, significantly diminished and introverted from their public and much larger predecessors. This chapter has, on the other hand, made a different argument: namely, that motivations for the diminution and introversion of bathing should instead (or at least in part) be ascribed to social factors, which recognized the potential for baths to become spaces of segregation, conflict and urban stasis, technological envy and desire, and gross overconsumption of a valuable resource, water.
CHAPTER 5
CONCLUSION

While Roman and medieval water systems have primarily been the province of engineers and to a lesser extent, epigraphers or historians arguably over-invested in continuist/catastrophist debates, this dissertation has tried to adopt water infrastructure as a platform or vista from which to observe a range of broader shifts in society and culture during Late Antiquity, and to interpret elements of water infrastructure as integrated components in larger urban systems that changed throughout time. While the collapse of Roman water infrastructure is too often simplistically pinned on climate change, technological decline, or political instability, in these pages we have preferred a social orientation that strives to understand the fragility or resilience of these systems, which caused some systems to be maintained for centuries, and others to be given up and abandoned after only a few decades of functionality. Such shifts are particularly important today, when states like California are plagued by drought and remain overinvested in infrastructural, statist, and technological solutions, with deep uncertainty about how best to change water consumption and conservation behaviors at the level of society and culture. Changes in water supply and consumption after antiquity are important if understudied examples of precisely such a process. The seventh century does not mark a simple caesura and break from classically Roman patterns of water supply. More important are long-term changes of cultural value and material practice that trended towards the acceptance and application of new options for the supply and consumption of
water over a period of several centuries, and which foreshadowed the utility-oriented and church-organized patterns typical of water management in the later Middle Ages.

In the first chapter we saw how characteristics of water infrastructure change in cities particularly susceptible to climate-induced water scarcity, also have wide parallels in areas with different historical climate trajectories, like Anatolia. This observation supports an interpretation of Late Roman water culture change that is not predominantly climatic, but is driven instead by society and culture: namely, shifting administrative contingencies, changing attitudes to water as a potable or useful resource, and social tensions concerned for the distribution, consumption, and pollution of water supplied by aqueducts.

Social and cultural factors for water management evolutions after antiquity were introduced in the second chapter, an extended investigation of an understudied Late Antique source, the Buildings of Procopius. This investigation laid bare the inadequacy of imperial Roman language and concepts that had traditionally been used to praise an emperor’s involvement and investment in the empire’s water infrastructure, insofar as Procopius could apply them in the changed circumstances of the empire’s water management in the sixth century. Procopius points, as best he could within the constraints of his rhetorical training and genre of literary production, to wholly novel Late Antique concerns that pertain to the sources, defensibility, and church-relationships of aqueducts; baths as locations
for the undue display of wealth, or the conversion and sedentarization of foreign peoples on the edge of empire, and the elevation or aggrandizement of thermal spring locations. Procopius ennobles the humble cistern, which had never been the target of imperial patronage before Justinian, an indication of the increasing importance of water storage in Late Antique cities. Further, we saw how Procopius essentially withdraws from consideration of pollution and certain macro-scale drainage issues, which were beyond the ken of both the author, or the abilities of the state. These shifts are distinctly pragmatic and un-Roman, and constitute important components of shifts in the ideologies and practices of water management during Late Antiquity.

The wide-ranging third chapter, concerned with aqueducts, examined these shifts in finer detail from the perspective of aqueducts, both in their ideological and practical dimensions. Waters introduced into locations where they did not naturally belong – such as the temple-sanctuaries perched on acropolises across the eastern Mediterranean – made for heady demonstrations of worldly or divine power in the palaces and temples where inverted siphons were first introduced in the Hellenistic period, at locations privileged by aqueduct supplies in the Roman centuries that followed. Technologically sophisticated systems were thus in their origins closely linked to religion and the state, though their principles proliferated in large-scale supply systems throughout the Roman world after the first century AD. Such technologically sophisticated systems for municipal supply with siphons – as at Aspendos – were universally abandoned after the fourth century
in favor of simpler water-supply systems carried in open-channel systems, which survived more readily. Open-channel systems that had privileged consumption for Roman pleasure and display were increasingly maintained for Byzantine utilitarian applications, however, the waters from baths and temples being diverted for churches, industry, and large-scale storage in cisterns that were architecturally and – in their public, institutional contexts – without precedent before the later fourth century.

We argued that the “church take-over” of Roman water infrastructure was not initiated by Justinian; rather his edict of 530 CE served merely to formalize arrangements benefiting the church that were in motion since the middle of the fourth and especially the fifth century, when the implantation of episcopal complexes in Roman cities set new standards for the acceptable provision and consumption of water, that became the status quo during the sixth century. At the same time, we observed in a survey of the empire’s metropolitan cities that there was no singular model for the Christianization of water infrastructure in Late Antiquity: rather, cities can be placed on a multi-dimensional spectrum, defined by the variety of water features around churches, and the degree to which they were integrated into evolving local supply networks. Most churches before the sixth century acted primarily as consumers in systems that were still tightly controlled, centralized and state-managed, in some locations well into the seventh century. Bishops in other locations where the church became more directly involved appear relatively fewer in number, though it was pointed out that
these changes could occur rather early in the grand scheme of things – in the later fourth or early fifth century – and consequently their bishops set important precedents for behaviors that became the norm after the promulgation of Justinian’s edict recognizing the authority of the church for urban water management.

We observed that water-facilitated industrialization in cities was a feature of both state-directed and church-directed water infrastructure development schemes; our analysis has indicated that in many cases industrialization should not be viewed as encroachment, but rather by virtue of its relation to administrative complexes, appears to have been carefully controlled by Late Antique city managers, secular or ecclesial.

Six models were offered for the afterlives of aqueducts: (1) catastrophe and sudden abandonment, (2) neglect and gradual abandonment, (3) disaggregation of cities to proximal water resources, (4) nucleation of cities towards locations naturally blessed with abundant resources, (5) outright continuity in select locations of especial value, and (6) rejection of aqueducts as supplies for cities of status as metropolitan or military capitals. It was argued, through an examination of the military capitals that emerged after the seventh century, that by this point in time the Roman state had already largely disinvested from aqueducts as a mode of urban supply, in favor of proximal lake and river sources; twenty-three of thirty-three military capitals had formerly been supplied by aqueducts, but perhaps only
five or six of these remained in use. Rather than any sudden catastrophe in the seventh century that destroyed aqueducts or rendered them dysfunctional, the gradualist and progressive nature of the replacement of aqueducts with ground-, surface- and rain-water sources was stressed. Crucially, the continued investment of the Byzantine state in aqueducts at other locations (like Constantinople, Antioch, and Thessaloniki) demonstrates that the repair of these systems was not beyond the technical reach of Byzantine engineers, but was instead a consequence of administrative decisions that did not extend the potentiality of repair into the provinces from the capital, where Constantine V hoarded both technical prowess and capital resources following the restoration of Constantinople’s aqueduct in 765. It is perhaps no coincidence, that at precisely this moment in the later eighth century, aqueducts begin to emerge as features of court capitals in neighboring polities, at Bulgarian Preslav and Pliska, for the Abbasid palaces at Samarra, and in the Carolingian world or early medieval Italy.

Our most comprehensive accounts of Late Antique urban change, by Liebeschuetz and Wickham, almost completely ignore cultural-environmental variables like water as structuring elements in history. Yet the diverse and multifarious transformations of Roman water infrastructure after antiquity provide unique vantage points, from which can be seen deep shifts in Late Roman society over a period of several centuries, long before the aqueducts died, if in a few places, they never really did.
APPENDICES

A: Coarse Ware Fabrics In Hydraulic Mortar Linings At Jarash
B: Levels from a Traverse at Jarash made on 09/06/12
C: A Note On The Value Of Late Antique Constructions For Municipal Water Supply at Jarash

D: A Hydraulic Roadmap of Procopius’s Buildings

E: Inscriptions for Aqueducts in the Eastern Mediterranean
F: Water Systems in Cities in the Late Antique Eastern Mediterranean
Appendix A: Coarse ware fabrics in hydraulic mortar linings at Jarash

Ceramic samples were collected from the mortar-linings of water features – which contain high proportions of crushed ceramics - so as to ascertain whether any of the fabrics collected could be independently compared with those known from secure archaeological contexts or known local kiln sites, and to compare the fabrics of crushed ceramics used in structures of unknown date with better dated monuments. Similar techniques have been applied at other sites in the Levant for dating hydraulic installations, but not at Jerash.\(^{879}\) Samples were photographed under magnification on site. The relational chart below indicates 1) that two locations [the Placcus Bath reservoir and the Cardo Fountain by the Cathedral] used mortar-linings which contained a securely Umayyad type of grey ware fabric, and 2) that the linings of several Cardo fountains contained a fabric which is also used in securely post-sixth century basins and cisterns at the St Theodore complex. These fabrics were independently dated by Ina Kehrberg-Ostrasz to the Late Byzantine or Early Islamic period.\(^{880}\)

<table>
<thead>
<tr>
<th>Location</th>
<th>Fabric 1 (bifurcated orange-red on tan)</th>
<th>Fabric 2 (bifurcated orangey-tan on gray)</th>
<th>Fabric 3 (orangey-tan)</th>
<th>Fabric 4 (gray ware)</th>
<th>Tentative Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fountain 5 – Propylaea</td>
<td>X</td>
<td>x</td>
<td>x</td>
<td></td>
<td>LBYZ-EISL</td>
</tr>
<tr>
<td>Fountain 7 – Cardo A</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>UM, LBYZ-EISL</td>
</tr>
<tr>
<td>Fountain 8 – Tetrakionia</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td>LBYZ-EISL</td>
</tr>
<tr>
<td>Cardo Fountain B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placcus Bath</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LBYZ-EISL; UM-EISL</td>
</tr>
<tr>
<td>Theodore Baptistery</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>LBYZ-EISL</td>
</tr>
<tr>
<td>Theodore Fountain Court</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>EISL</td>
</tr>
<tr>
<td>Sawmill</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td>LBYZ-EISL</td>
</tr>
</tbody>
</table>

\(^{879}\) e.g. Hirschfeld 1978.
\(^{880}\) My thanks to Ina Kehrberg-Ostrasz for her expert opinion on tentative dates for these ceramic fragments.
Fabric Definitions -
1) very lightly bifurcated fabric with orangey-brick red sandwiching an orange-tan; white (calcareous/micah/quartz) inclusions?

2) more strongly bifurcated fabric, with orangey-tan sandwiching gray; calcareous/micah/quartz

3) orangey-tan fabric with grog and calcareous/micah/quartz inclusions. Compare with Ware C from the N. Theater excavations “an orangey red ware, smooth paste, small calcite grits, smoothed or unsmooted, often has grey core, fired hard.”
4) gray ware

Compare these, for instance, with the pottery of the North Theater.\textsuperscript{881}

**Late Antique Wares of the Third to Fifth Centuries:**
1: Red wares with limestones grits.

2: Red ware with quartz, burnished orange slip.

3: Red ware with pinkish red ware limestone and basalt grits.

4: Grey ware with red white and black grits, thin cream wash on exterior.

**Umayyad Eighth Century Wares:**
Four wares are usual at Jerash in this period.

**Ware A** – dark grey, smooth paste with tiny grits, well fired. Surface is often unsmoothed or may be partially burnished. Ware restricted to basins, large powls and pithoi. Surface often has combed decoration.

\textsuperscript{881} Zayadine 1986, 249-250
**Ware B** – dark grey ware smooth paste with calcite grits, even firing, surface smoothed or unsmoothed. Usually found in cooking vessels, lids and jars.

**Ware C** – orangey red ware, smooth paste, small calcite grits, smoothed or unsmoothed, often has grey core, fired hard. Usually has white painted horizontal straight or wavy lines. Found in bowls cups jugs casseroles and lids.

**Ware D** – buff ware, soft well fired, smooth paste with fine grits. Exterior has whitish slip with reddish brown painted decoration. Usually found in jars and cup like bowls. Not common in the north theater.”
## Appendix B: Levels from a traverse at Jarash made on 09/06/12

TBM 579.2 = IJP Site Datum = 100m site ht

<table>
<thead>
<tr>
<th>Site</th>
<th>BS</th>
<th>FS</th>
<th>Description</th>
<th>Constant</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST 1</td>
<td>0.00</td>
<td>0.44</td>
<td>Baseline measurement from northeast corner of Umayyad Mosque at intersection of Cardo / south Decumanus</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Fountain 8</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1.45</td>
<td></td>
<td>Bottom of basin</td>
<td>577.75</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.83</td>
<td></td>
<td>Side channel</td>
<td>578.37</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.65</td>
<td></td>
<td>Lower surface – mortar/stone</td>
<td>578.55</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.59</td>
<td></td>
<td>Upper surface – tile</td>
<td>578.61</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1.53</td>
<td></td>
<td>Lower outlet</td>
<td>577.67</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1.45</td>
<td></td>
<td>Upper outlet</td>
<td>577.75</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1.06</td>
<td></td>
<td>Pipe behind column</td>
<td>578.14</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>2.35</td>
<td></td>
<td>Cut in pavement, north side of Tetrakonia</td>
<td>576.7</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>2.52</td>
<td></td>
<td>Cut in pavement, northwest pylon of Tetrakonia</td>
<td>576.53</td>
<td></td>
</tr>
<tr>
<td>ST 2</td>
<td>2.12</td>
<td>1.00</td>
<td></td>
<td>580.88</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Fountain 7</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1.97</td>
<td></td>
<td>10cm dia. outlet pipe</td>
<td>579.91</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1.71</td>
<td></td>
<td>High end of basin (2nd phase)</td>
<td>579.17</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1.83</td>
<td></td>
<td>Low end of basin (2nd phase)</td>
<td>579.05</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>1.78</td>
<td></td>
<td>Tiled first phase</td>
<td>579.10</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>1.56</td>
<td></td>
<td>Step (with mortar)</td>
<td>579.32</td>
<td></td>
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<tr>
<td>15</td>
<td>1.61</td>
<td></td>
<td>Water inlet (lower)</td>
<td>579.37</td>
<td></td>
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<tr>
<td>16</td>
<td>0.84</td>
<td></td>
<td>Behind stylobate</td>
<td>-0.15</td>
<td>579.89</td>
</tr>
<tr>
<td>17</td>
<td>-0.16</td>
<td></td>
<td>Lion head outlet</td>
<td>581.04</td>
<td></td>
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<tr>
<td>18</td>
<td>1.16</td>
<td></td>
<td>Raised paving between fountains 7 + 8</td>
<td>579.72</td>
<td></td>
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<tr>
<td>19</td>
<td>1.34</td>
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<td>Lions head on fountain 8</td>
<td>579.54</td>
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<tr>
<td>20</td>
<td>1.60</td>
<td></td>
<td>Basin on top of fountain 8</td>
<td>579.28</td>
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<tr>
<td>21</td>
<td>1.14</td>
<td></td>
<td>Cut paving for Nymphaeum, west side of Cardo</td>
<td>579.74</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>1.11</td>
<td></td>
<td>Cut paving for Nymphaeum</td>
<td>579.69</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>0.1</td>
<td></td>
<td>Behind west stylobate</td>
<td>580.78</td>
<td></td>
</tr>
<tr>
<td>ST 3</td>
<td>2.765</td>
<td>2.68</td>
<td></td>
<td>582.645</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>2.15</td>
<td></td>
<td>Bottom of basin south of processional way (Fountain 5)</td>
<td>580.495</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.26</td>
<td></td>
<td>Top of back plastering</td>
<td>581.385</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Description</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>26</td>
<td>1.05</td>
<td>Boltholes in blocks behind basin</td>
<td>581.595</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>2.805</td>
<td>Pipe channel cut in the cardo street paving (east side)</td>
<td>-0.15 579.69</td>
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<tr>
<td>28</td>
<td>2.79</td>
<td>Pipe channel cut in the cardo street paving (west side)</td>
<td>-0.15 579.675</td>
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<tr>
<td>29</td>
<td>1.49</td>
<td>Side stone of most northerly fountain</td>
<td>581.155</td>
<td></td>
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<tr>
<td>30</td>
<td>2.87</td>
<td>Pipe channel cut in the cardo street paving (east side of most northerly cut)</td>
<td>579.625</td>
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<td></td>
</tr>
<tr>
<td>ST 4</td>
<td>3.00</td>
<td>North-most pipe channel</td>
<td>582.965</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>3.12</td>
<td>North-most pipe channel</td>
<td>-0.15 579.845</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>1.88</td>
<td>Stylobate on east side of cardo at most northern pipe channel cut</td>
<td>-0.15 580.935</td>
<td></td>
<td></td>
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<tr>
<td>34</td>
<td>3.18</td>
<td>Most northern pipe channel cut in the cardo street paving (same as 30)</td>
<td>-0.15 579.635</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST 5</td>
<td>1.285</td>
<td>Behind west stylobate at most northern pipe channel cut in cardo</td>
<td>584.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>2.72</td>
<td>Behind west stylobate at the second most northern pipe channel cut in cardo</td>
<td>-0.15 581.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>2.74</td>
<td>Circassian water channel south of compound</td>
<td>601.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST 10</td>
<td>1.30</td>
<td>Top of platform at Artemis temple</td>
<td>602.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>2.92</td>
<td>Bottom of channel to stone saw</td>
<td>599.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>3.53</td>
<td>Fill in cistern for stone saw</td>
<td>599.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>4.45</td>
<td>Channel N of apse in single ailed church on intermediate terrace</td>
<td>598.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>4.98</td>
<td>Channel S of apse in single ailed church on intermediate terrace</td>
<td>597.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>5.10</td>
<td>Channel N of aisle in church</td>
<td>597.51</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Description</td>
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<td>------------------------------------------------------------------------------</td>
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<td></td>
</tr>
<tr>
<td>44</td>
<td>5.08</td>
<td>Channel S of aisle in church on intermediate terrace</td>
<td>597.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>3.73</td>
<td>Plaster in cistern</td>
<td>598.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>1.96</td>
<td>Baths of placcus cistern, top of highest surviving wall</td>
<td>600.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>3.06</td>
<td>Outtake channel on Placcus cistern</td>
<td>599.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>3.93</td>
<td>Floor of Placcus cistern</td>
<td>598.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST 11</td>
<td>1.56</td>
<td></td>
<td>599.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>4.76</td>
<td>Water supply to Theodore courtyard</td>
<td>594.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST 12</td>
<td>0.12</td>
<td></td>
<td>594.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>4.17</td>
<td>To paving in courtyard</td>
<td>590.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>4.68</td>
<td>Exit of water channel in courtyard</td>
<td>589.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST 13</td>
<td>2.94</td>
<td></td>
<td>597.145</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>0.72</td>
<td>Level of paving/wellhead in Theodore atrium</td>
<td>596.425</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST 14</td>
<td>0.03</td>
<td></td>
<td>592.315</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST 15</td>
<td>0.26</td>
<td></td>
<td>587.575</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST 16</td>
<td>1.18</td>
<td></td>
<td>584.15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Traverse closed with an error of 18cm.
Appendix C: A note on the value of Late Antique constructions for municipal water supply at Jarash

A quick series of very basic calculations may be made to assess the value of cisterns versus fountains for those living in close proximity to them, and to justify the conclusion that ecclesial water features were sufficient not only to benefit churchmen or liturgical activities, but also to provide for the wider community. For the sake of consistent comparison, we can reasonably assume as control factors that, 1) the cisterns were full at the end of the spring rains in April or May, 2) that very minimal recharge of the cisterns occurred in the following four dry months (120 days) that followed, and 3) that the minimum water requirement for persons in arid climates for personal consumption only is 3 liters per day (no animals or other uses). This is an admittedly low number, which would exclude animals and non-consumption activities.

For the fountains, we might assume that 4) they were refilled once a day, as a simple fixed variable, and thus accounted for roughly 4m$^3$ or 4,000 liters of aqueduct-distributed spring water.

Thus, because 1 m$^3$ of water = 1000 liters, the number of persons per day who could be sustained from a cistern’s water supply during the arid months (P) = Volume (m$^3$ * 1000) / 120 days / 3l, while for a cistern (P) = volume of fountain basin (m$^3$ * 1000) / 3, since we assume that (hypothetically) the fountain is refilled once per day.

<table>
<thead>
<tr>
<th>Cistern Locations (dates)</th>
<th>Volume (m$^3$ * 1000 = Liters)</th>
<th>Persons sustained for 120 days dry-season from one cistern recharge, at 3L/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cistern 1 southwest of Theodore (early-mid 4th c?)</td>
<td>300</td>
<td>830</td>
</tr>
<tr>
<td>Cistern 2 immed west of Theodore (post mid 5th c.)</td>
<td>12</td>
<td>33</td>
</tr>
<tr>
<td>St Theodore Baptistry (post mid 5th c.)</td>
<td>5.2</td>
<td>14</td>
</tr>
<tr>
<td>St Theodore’s Clergy House (post mid 5th c.)</td>
<td>7</td>
<td>19</td>
</tr>
<tr>
<td>St Theodore’s Atrium (post mid 5th c.)</td>
<td>70</td>
<td>194</td>
</tr>
<tr>
<td>St Genesios Atrium (last addition early 7th c)</td>
<td>67</td>
<td>186</td>
</tr>
<tr>
<td>Artemis Temple Substructures (mid 2nd c)</td>
<td>68</td>
<td>189</td>
</tr>
<tr>
<td>Artemis Temple Long Basin (mid 2nd c)</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td><strong>Artemis Temple Open Reservoir</strong></td>
<td><strong>&gt;125</strong></td>
<td><strong>&gt;69</strong></td>
</tr>
</tbody>
</table>
### Fountain Locations

<table>
<thead>
<tr>
<th>Fountain Location</th>
<th>Volume (m³)</th>
<th>Persons sustained from fountain if filled 1x / day, at 3L /d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fountain 5</td>
<td>0.54</td>
<td>180</td>
</tr>
<tr>
<td>Fountain 7</td>
<td>1.59</td>
<td>530</td>
</tr>
<tr>
<td>Fountain 8</td>
<td>1.60</td>
<td>533</td>
</tr>
<tr>
<td>Fountain Court at Cathedral</td>
<td>16</td>
<td>5300</td>
</tr>
<tr>
<td>Severan Nymphaeum basin</td>
<td>32</td>
<td>10670</td>
</tr>
</tbody>
</table>

Ten percent could reasonably be subtracted from these figures for cisterns, on account of the concentrated impurities that would settle at the bottom of each tank, rendering the last remnants of water in cisterns mostly undrinkable.

From the above figures it may be concluded that the water provided by the public cisterns in churches represents a sizeable investment on the part of church authorities, as well as a considerable contribution to the town’s water supply.
Appendix D: A hydraulic roadmap of Procopius’s *Buildings*

The hydraulic content of the *Buildings* can be expressed, in relation to the work’s narrative structure, as follows:

<table>
<thead>
<tr>
<th>Passage</th>
<th>Location</th>
<th>Problem</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Constantinople</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1.1-3</td>
<td>Proemium</td>
<td>F + Inf + Sh + Su</td>
<td>Dam, aqueduct, streets and drainage, river management</td>
</tr>
<tr>
<td>2.1.4-2.3.26</td>
<td>Dara</td>
<td>F + Inf + Sh + Su</td>
<td>Dam, aqueduct, streets and drainage, river management</td>
</tr>
<tr>
<td>2.3.27-8</td>
<td>Amida / Edessa</td>
<td>F</td>
<td>Cistern at refugium / fortifications surrounded by agricultural land, with channels for rain water collection</td>
</tr>
<tr>
<td>2.4.1-8</td>
<td>Rhabdios</td>
<td>Sh</td>
<td>Well construction</td>
</tr>
<tr>
<td>2.4.14-21</td>
<td>Agricultural villages on river valley</td>
<td>F</td>
<td>Refugia</td>
</tr>
<tr>
<td>2.4.22-24</td>
<td>Baras</td>
<td>Sh</td>
<td>Well construction</td>
</tr>
<tr>
<td>2.5.1-8</td>
<td>Theodosiopolis and Constantina</td>
<td>F</td>
<td>Circuit walls</td>
</tr>
<tr>
<td>2.5.9-11</td>
<td>Constantina</td>
<td>F + Sh</td>
<td>Aqueduct + fountains</td>
</tr>
<tr>
<td>2.6.1-11</td>
<td>Circesium, Osrhoene</td>
<td>F + Su</td>
<td>River management, at the confluence of the Khabur river with the Euphrates</td>
</tr>
<tr>
<td>2.6.12-16</td>
<td>Various locations</td>
<td>F</td>
<td>Flood management and river diversion</td>
</tr>
<tr>
<td>2.7.1-14</td>
<td>Edessa</td>
<td>F + Su</td>
<td>Flood management and river diversion</td>
</tr>
<tr>
<td>2.7.15-19</td>
<td>Edessa and Carrhae, Callinicum</td>
<td>F</td>
<td>Circuit wall restoration</td>
</tr>
<tr>
<td>2.8.1-7</td>
<td>Persian/Roman border</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>2.8.8-15</td>
<td>Zenobia</td>
<td>F</td>
<td>Restoration</td>
</tr>
<tr>
<td>2.8.16-25</td>
<td>Zenobia</td>
<td>Su</td>
<td>River management + bath construction</td>
</tr>
<tr>
<td>2.9.1-2</td>
<td>Fort Sura</td>
<td>F</td>
<td>Circuit construction</td>
</tr>
<tr>
<td>2.9.3-9</td>
<td>Resafa</td>
<td>F + Sh</td>
<td>Circuit fortification + Reservoir construction</td>
</tr>
<tr>
<td>2.9.10-11</td>
<td>Hemerium</td>
<td>F + Sh</td>
<td>Cistern construction in fortifications</td>
</tr>
</tbody>
</table>

---

882 Key: B = Border; Ch = Churches; F = Fortifications; Sh = Shortage; Su = Superabundance; I = Infrastructure; ST = Settlement Transfer.

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.9.12-17</td>
<td>Hierapolis</td>
<td>Pollution</td>
<td>Unregulated garbage and washing in clean lake source</td>
</tr>
<tr>
<td>2.9.18-20</td>
<td>Various locations</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>2.10.1-5</td>
<td>Antioch</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>2.10.6-8</td>
<td>Antioch</td>
<td>Su</td>
<td>River diversion + bridge construction</td>
</tr>
<tr>
<td>2.10.9-12</td>
<td>Antioch</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>2.10.13-14</td>
<td>Antioch</td>
<td>Sh</td>
<td>baths and cisterns built on leveled hills inside circuit</td>
</tr>
<tr>
<td>2.10.15-18</td>
<td>Antioch</td>
<td>Su</td>
<td>arch dam construction with sluice gates</td>
</tr>
<tr>
<td>2.10.19-25</td>
<td>Antioch</td>
<td>Ch + Sh</td>
<td>Construction of streets and ramified urban supply/drainage systems + church construction</td>
</tr>
<tr>
<td>2.11.1</td>
<td>Chalcis</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>2.11.2-7</td>
<td>Cyrrhus</td>
<td>Sh</td>
<td>Hidden aqueduct construction</td>
</tr>
<tr>
<td>2.11.8-9</td>
<td>Chalcis</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>2.11.10-12</td>
<td>Palmyra</td>
<td>F + Sh</td>
<td>“provided it with abundant water”</td>
</tr>
<tr>
<td>3.1-6</td>
<td>Armenia</td>
<td>F + Su + ST</td>
<td>Generally concerned with fortifications, but note new “abundant water supplies” for fortified place with garrison at Citharizôn [3.3.7-8]; and see settlement transfer from Bizana to Tzumina (3.5.13-5)</td>
</tr>
<tr>
<td>3.7.1-4</td>
<td>Trabzon</td>
<td>Sh</td>
<td>St Eugenius aqueduct construction</td>
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<tr>
<td>3.7.18-25</td>
<td>Anchialus</td>
<td></td>
<td>Elevation and fortification of thermal-spring town</td>
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<tr>
<td>4.1.1-16</td>
<td>Europe</td>
<td></td>
<td>Geographical description</td>
</tr>
<tr>
<td>4.1.17-27</td>
<td>Justiniana Prima</td>
<td>Sh + Ch</td>
<td>Construction of aqueduct + bath + fountains + streets and stoa. Elevation to Archbishopric of Illyricum.</td>
</tr>
<tr>
<td>4.1.28-36</td>
<td>Ulpiana / Justiniana Secunda and elsewhere</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>4.1.37-42</td>
<td>Phœnicê/ Photicê</td>
<td>F + Su + ST</td>
<td>Phouria built close to two towns with irresolvable drainage problems</td>
</tr>
<tr>
<td>Section</td>
<td>Location</td>
<td>Type</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>----------</td>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>4.2.1-8</td>
<td>Thermopylae</td>
<td>F + Sh</td>
<td>Cistern construction</td>
</tr>
<tr>
<td>4.2.9-15</td>
<td>Greece</td>
<td>F + Sh</td>
<td>Reservoir + granary construction</td>
</tr>
<tr>
<td>4.2.16-22</td>
<td>Heraclea</td>
<td>F + Su</td>
<td>Torrent in deep pass between two forts blocked with cross-wall, for defense and to form retaining wall for pond forming behind</td>
</tr>
<tr>
<td>4.2.23-26</td>
<td>Athens and towns of Boeotia</td>
<td>F</td>
<td>Restoration after earthquakes</td>
</tr>
<tr>
<td>4.2.27-28</td>
<td>Isthmus</td>
<td>F</td>
<td>Isthmus walls</td>
</tr>
<tr>
<td>4.3.1-5</td>
<td>Diocletianopolis</td>
<td>F + ST</td>
<td>City moved to nearby island</td>
</tr>
<tr>
<td>4.3.6-15</td>
<td>Thessaly</td>
<td>F</td>
<td>Plentiful water is meaningless if citizens are endangered</td>
</tr>
<tr>
<td>4.3.16-26</td>
<td>Euboea</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>4.3.27-30</td>
<td>Rhechius river / mod. Vardar? near Thessalonike</td>
<td>F</td>
<td>Plentiful water is meaningless if citizens are endangered</td>
</tr>
<tr>
<td>4.4</td>
<td>Europe</td>
<td>F</td>
<td>History of river as border</td>
</tr>
<tr>
<td>4.5</td>
<td>River Ister/ mod. Danube</td>
<td>F</td>
<td>Ruins of Trajan’s bridge impedes boat traffic</td>
</tr>
<tr>
<td>4.6.1-18</td>
<td>River Ister</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>4.6.19-37</td>
<td>River Ister</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>4.7</td>
<td>Mysia</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>4.8.2-9</td>
<td>Rhegium, Thrace</td>
<td>Su</td>
<td>Drainage on roads improved</td>
</tr>
<tr>
<td>4.8.10-17</td>
<td>Rhegium, Thrace</td>
<td>Su</td>
<td>Bridge construction</td>
</tr>
<tr>
<td>4.8.18</td>
<td>Athyras, Thrace</td>
<td>F + Sh</td>
<td>Reservoir construction</td>
</tr>
<tr>
<td>4.8.19-25</td>
<td>Episcopia</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>4.9.1-13</td>
<td>Thrace</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>4.9.14-16</td>
<td>Heraclea / mod. Silivri</td>
<td>Sh</td>
<td>Aqueduct construction</td>
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<td>4.9.17-21</td>
<td>Rhaedestus</td>
<td>F</td>
<td></td>
</tr>
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<td>4.10.1-23</td>
<td>Chersonese, Gallipoli</td>
<td>F + I</td>
<td>Bath + guest house construction</td>
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<tr>
<td>4.10.24-28</td>
<td>Sestus, Hellespont</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>4.11</td>
<td>Thrace</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>5.1.1-3</td>
<td>Proemium</td>
<td></td>
<td>“repairing all the parts of cities which had become defective”</td>
</tr>
<tr>
<td>5.1.4-6</td>
<td>Ephesus</td>
<td>Ch</td>
<td>St. John at Aya Soluk</td>
</tr>
<tr>
<td>5.1.7-16</td>
<td>Tenedos</td>
<td>I</td>
<td>Granary construction</td>
</tr>
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<td>5.2.1-5</td>
<td>Helenopolis, Bithynia</td>
<td>Sh</td>
<td>Aqueduct construction + bath construction and restoration</td>
</tr>
<tr>
<td>5.2.6-13</td>
<td>Helenopolis, river Dracon, Bithynia</td>
<td>Su</td>
<td>River Dracon management + bridge construction + forest clearance</td>
</tr>
<tr>
<td>5.3.1-3</td>
<td>Nicaea, intra-muros</td>
<td>Sh</td>
<td>Aqueduct restoration + bath restoration + churches and palace</td>
</tr>
<tr>
<td>5.3.4-6</td>
<td>Nicaea, extra-muros</td>
<td>Su</td>
<td>Bridge construction</td>
</tr>
<tr>
<td>5.3.7</td>
<td>Nicomedia</td>
<td>I</td>
<td>Bath restoration</td>
</tr>
<tr>
<td>5.3.8-11</td>
<td>Nicomedia</td>
<td>Su</td>
<td>Bridge construction on Sangarius river.</td>
</tr>
<tr>
<td>5.3.12-15</td>
<td>Bithynia-Phrygia border</td>
<td>Su</td>
<td>Road drainage improvement.</td>
</tr>
<tr>
<td>5.3.16-20</td>
<td>Pythia</td>
<td>Sh</td>
<td>Aqueduct + bath construction, with church and hospital</td>
</tr>
<tr>
<td>5.4.1-4</td>
<td>Galatia, River Siberis/Hierus in Galatia</td>
<td>Su</td>
<td>River Siberis management + dam + bridge construction, with church</td>
</tr>
<tr>
<td>5.4.5-6</td>
<td>Iuliopolis, Bithynia</td>
<td>Su</td>
<td>Circuit walls of city weakened by torrent; drainage correction</td>
</tr>
<tr>
<td>5.4.7-14</td>
<td>Caesarea, Cappadocia</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>5.4.15-18</td>
<td>Mokissos, Cappadocia</td>
<td>Sh</td>
<td>Aqueduct + bath construction, with hospices and churches</td>
</tr>
<tr>
<td>5.5.1-3</td>
<td>Platanôn, Cilicia</td>
<td>Su</td>
<td>Road drainage correction</td>
</tr>
<tr>
<td>5.5.4-7</td>
<td>Mopsuestia, Cilicia on Pyramus River</td>
<td>Su</td>
<td>Bridge restoration</td>
</tr>
<tr>
<td>5.5.8-13</td>
<td>Adana, Cilicia</td>
<td>Su</td>
<td>Bridge restoration</td>
</tr>
<tr>
<td>5.5.14-20</td>
<td>Tarsus, Cydnus River, Cilicia</td>
<td>Su</td>
<td>Flood management: diversion of river Cydnus followed by bridge restorations</td>
</tr>
<tr>
<td>5.6.1-26</td>
<td>Jerusalem</td>
<td>Ch</td>
<td>Construction of the Nea church, no mention of cistern patronized by Justinian and known by inscription</td>
</tr>
<tr>
<td>5.7.1-17</td>
<td>Neapolis/Garizim</td>
<td>Ch</td>
<td></td>
</tr>
<tr>
<td>5.8.1-10</td>
<td>Palaestina Tertia</td>
<td>Ch + B</td>
<td>Wells and cistern construction in monastic contexts</td>
</tr>
<tr>
<td>5.9.14</td>
<td>Palestine Lists</td>
<td>Sh</td>
<td>Wells and cistern construction in monastic contexts</td>
</tr>
<tr>
<td>5.9.34</td>
<td>Curicum, Mesopotamia</td>
<td>I</td>
<td>Bath + poorhouse restoration</td>
</tr>
<tr>
<td>5.9.36</td>
<td>Cyprus</td>
<td>Sh</td>
<td>Aqueduct of St Conon restoration</td>
</tr>
<tr>
<td>6.1.12-</td>
<td>Taphosiris, near</td>
<td>I + F</td>
<td>bath and magistrate residences,</td>
</tr>
<tr>
<td></td>
<td>Alexandria Egypt</td>
<td>with city wall</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>6.2.3-6</td>
<td>Bernice, Libya (Benghazi)</td>
<td>I</td>
<td>public bath construction</td>
</tr>
<tr>
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Appendix E: Inscriptions for aqueducts in the Eastern Mediterranean

A brief introductory note for Appendix E: These inscriptions for aqueducts in the eastern Mediterranean are gathered together here for the first time, so I hope the reader will excuse their shortcomings with a mind towards the utility of the greater collection: I have been reliant on published editions rather than first hand inspection of the inscriptions for aqueducts included below. Given the well-known irregularities of conventions as regards universal epigraphic abbreviations and so forth, the texts included are not meant as substitutes for the principal editions, but rather as convenient markers of reference with bibliographic apparatuses and notices of alternative restorations and commentaries.

**HELLENISTIC – 1st BCE**

#1
Place: Boeotia, Oropos
Date: 4th BCE
Thing: Inscription
Action: Bath contracting supply of water from a rainwater collection channel at a temple

#2
Place: Caria, Herakleia am Latmos
Date: 2nd BCE 196/3
Thing: Inscription, letter of Antiochos III
Action: Funding for aqueduct construction
Patron Status: Royal [Antiochos III]
Dedicant: na
Status: na
Greek Text: ... τὸ τε | [ἐσόμενον ἂ]νήλωμα εἰς τὴν ἐπισκευὴν τοῦ ύδραγωγίου οἰόμε- | [θα δείν διδο]σθαι ἐκ βασιλικοῦ ἐφ’ ἔτη τρία, καὶ περί τούτων γεγράφαμεν | [. . c.8 . . . τ]ῷ διοικητῆι ποιουμένους δὲ καὶ εἰς τὸ λοιπὸν διὰ τῶν [έρ]- | [γων τὰς προσηχούσας ἀποδείξεις τῆς πρὸς τὰ πράγματα ἡμῶν εὐνοίας]

#3
Place: Caria, Lagina / Turgut, Mugla prov.
Date: Hellenistic
Thing: Inscription on a fragment of cornice
Action: Aqueduct construction, connected to fountain
Patron Status: No title given [Chrysaor Iasonos Koraeius]
Dedicant: na
Status: Greek Text: Χρυσάωρ Ἰάσονος τοῦ Χρυσάορος [Κω(ραιε ὺς) τὸ ὑδραγώγιον] τὸ φέρον ἐπὶ τὴν κρήνην ἀπό τοῦ [—]
Reference: Hatzfeld in BCH 44 (1920): 96, no. 34 = IK 22.522

#4
Place: Ionia, Priene
Date: After 3rd BCE
Thing: Inscription
Action: Aqueduct and reservoir/ἐγδόχιον construction
Patron Status: Stephanephoressa [Phile]
Dedicant: na
Engl Text: Phile wife of Apollonius, daughter of Thessalos son of Polydeukes, stephanephoressa first among wives built the reservoir of water and the conduit in the city from her own
Reference: von Gaertringen 1906, 144 #208

#5
Place: Mysia/Asia, Pergamon
Date: 2nd – 1st BCE
Thing: Construction commemorative inscription
Action: aqueduct/hydragwgon construction
Patron Status: Unknown
Dedicant: na
Status: Greek Text: [ὁ δῆμος ἐτίμησεν] | [— — — — — — — — — — — — — — — — — — — — — — — —] | [ἐν τῇ ἀρχαῖς καὶ λιτουργίαις] | [και] ἐν τῇ ἐπὶ τῶν ὑδραγω[γίων] | [ἐπιμελείαι] ἐκ ἰδίου τῶι δήμωι
Notes: inscription in which the demos honors an unknown indiv, who among other offices and liturgies built a water supply/hydragwgon from his own … and six thousand silver drachmas.
Reference: MDAI(A) 33 (1908): 410

#6
Place: Peloponnese, Andania
Date: 1st century BCE, 92/91
Thing: Inscription
Action: Prescriptions concerning water-related offenses and punishments related to a conduit flowing through sanctuary
Greek Text: ὕδατος. ἐχέτω δὲ ἐπιμέλειαν ὁ ἀγορανόμ ος καὶ περὶ τοῦ ὕδατος, ὅπως κατὰ τὸν τὰς παναγύριος χρόνον μηθείς κακοποιεῖ μήτε ἣλημα μήτε τοὺς ὀχετοὺς μήτε ἃν τι ἄλλο κατασκευασθεῖ ἐν τῷ ἱερῷ χάριν τοῦ ὕδατος, καὶ ὅπως, καθὼς ἂν μερισθεῖ, ἐριῒ τὸ ὕδωρ καὶ μη- ἃ εποκωλύει τοὺς χρωμένους· ἂν δὲ τινα λαμβάνει ποιοῦντά τι τῶι κεκωλυμένων, τὸν μὲν δοῦλον μαστιγούτω, τὸν δὲ ἐλεύθερον ἐκοσὶ δραχμαῖς, καὶ τὸ κρίμα ἔστω ἐπὶ τῶι ἱερῶι ἱερῶν.
Engl Text: “Regarding water. The supervisor of the market/agoranomos is to be careful concerning the water, that at the festival time no one harms the sluice or the conduits or contrives anything else in the sacred area with regard to the water; and that the water flows just as it is apportioned, and no one hinders those using it. If he catches someone doing something that is prohibited, he is to scourge him if he is a slave or fine him twenty drachmai if he is a free man, and the judgment is to rest with the sacred priests.
Reference: IG V.1.1390 lines 103-105 = trans. Arnaoutoglou 2007, 139

#7
Place: Peloponnese, Megalopolis
Date: 4th BCE
Thing: Inscription
Action: Construction of seats and conduit
Patron Status: Agonothete [Antiochos]
Dedicant: na
Status: na
Greek Text: Ἀντίοχος ἀγωνοθετήσα̣ς̣ ἀνέθηκε τὸς θρόνος πάντας καὶ τὸν χετόν.
Reference: IG V.2.450

FIRST CENTURY

#8
Place: Caria, Mylasa / Milas
Date: 1st CE
Thing: Inscription on marble block, found “beim Bau der neuen Synagogue in Milas”
Action: Aqueduct construction
Patron Status: Stephanephoros and priest of Zeus [Aristomenes Skymnos]
Dedicant: “To the emperors”
Σε[βαστοῖς Ἀριστομένης Σκύμνοθ Μάτρις ὁ καὶ Ὡσσαλώδωμος | καὶ στεφανηφόρος καὶ ἱερεὺς Διὸς Ὀσογω εἰσήγαγεν | σεν τῇ πατρίδι εἰς τε τὰς προγονικὰς κρήνας καὶ τὰ Σεβαστά | ηὰ πηραγώγια κατὰ τὴν τῶν προγόνων ἐπανελείαν


#9
Place: **Cilicia, Anazarbos**
Date: 1st century CE c. 90
Thing: Inscription, construction commemorative
Action: aqueduct/hydragwgon construction
Patron Status: Demos
Dedicant
Status:
Greek Text: Σεβαστοῖς Αριστομένης Σκύμνοθ Μάτρις ὁ καὶ Ὡσσαλώδωμος | καὶ στεφανηφόρος καὶ ἱερεὺς Διὸς Ὀσογω εἰσήγαγεν | σεν τῇ πατρίδι εἰς τε τὰς προγονικὰς κρήνας καὶ τὰ Σεβαστά | ηὰ πηραγώγια κατὰ τὴν τῶν προγόνων ἐπανελείαν

Notes: See *SEG* 46.2281 with commentary by H.W. Pleket on the question of whether or not the construction of the aqueduct was financed by the city (pro M. Horster = *SEG* 52.1136 bis and contra Winter 1995, 73 and 181)
Reference: Text with German translation, *IK* 56.1.#20.

#10
Place: **Cyprus, Amathonte**
Date: 1st CE late 84-85
Thing: stamped terra cotta pipes
Action: Aqueduct in use
Patron Status: Emperor? [Domitian?]
Dedicant
Status:
Greek Text: a) [Ἔτους?] Δ Δομιτιανοῦ Ὀλυσσαπασιανοῦ υἱῷ | Σεβαστῶι Γερμανικῶι ἀρχιερεῖ | μεγίστωι, δημαρχικῆς ἐξουσίας | τὸ ιʹ, αὐτοκράτορι τὸ κβʹ, ὑπάτωι τὸ | τειμητῆι διὰ βίου, | Καισαρέων ὁ δῆμος | σεβαστὸν ύδραγωγίον.

Reference: *AE* (2000) #1493

#11
Place: **Cyprus, Angustina [Famagusta district]**
Date: 1st CE
Thing: Fragmentary plaque of white marble
Action: Aqueduct construction
Patron Status: Emperor [Nero] (nominative)
#12
Place: Crete, Hagioi Deka / Gortyna
Date: 1st century CE
Thing: Inscription
Action: Aqueduct construction
Patron Status: Highpriest of koinon [Soarchos Kyliandros]
Dedicant Status: na
Greek Text: Σόαρχος Κυλίνδρου, ἀρχιερεὺς τοῦ κοινοῦ, ἐκ τῶν ἰδίων τὸ ὕδωρ εἰσήγαγεν
Reference: Inscriptiones Creticae IV 330

#13
Place: Cyprus, Kyrenia
Date: 1st CE 42-3
Thing: Inscription
Action: Aqueduct construction
Patron Status: Proconsul/anthupatos [Titus Cominius Proclus] with presbyter and antistrategos [Titus Lartinus Sabinus]
Dedicant Status: na, described merely as “in the third year of the Emperor’s reign”
Greek Text: Ἐπὶ Αὐτοκράτορος Τιβερίου Κλαυδίου Ἐτος τρίτου, Τίτος Κομίνιος Πρόκλος ἀνθύπατος ἀντιστράτηγος ἐσάν ὑδωρ τὸ δέκαλλης
Reference: SEG 6.834

#14
Place: Cyprus, Soloi
Date: 1st CE
Thing: Inscription
Action: Aqueduct construction
Patron Status: emperor, with local anthupatos / proconsul [Nero with Vilius? Milionius (a Milionus known from Paphos; cf. SEG 31.1358) and Iulius Cordus (proconsul attested during reign of Nero)] (emperor’s name in nominative + διὰ and bureaucrat’s name in genitive)

Dedicant Status: Na

Greek Text: [Νέρων Κλαύδιος Καὶ- | σαρ Σεβαστὸς Γερμανι-] [κός τὸ ὕδωρ] εἰσήγαγε | [διὰ Οὐειλίου()] μειλίων {Ἰου- | [λίου Κόρδου ἄ]νθυπάτου} or {τοῦ ἁγνοῦ(?) ἄ]νθυπάτου}

Notes: See SEG 36.1264 for a discussion on the gentilicium here


#15
Place: Dacia, Sarmizegetusa
Date: 1st CE
Thing: Inscription
Action: Aqueduct construction
Actor Status: Legate [Cn. Papirius Aelianus] (per + accusative), thus on behalf of emperor
Dedicant Status: Trajan [emperor] (nominative + filial genitive)


Reference: AE (2007) 1181

#16
Place: Dalmatia, Iader / Zadar
Date: 1st CE
Thing: Inscription
Action: Aqueduct construction
Patron Status: Emperor? [Trajan] (nominative)
Dedicant Status: Na


| Place: Epirus, Dyrrachium / Dürres |
| Date: 1st CE late |
| Thing: Stamped lead pipes |
| Latin Text: L. Flavius Titi filius Tellus Gaetulicus |
| Notes: Patron was later an equestrian |

**#18**

| Place: Ionia, Ephesus |
| Date: 1st CE 4-14 |
| Thing: bilingual inscription |
| Action: Aqueduct bridge construction |
| Patron Status: Emperor + oversight of former consul [Gaius Sextilius Pollio and Gaius Ofilius Proclus] |
| Dedicant: Emperor + Goddess [Augustus, Tiberius and Artemis] |
| Status: |
| Greek Text: Imp(erator) Caesar Aug(ustus) et Ti(berius) | Caesar Aug(usti) f(ilius) | aquam Throessiticam | induxerunt curam | agentibus C(aio) Sextilio P(ublii) f(ilio) Pollione | et C(aio) Offilio Proculo. | Αὐτοκράτωρ Καῖσαρ | Σεβαστὸς | καὶ Τιβέριος Καῖσαρ, Σέβαστοι | υἱός | τὸ Θροεσσειτικὸν ὕδωρ εἰσήγαγον | έπιμεληθέντων Γαίου Σέξτιλ[ίου] | [Ποπλίου υἱοῦ, Πωλλίωνος καὶ Γαῖου] |
| Engl Text: [Lat] Emperor Caesar Augustus and Tiberius, Caesar son of Augustus, led in the aqua Throessitica with care, having the support of Gaius Sextilius Publius son of Pollio and Gaius Ofilius Proculus. / [Grk] Emperor Caesar Sebastos and Tiberios Caesar, son of Sebastos, led in the Throessitica’s water with the assistance of Gaius Sextilus Pollio, son of Publius, and Gaius Ofilius Proculus |
| Notes: Pollio and his son Proculus both donated and acted as supervisors for the project (they also donated the stoa beside civic agora, and were given civic monument by the demos) |
| Reference: IvE #152 (on section of aqueduct bridge belonging to Marnas/Throesseitica water line) and #153 (bilingual inscription, found reused in western façade of vedius gymnasium (see Keil, ÖJh 35 (1943) Beibl. 103 and IvE #402) |

**#19** Vacat

**#20**

| Place: Ionia, Ephesus |
| Date: 1st CE 54-68 [dated by letter forms cf SEG 55.1245] |
| Thing: Inscription |
| Action: aqueduct repair |
Patron Status: Emperor [Nero]
Dedicant: Goddess [Artemis]

Greek Text: [front] Νέρωνι Καίσαρ Σεβαστὸς Γερμανικὸς | Αὐτοκράτωρ Ἀρτέμιδι ἀποκατέστησεν | [back] | τὸ·ὕδωρ | ἐκ Βωνων | [etc]

Notes: τὸ·ὕδωρ ἐκ Βωνων = water from Kaystros valley
Reference: SEG 34.1122 = IvE 3219

#21
Place: Ionia, Smyrna
Date: 1st century CE 79-80
Thing: Inscription on marble
Action: Construction of aqueduct terminating at the temple of Zeus Akraios
Patron Status: Proconsul [Ulpius Traianus (father of Trajan)]
Dedicant: Na
Status: Na

Greek Text: Ἐκ τοῦ εἰσαχθέντος | ὕδατος ἐπὶ τὸν δία τὸν | 'Ακραῖον, ἐπὶ Ὀυλπίου | Τραιανοῦ τοῦ ἀνθυπάτου, | ἐν ταῖς στρατηγίαις | ταῖς Μάρκων Ἰουνίων | υἱοῦ καὶ πατρὸς κατὰ | τὸ ἔξης.
Reference: IK 23.680 with German translation, see also CIG 3146 = G.
Weber in JDAI 14 (1899): 174 = W. Dittenberger, OGI 477 = IGR IV.1411. Note also IK 23.#681 (a) and (b) for the repair of Trajan’s aqueduct, by Baebius Tullus, dated 110/111 CE

#22
Place: Lycia, Patara / Delikkemer
Date: 1st cent CE, 70-71
Thing: inscription, from wall supporting aqueduct led from Islamlar via an inverted siphon over the depression at Delikkemer, to Patara
Action: aqueduct repair after earthquake of 68 CE
Patron Status: emperor + governor; w/ ref to earlier work by 2 governors, titled presbyters and antistrategoi [Sextus Marcus Priscus, with ref to earlier construction by Vilius Flaccus and Eprius Marcellus (governors 48-50 and 50-55 CE, respectively). Note that Priscus was also responsible for construction of a bath in Patara SEG 57.1672, and a lighthouse SEG 57.1672, dated 64/5]
Reference: SEG 57.1673, with valuable line-by-line observations on this difficult and important text

#23
Place: **Lycia, Balboura / Çölkayiği**
Date: 1st cent CE, 74-76
Thing: inscription, from monumental fountain?
Action: Aqueduct construction
Patron Status: inscription erected by boule and the demos magistrates (presbyteros and antistrategos) to commemorate construction of aqueduct paid from their own [Loukios Louskios Okra with C. Pompeius Planta [epitropos/procurator friend of Trajan]
Dedicant: Emperor [Vespasian and sons]
Status: Na
Greek Text: Β[α]λβο[υρέων ἡ βουλὴ καὶ ὁ δῆμος κατεσκεύασεν τὸ ὕδραγωγεῖον ἐκ τῶν ἰδίων χρημάτων and much longer inscription of SEG 28.1218

#24
Place: **Lycia, Myra**
Date: 1st cent CE, 73
Thing: inscription, found in medieval Byzantine church of St Nikolaos
Action: construction commemorating; fragmentary but compare with the similar formula of inscription from Balboura SEG 28.1218
Dedicant: Emperor Vespasian and sons Titus and Domitian.
Status: Emperor Vespasian and sons Titus and Domitian.
Greek Text: [Αὐτοκράτωρ Καίσαρ Οὐεσπασιανὸς Σεβαστὸς | δίκαιος κύριος γῆς καὶ θαλάσσης | διὰ τῆς Τίτου Αὐρελίου Κυήτου πρεσβευτοῦ | ἰδίου καὶ ἀντιστρατηγοῦ προνοίας | ἐκ θεμελίων τὸ βαλλανεῖον]

Notes: It is unclear how the inscription was discovered or displayed within the church of St Nikolaos, if at all, though it is interesting to note the similar reuse of a construction inscription for the Aristion aqueduct – there it was whole, upside-down but text side-out – in the Marienkirche at Ephesus. The Aristion aqueduct line was in fact repaired around the fifth century; one of its destinations was the church complex in question. Could a similar situation have prevailed at Myra?

Reference: SEG 40.1280

#25
Place: Lycia, Olympos / Korykos
Date: 1st cent CE [Vespasianic]
Thing: Inscription, found in baths
Action: Aqueduct + bath construction
Patron Status: Emperor [Vespasian] with presbyter and antistrategos from his own [Titus Aurelius Kueetos]
Greek Text: [Αὐτοκράτωρ Καίσαρ Οὐεσπασιανὸς Σεβαστὸς | δίκαιος κύριος γῆς καὶ θαλάσσης | διὰ τῆς Τίτου Αὐρελίου Κυήτου πρεσβευτοῦ | ἰδίου καὶ ἀντιστρατηγοῦ προνοίας | ἐκ θεμελίων τὸ βαλλανεῖον]

Reference: SEG 54.1427

#26
Place: Phrygia-Lydia, Sardis
Date: 1st cent CE 53-54
Thing: bilingual inscription found reused in north face of northeast bastion of acropolis.
Action: Aqueduct construction
Patron Status: Emperor [Tiberius Claudius]. Supervision of the works by Tiberius Claudius Apollonenes, son of Demetrius, Qurina (tribe).
Greek Text: [Ti. Claudijus Drusi f. Caesar August[us Germanicus, pont(ifex)
[Τι. Κλαύδιος Δρούσου υἱὸς Καῖσαρ Σεβαστὸς Γερμανικός, ἀρχιερεύς, δημαρχῆς τῷ ἕκτῳ, ὕπατος τῷ εἴσῳ, ἀυτοκράτωρ τῷ κὺς, πατὴρ πατρίδος, ὕδωρ ἀπὸ πηγῆς πρὸς τὴν Σαρδιανῶν πόλιν διήγαγεν, ἐργεπιστατήσαντος Τιβερίου Κλαυδίου Δημητρίου υἱοῦ Κυρείνα Ἀπολλοφάνους].

Notes: Note that Apollonipes may also have overseen erection of statues for imperial family in Sardis bath, and his name was found on two water pipes at Pergamon (indications there of a longterm project, 18+ years)

Reference: IK 59.165 = l. Sardis 10 = CIL III.409 = IGRR 4.1505

#27
Place: Mysia/Lydia, Thyateira / Haciosmanlar or Akhisar
Date: 1st century CE
Thing: aqueduct w/ [erion] in stoa [ergasterion, oiketerion suggested as restorations]
Action: Aqueduct construction
Patron Status: Comarques [Aurelii lulianus and anonymous] + a logistes
Dedicant: Na
Status: N/a [fountain at Asklepius sanctuary]
Reference: AE (1976) 651 = Petzl in ZPE 23 (1976): 243-250. Construction was controlled by the logistes = curator rei publicae, called Tatianus, who was named by the emperor; with cost furnished from the town’s resources.

#28
Place: Peloponnese, Epidaurus
Date: 1st CE
Thing: Construction commemorative inscription
Action: Aqueduct and fountain construction
Patron Status: None given [Menophilos, by his virtue]
Dedicant: Na [fountain at Asklepius sanctuary]
Status: N/a
ἀνδρὸς Μηνοφί- | λου ἀρετῆς ἕνεκεν.

Reference: IG IV² 1.26

#29
Place: Phokis, Delphi
Date: 1st CE 87-91
Thing: Construction commemorative inscription
Action: Aqueduct and fountain construction
Patron Status: High priest with epimeletes, from temple revenues [Flavios Megaleinos]
Dedicant God [Pythian Apollo]

#30
Place: Syria, Apamea on Orontes
Date: Late 1st – early 2nd cent CE
Thing: Inscription
Action: aqueduct/bath construction, with dedication of bronze statues in baths, groups of marsyas, Theseus and the minotaur, Apollo olympos
Patron Status: descendant of tetrarchs + governor [Lucius Iulius Agrippa with Iulius Bassus]
Dedicant Agrippa’s ancestors

#31
Place: Syria, Apamea on Orontes
Date: 1st cent CE 47-8
Thing: Inscription
Action: aqueduct and nymphaeum construction
Patron Status: Emperor [Claudius] (nominative)
Greek Text: TI. CLAUDIUS. DRUSI. F. CAESAR. AUG. GERMANICUS.
PONT. MAX. TRIB. POT. VII. COS. IIII. IMP. XV. P. P.
CENSOR. AQUAS. INDUXIT.
Engl Text: Tiberius Claudius Caesar son of Drusus, Augustus Germanicus
Pontifex Maximus, having been tribune seven times, consul four times, acclaimed emperor fifteen times, father of the fatherland, censor, led water in [to the city]

Reference:  

#32

Place: Thrace, Perinthos / Herakleia [southernmost city along circuit of the Anastasian Long Walls]

Date: 1st cent CE [imperial]

Thing: Epitaph on relief

Action: Officer financed aqueduct construction; simultaneous donation with epitaph

Patron Status: Military officer, high priest, agonothete [T. Flavius Miccalus]

Dedicant: His wife, high priestess [Claudia …]


Notes: The head waters of the Değirmen creek some 30km to the NNE are the likely source for an aqueduct system serving Perinthos-Herakleia [Sayar 1998, 61-3]. Sayar also found a spring house with brick and ashlar stone work in the creek bed at Degirmen [Sayar 1998, 62 and Taf. VIII, Abb. 27-29]. In addition to a stretch of retaining wall associated with an aqueduct north of the city [Sayar Taf. VIII, Abb. 26], there are also a number of bridges in the area which, at least in the north, could be related to this system, see Sayar 1998, 63-5 and Taf. X-XI (Abb. 33-38).

Justinian is also attributed with the restoration of this aqueduct system (Buildings. 4.9.14-16). Interestingly, rather later, in 813
during the reign of Michael I, the emperor left Constantinople with the tagmata and his Augusta Prokopia, “who accompanied him as far as ‘the aqueducts’ near Herakleia,” or ἕως τῶν Ἀκεδούκτοθ πλησίον Ἡρακλείας (Theophanes AM 6305).

Reference: Text and translation from Sayar 1998, 257-8, inscription nr. 72

SEG 48.906 is doubtful of Sayar’s interpretation of this inscription, noting that “the restoration of LL. 4/5 ([τὸ | ὕδωρ σὺν τῷ μνημείῳ ἐκ τῶν ἰδίων ἀπήρτισεν) is improbable; at the beginning one expects a reference to some funerary structure, and not to an aqueduct (cf. no. 74 L. 2: τὸ μνημεῖον σὺν τῇ ἐπικείμενῃ στήλῃ), Chaniotis]."

SECOND CENTURY:

#33
Place: Achaia, Athens
Date: 2nd century CE, 125
Thing: Inscription
Action: Aqueduct construction commemoration
Patron Status: Emperor (Hadrian)
Dedicant Status: Deified Trajan (father of Hadrian)
Greek Text: IMP CAESAR T AELIUS | AUG PIUS COS III TRIB POT II | P P AQUAEDUCTUM IN NOVIS | CONSUMMAVIT | HADRIANUS ANTONINUS | ATHENIS COEPTUM A DIVO HADRIANO PATRE SUO DEDICAVIT

#34
Place: Achaia, Eleusis
Date: 2nd century CE
Thing: Inscription
Action: Aqueduct and fountain construction, for temple
Patron Status: Emperor (Hadrian)
Dedicant Status: “the gods”
Greek Text: [Αὐτοκράτωρ Καῖσαρ Τραιανὸς Ἀδριανὸς? Σεβ]αστὸς π(ατήρ) π(ατρίδος) ταῖς θεαῖς | [τὴν κρήνην ἀνέθηκε καὶ τὸ ὕδωρ εἰς τὸ ἱερόν ἠγαγεν]
Reference: AE (1999) 1488 = IG II².3196 = SEG 49.207

391
#35
Place: Arabia, Canatha/Qanawat
Date: 2nd century CE [104-8]
Thing: Inscription
Action: Aqueduct construction
Patron Status: {Presbyter and antistrategos [Cornelius Palma]}
Dedicant Status: Emperor (Trajan)

Greek Text: ὑπὲρ σωτηρίας | καὶ ύγείας | ἀυτοκράτορ[ς] | ὁς Νέρουα Τραϊανοῦ | ραϊανοῦ και | σαρος σεβαστ- | ὡγὸς ὕδατων | νερον Κάνατα ὑδατον [ἐρεμείων εἰς Κάνατα ἐκ προνοιας — — —].

Engl Text: For the salvation and health of the emperor Nerva Trajan Caesar Sebastos, Germanikos Dakikos, the aqueduct carrying water into Kanatha [was built] with the care of ...

Notes: Compare infra with #36, immediately below
Reference: SEG 7.977 = Syria 11 (1930) 275 [see also SEG 7.978 = Syria 11 (1930): 276 and SEG 7.1148 = RB 42 (1933): 239, 162]

#36
Place: Arabia, Canatha/Suweida
Date: 2nd century AD [104-8]
Thing: Aqueduct
Action: Construction
Patron Status: Presbyter and antistrategos [Cornelius Palma]
Dedicant Status: Emperor, for health/salvation [Trajan]

Greek Text: ὑπὲρ σωτηρίας αὐτο- | κράτορος Νέ- | ρουα Τραϊαν[ο]- | ου καίσαρος σεβ- | ου Γερμανικ- | ου Δακικοῦ ἀν- | ωγὸς ύδατων | ν εἰσφερομένων εἰς Κάνατα ἐκ προνοίας Κ- | ορνηλίου Πάλμας πρεσβευτοῦ ἀντιστρατήγου.

Engl Text: For the health/salvation of the emperor Nerva Trajan Caesar Sebastos, Germanikos Dakikos, the aqueduct carrying water into Kanatha was built by the foresight and care of Kornelius Palma presbyter and antistrategos of the sebastos


#37
Place: Argeia, Argos
Date: 2nd, ante 124 CE
Thing: Aqueduct
Action: Construction
Patron Status: Emperor [Hadrian] (nominative)
**Dedicant**
Na

**Status:**
Imperial ["Victory of the emperors"]

**Greek Text:**
['Υπὲρ τῆς τῶν Σεβαστῶν νείκης καὶ αἰώνιου διαμονῆς Αἰλιανὸς Φιλόπαππος ὁ και ἐπιμεληθεὶς τῆς τοῦ ὕδατος εἰσαγωγῆς ἐκ τῶν δημοσίων χρῆματων, ἐξ ὑποσχέσεως ἐπὶ τῶν ἵδιων πρώτος ἀποκατέστησεν. ἐπὶ τῶν ἵδιων πρώτος ἀποκατέστησεν. ἐπὶ τῶν Σύμφορον Εἰρηνίων ἂρχοντα [ἀρχόντων —— ]

**Transl. Text:**
"Wegen des Sieges der Augusti und für den immerwährenden Bestand hat Aelianus Philopappus (diesen Stein aufgestellt) und er hat auch für den Zufluss des Wassers aus öffentlichen Mitteln gesorgt und gemäß eines Versprechens hat er mit seinen Mitteln die Quelle vorher wiederhergestellt; zur Zeit als unter dem Archonten Symphoros, dem Sohne des Eiresion (folgende Männer Archonten waren: ….)

**Reference:**
Text and trans. from *IK* 33.44 = *CIG* 3797c = *IGR* IV.242

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**#39**

**Place:**
Bithynia, Nicaea / Iznik

**Date:**
2nd CE, 117-138 (Hadrianic)

**Thing:**
Inscribed block found reused in tower 42

**Action:**
Construction of aqueduct with bridges

**Patron Status:**
Emperor [Hadrian] + Presbyter and other titles [name unknown]

**Greek Text:**
πρεσβευτῆς τοῦ μεγάλου Αὐτοκράτορος καίσαρος Τραιανοῦ [Αδριανοῦ ——] | παραγέλλεται πάσι τοῖς γειτνίωντα χωρία τῷ ὕδραγωγίῳ κατοικοῦ | κούσι μήτε | μήτε ἐπεμβαίνειν κατὰ μήδενα τρόπον, κῶσαι δὲ καὶ τὰς [ | αἱ ἄν] εἰμιδῆσιν
This aqueduct was begun under Trajan and completed in Hadrian’s reign.


#40
Place: Bulgaria, Odessa / Varna
Date: 2nd century, 157 CE
Thing: Inscription – statue base?
Action: Aqueduct construction
Patron Status: Emperor [Antoninus Pius]
Dedicant: Emperor [Antoninus Pius]
Status: Emperor [Antoninus Pius]
Greek Text: [ἀγαθῆι τύχηι]. | [Αὐτοκράτορι Καίσαρι Τίτωι Αἰλίωι] | [Ἁδριανῶι Ἀντων̣[ε]ίνωι Σεβαστῶι Ἐυσεβεῖ]. | [ἀρχιερεῖ μεγίστῳ πατρί πατ[ridοσ] ή πόλις] | [Ὀδησσιτῶν καινῶι ὁλκῷ τὸ ὕδ[ωρ εἰσήγαγεν προ]- | [νοομένου Τίτου] Θύτρασίῳ Πωλλίωνος] | [πρεσβευτοῦ καὶ ἀντιστρατῆγου].
Engl Text: To good luck. For the Emperor Caesar Titus Aelius Hadrian Antoninus, blessed Sebastos, great high priest, father of the fatherland, the city of Odessa built led water [into the city] by the new conduit, managed by Titus Vitratus Pollio, presbyter and antistrategos

Reference: *IGBulg* I² 60

#41
Place: Caria, Aphrodisias / Geyre
Date: 2nd century CE, 125
Thing: Inscription found reused in street paving between the Basilica and the southwest corner of the Hadrianic baths
Action: Letter #3 of Hadrian to Aphrodisias, an imperial rescript, in which exception is made for service in imperial priesthood for
those individuals who might choose to donate for the financing of an aqueduct

Patron Status: Emperor [Hadrian]
Dedicant: n/a
Status: Greek Text:

ἐπὶ Κλαυδίου Ὠψικλέους scroll ἦρως. Αὐτοκράτωρ Καῖσαρ, | [θ]εοῦ Τραίανου Τραπέζου υἱός, θεοῦ Νέρουα υἱόν, Τραίανος Ἀδριανός | Σεβαστός, ἀρχιερεύς μέγιστος, δημαρχικής ἐξουσίας τὸ ἐνατον, | ὑπατος νυς. τὸ τρίτον. Ἀφροδεισίων νη τοῖς ἀρχουσι καὶ τῇ βουλῇ καὶ τῷ δήμῳ ν. χαίρειν stop τοὺς πόρους οὓς ἀπετάξασθε εἰς τὴν τοῦ ὕδατος | καταγωγήν βεβαιῶ stop ἐπεὶ δὲ ἦσαν πινες πολεῖται ὑμέτεροι λέγον- | τες εἰς ἀρχιερωσύνην ἀδύνατοι όντες προβεβλήσασθαι ν. ἀνέπεμψα αὐ- | τοὺς ἐφ᾽ ὑμᾶς ἐξετάσασθαι πολεῖται ὑμέτεροι όντες λειτουργεῖν διά - | δύνονται, ἥ ἀλήθη λέγουσιν. ν. εἰ μὲνοι φαίνοντο πίνες αὐτῶν εὐπορωτέ- | ρα, προτέρους ἐκεῖνοις ἀρχιεράσθαι δικαίον stop συνχωρῷ ύμείν παρὰ τῶν | ἀρχιερέων ἀντὶ μονομαχιῶν ἀργύριον λαμβάνει καὶ οὐ συνχωρῷ μόνον | ἀλλὰ καὶ ἔπαινη τὴν γνώμην. οἱ αἱρεθησόμενοι ὑφ᾽ ὑμῶν ἐπιμελη- | ταὶ τοῦ ὕδραγωγίου περὶ ὑμῶν ἐντυγχάνειν, | κἀγὼ γέγραπ- | [Engl Text: Letter 3 (lines 27-41): In (the stephan ephorate of) Claudius Hypsikles, heros. The imperator Caesar, son of divine Trajan Parthicus, grandson of divine Nerva, Trajan Hadrian Augustus, pontifex maximus, holding tribinician power for the ninth time, consul for the third time (CE 125) greets the magistrates, the Council and the People of Aphrodisias. The funds which you have reserved for the aqueduct I confirm. And since there are certain of your citizens who say that they have been nominated for the high priesthood when they are incapable of undertaking it, I have referred them to you to examine whether they are able to undertake the liturgy and are evading it, or are telling the truth; if, however, some of them were to appear to be better off, it is fair that they should hold the high priesthood first. I concede that you should take money from the high priests instead of gladiatorial shows; not only do I concede but I praise your proposal. The supervisors who will be chosen by you for the water-channel will be able to get advice and help on those matters on which they need them from my procurator Pompeius Severus, to whom I have written. Farewell. [trans. from Reynolds 2000] Reference: AE (2000) 1441 = SEG 50.1096 = SEG 51.1491 = Reynolds 2000]
**#42**
Place: Crete, Ano Paleocastro / Polyrhrenia  
Date: 1st late – 2nd early CE  
Thing: inscription; reused in fountain of village  

**#43**
Place: Cyprus, Amathous  
Date: 2nd CE early?  
Thing: stamped terra cotta pipes  
Action: Aqueduct / bath in use  
Patron Status: Emperor [Hadrian?]  
Greek Text: fragments of stamped pipe, referring to demesion and 20th/11th/x? year of Hadrian’s [?] reign  
Reference: SEG 41.1474, note another pipe w/ reign of trajan [84/85ad; SEG 50.1370]

**#44**
Place: Ionia/Asia, Ephesus  
Date: 2nd early  
Thing: Inscribed cornice from the Nymphaeum Traianii  
Action: Dedication of aqueduct + fountain terminus  
Patron Status: Asiarch, neokorate priest with his wife [Claudius Aristion]  
Dedicant Status: Gods + emperor [Ephesian Artemis + Trajan]  
Greek Text: 

For Ephesian Artemis and the emperor Nerva Traianus Caesar Sebastos Germanicus Dacicus and for the fatherland, Claudius Aristion thrice asiarch and neokoros with Julia Lydis Laterane his wife, daughter of Asia, high priestess and prytaneis … built ten stades of conduit … leading in the water and the fountain with all its decoration from his own.  

**#45**
Place: Ionia/Asia, Ephesus  
Date: 2nd century CE, 113/4  
Thing: Inscription  
Action: Proconsular edict protecting water supply
Patron Status: Proconsul
Dedicant Status: n/a
Greek Text: Αὖλος Οὐικίρ[ιος Μαρτιάλιος] | ἀνθύπατος λέγει[· —] | Αἰχμοκλέους καὶ Ἀντ[ωνίου; — ἐπι]- | κυρίως ὥστε ἑπτά τῆς λαμπροτάτης Ἐφε- | σιων πόλεως εἰσηγμ[ένου υπὸ Κλαυδίου] | Ἀριστιώνος ἄνδρος ὁ. [— ἐντυχόν]- | των μοι καὶ μενψαμέ[νων τούς κτήτορας] | [τῶν ἄγρων ὡς ἐπὶ τὸν ὄχθην ἄροτριών]- | [τας,] δέν ἀπό μέτρου ἠκαίνησαν τὰς ὕδατας τῆς Ἐφεσου ἐπιμελητῶν ἀνδρὸς ἀντίοις | μέρη ἄροτριά[ν, ἐπὶ τοὺς ἔχοντας] | [ἐν τῇ πόλει τὰς ὕδατας ἀδικεῖν τὸ ὕδωρ] | [ἀνοίγματα ποιοὶ[όντας καὶ εἰς ἀπρέ-] | [πεῖς αἵματι] ὑπηρε[σίας καταχρωμένου] ὡς τῇ ἁμαρτίᾳ αὐτῶν πολλὰ άτοπα γε- | [ν]έσθαι κελεύω τοὺς μὲν ἐπὶ τῶν ἄγρων παρ' ἐπικύρωσιν τῶν ὑπηρεσιῶν ὑπὸ Κλαυδίου Ἀριστίωνος ἀνδρὸς διασημοτάτου λέγοντες τοὺς γειτνιῶν- | τῷ ὀχετῷ καὶ τὴν περιττὴν χώραν μὴ τετηρηκέναι τὸ συνκεχωριμένον {τοῖς} τοῖς ὕδασιν εἰς κατασκευὴν καὶ ἀσφάλειαν τοῦ ἀγωγοῦ διάστημα, ἀλλὰ ἄκαίνησά ἐκατέρω[] ἐκατερώθη ἐδειμένον {Ἰ} Ὁικίριου

Engl Text: Notes: Reference:

#46

Place: Ionia/Asia, Ephesus
Date: 2nd century CE, 114/120
Thing: Bilingual inscription
Action: Proconsular edict protecting water supply
Patron Status: Proconsul [Sextus Subricius Dexter Cornelius Priscus]
Dedicant Status: n/a
Greek Text: Σέξτος Σούβ̣ρ̣ιος Δέξτερ Κορ- | ν[ιος Ρίσκος ἀνθύπατος λέγει· | ἐντυχόν μοι ἐκείνου τῶν εἰσηγμέ- | νων τῇ λαμπροτάτῃ πόλι ὑπὸ Ἐφεσοῦ Ἀριστιώνος ἄνδρος διασημοτάτου λέγοντες τοὺς γειτνιῶν- | τας τῷ ἀγωγῷ καὶ τὴν περιστεράν χώραν μὴ τετηρηκέναι τὸ συνκεχωριμένον {τοῖς} τοῖς ὕδασιν εἰς κατασκευὴν καὶ ἀσφάλειαν τοῦ ἀγωγοῦ διάστημα, ἀλλὰ ἄκαίνησά ἐκατέρω[· ἐκατερώθη ἐδειμένον {Ἰ} Ὁικίριου

Μαρτιαλίου, ἐν ό το τε | τῆς χώρας ὑρίκει μέτρον, οὗ τοὺς
gειπνιῶντας | ἐκέλευσεν ἀπέχεσθαι πλέω μὲν ἀκαίνης |
<ὁπ>τωρικ.debian τοῖς φυτεύουσιν, ἀκαίναν δὲ τοῖς εἰς <σ>πό- | ρον
gεωργοῦσιν, καὶ πρόστειμον ὑρίσεν κατὰ τῶν ἀπειθοῦντων·
ἐγὼ δὲ, εἰ καὶ μὴ τοῦτο ἐφθα- | κεν γεγραμμένον ὑπὸ ἀνδρός
λανπροτάτου, δικα[ι][ ]- | αὖ ἂν ἡγησάμην τοὺς βλάπτοντας τὴν
κοινήν | καὶ μεγίστην ὡδάτων εὐχρηστίαν προστείμω | ε<σ>ται
ὑπευθύνος· καὶ νῦν οὐ μόνον τηρῶ τὸ διά- | ταγμα Οὐικιρίου
Μαρτιαλίου, ἀλλὰ καὶ κελεύω | τοῖς κρατίστοις ἐπιμεληταῖς
<ὁπ>ῳ τῶν ἀπειθοῦντων·

Reference: IEph 3217b lines 18-47 = SEG 31.953

#47
Place: Ionia, Erythrai in the Sibylline Grotto east of the acropolis
Date: 2nd CE 162
Thing: Inscription
Action: aqueduct/hydragogion construction from spring [pege]
Patron Status: Unknown
Dedicant: dedication to demeter thesmorphos, Marcus Aurelius and
Lucius Verus
Greek Text: Δήμητρι θεσμοφόρι και [.............. ..............] καὶ τοῖς
αὐτοκράτορ[σι Μἀρκωι Αὐρηλίωι Ἀντω-] | νεῖνω και Λουκίωι
Αὐρηλίῳ | Οὐήρῳ και τῇ γλυκυτάτῃ πατρίδι Μάρκο[σ]
Κλαύδιος Π[..... ......] | τὴν πηγὴν τοῦ ὕδατος
ἀν[ ].... c.18. ......... ε[ι]σίγαγεν καὶ τὸ ὑδρα[γώγιον σ]ὺν τοῖ[ς
ἀγάλμασι] | ἐκ τῶν ἰδιω[ν—]

Engl Text: Für Demeter Thesmophrōs und [    ] und die Kaiser M.
Aurelius Antoninus und L. aurelius Verus und für seine geliebte
Heimatstadt hat Marcus [Clau?] -dius Π[ _ _ ] die Wasserquelle
[Hergerichtet und in einer Leitung] hergeführt und die
Brunnenanlage (?) mit den Statuen auf eigene Kosten gestiftet.

Notes: IK 2.2 p. 378 = Corssen in Athen. Mitt. 38 (1913): 2-4. The
grotto itself was discovered by a local in 1891 – it held a spring
which came out of a water channel and flowed into a small
basin, about 2m in diameter and revetted with marble.
Inscriptions indicate that the cave had statues of the Erythraian
Sibyl and a statue of her mother Nais.

(1892): 17-9, no.’s 4-8 = IK 1.#225

#48
Place: Ionia/Asia, Smyrna / Izmir
Date: 2nd CE 110-111

398
#49

**Place:** Lydia, Dağmarmara/Karaköy

**Date:** 2\(^{nd}\) cent CE, 180-192

**Thing:** inscription + donation of priest to aqueduct instead of 'covering costs for meals' of summa honoraria

**Action:** Aqueduct construction

**Patron Status:** Anthupatos [Geminus Markianos, governor under Commodus]

**Dedicant Status:** na

**Greek Text:**

(a) Τραιανοῦ | ὕδατος ἀποκατασταθέντος | ὑπὸ Βαιβίου | Τούλλου | ἀνθυπάτου (b, nearly identical)

**Notes:** See the perceptive notes of SEG 49.1556 = "LL. 3-6. Dionysios paid for the water-supply instead of 'covering the expenses for the meals': a reference to the summa honoraria commonly paid by the priest of the god [see now Reynolds in JRA 13 (2000): 5-20 and Chaniotis, EBGR 15 (2002) no. 148."

**Reference:** SEG 49.1556

#50

**Place:** Makedonia, Beroia

**Date:** 1\(^{st}\) late – 2\(^{nd}\) early CE

**Thing:** Construction commemorative inscription

**Action:** aqueduct + reservoir construction [hydragwgioν/ ἐκτοχεῖον = ἐκδοχεῖον]

**Patron Status:** Mother of high priest for life [Claudia Peierinos with her children, for the memory of her husband]

**Dedicant Status:** To memory of patron’s family


#51
Place: Makedonia, Europos (Lower Paionia)
Date: 2nd century CE
Thing: Construction commemorative inscription
Action: Aqueduct construction
Patron Status: None given
Dedicant: N/a
Status: 
Greek Text: Φίλιππος Ἀλεξάνδρου τὸ ὑδραγώνιν τῇ πόλει.

#52
Place: Palestine, Caesarea
Date: 2nd cent.
Thing: Tabula ansata on cornice of aqueduct
Action: Aqueduct construction
Greek Text: Vexillatio leg(ionis) X Fr(e)te(nsis ) [and] Imp. Caes. Tra. Hadr. Aug. per vexil. Leg. VI Fe[r.]

#53
Place: Palestine, Jerusalem
Date: 2nd CE?
Thing: Inscription
Action: aqueduct construction/repair
Patron Status: Centuria [military construction]
Greek Text: (Centuria) (Ο)ὐέρη | Veri (VEI Π | VERI

#54
Place: Palestine, Jerusalem
Date: 2nd CE?
Thing: Inscription
Action: Aqueduct construction/repair
Patron Status: Centuria [military construction]
Greek Text: (Centuria) Αὔλου Πο(- -)
Reference: SEG 52.1619 = Di Segni 2002, 51 with parallel texts for several centuriae of the Legio X Fretensis

#55
Place:
Date:
Thing:
Action:
Patron Status:
Dedicant
Status:
Greek Text:

Reference:
#56
Place:
Date:
Thing:
Action:
Greek Text:

Phrygia, Aezanoi / Çavdarhisar
2nd CE 139-161
Construction commemorative inscription
Aqueduct + fountain construction
Senator [Lucius Claudius Severinus]
God + emperor [Zeus and Antoninus Pius]
Διὶ Α̣ἰ̣ζ̣ανῶν καὶ Αὐτ̣ο̣κράτορι Καίσαρι Τ̣ίτ̣ῳ Αἰλίῳ Ἁδ[ριανῷ
Ἀντωνείνῳ Σεβασ]- | [τ]ῷ Εὐσεβεῖ καὶ Αὐρηλίῳ Καίσαρι καὶ τῷ
σύνπαντι οἴ[κῳ τοῦ Σεβαστοῦ {²vac.}²] | ἡ Αἰζανειτῶν πόλις τὸ
ὕδωρ εἰσαγαγοῦσα ἀποκατ[έστησεν — —c.12— — ἐκ] | τ̣ῶν
δημοσίων πόρων καὶ ἐκ δωρεᾶς χρημάτων [— — —c.15— —
—]- | [․ο]υ #⁵⁶ συντελεσθείσης τῆς τοῦ ὕδατος εἰσαγωγῆ[ς — —
—c.21— — —] | [Λου]κίου Κλαυδίου Σεβηρίνου τοῦ
ἀρχινεωκόρο[υ. {²vac.?}²]
AE (1989) 704 = AE (1973) 547 = SEG 45.1711 = MAMA IX.10

Pisidia, Kibyra
2nd cent CE , 169-177 or 180-192
Inscription
Protection of aqueduct
Vacat | [Κλ. Ἐτεωνεὺς ἀνθύπατος? Καισαρέων Κιβυρατῶ]ν
ἄρχουσι βουλῇ δήμῳ χαίρειν · ἡ μὲν εὐπειθία ΚΑ[- - - - - - - - -] |
[- - - - - - - - - - - - - - - τοῖς περὶ τῶ]ν ὑδάτων κριθεῖσιν εὐπειθῶς
ἐμμένειν · ὁ δὲ μέγιστ[ος αὐτοκράτωρ ἡμῶν - -] | [- - - - - - - - - - - - - - - - -]Ν ἐμέ τε ἠξιώσατε μεθ’ ὑμῶν ἐπιστεῖλαι, μαθὼν
ἕκασ[τα τὰ γεινόμενα? - - -] | [- - - - - - - - - - - - - - - - - - - -θεῖαν
ἐπιστολὴν ἀπέστει]λέ μοι ἧς ἀναγκαῖον ἡγη- σάμην ἀντίγραφον
ὑμεῖν ἀποστεῖλ[αι - - - - - - - -] | [- - - - - - - - - - - - -ἀναγρά]ψαντες
αὐτὴν καὶ θέντες πλησίον τοῦ βαλανείου πρὸς τῷ ν[αῷ?- - - - -]
| [- - - - - - ἵνα οἱ κακοποιοῦντες? ἐς τὸ μέ]λλον εὐλαβέστερον
ἔχωσιν μετα- κεινεῖν τι τῶν ἐπὶ σωτηρίᾳ κ[αὶ κατασκευῇ] | [τῶν
ὑδάτων κριθέντων? - - - - - - - - - - - - - - - - - - - -ἐρρ] ῶσθαι ὑμᾶς
καὶ εὐτυχεῖν εὔχομαι · vacat | [Αὐτοκράτωρ Καῖσαρ Μᾶρκος
Αὐρήλιος Ἀντωνε?]ῖ̣νος Σεβαστὸς Κλ. Ἐτεωνεῖ τῷ ἰδίωι χαίρειν ·
ὀρθῶς ἐποίησα[ς - - -] | [- - - - - - - - - - - - - εἰ - - - -] δύναιο
προσθῖναι καὶ τοῦτο προσθεὶς ὀρθῶς ποήσεις, ἐπιτεί[μια λαβὼν
- - -] | [καὶ δεῖ - - - - - - - - - - - - οὐ μόνον τῇ θείᾳ ἐπιστολῇ?
χ]ρήσασθαι ἧς ἀντίγραφόν σοι ἔπεμψα, ἀλλὰ καὶ τοὺς εἰς τὰ
βαλανε[ῖα - - -] | [- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - ]ΑΣ πάντα τρόπον ὀφεί- λουσιν καὶ τειμὴν ὑπὲρ ἑκάστου
δακτύλο[υ - - - - - - - -] | 12 [- - - - - - - - - - - - - - - -]ΣΙΣ βέβαιος
καὶ τῇ πόλει · ἦν δὲ εἰκός σε φροντίσαι καὶ τῶν σειτωνικ̣[ῶν
χρημάτων?] | [- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 401


ἐ]πανανκαιοτάτην δὲ ἡγοῦ- μαι ταῖς πόλεσιν εἶναι τὴν̣ [- - - - - - - - - -] | [- - - - - - - - - - - - - - - - - - - - - - - - - ὀχετὸν? ἠνο]ι̣γμένον
ὥστε ἅμα καὶ τῆς χρείας τῶν πόλεων καὶ τ̣[ῶν ἀγρῶν? . . .
βλαβείσης?] | 15 [- - - - - - - - - - - - - ἄλλ]οι τῶν γεωργούντων
παρὰ τοὺς δημοσ⟨ίους ὀχετοὺς ΔΙ[- - - - - - -] | [- - - - - - - - ἄλλοι
- - - - - - - -]Ν̣ εἰς τὰ ἑαυτῶν χωρία οἱ μὲν ἐπὶ προβάτων νομῇ ο[ἱ
δὲ - - - - - - - - - - -] | [- - - - - - - - - - - - - - - - - - - - - - - - - -]Φ[.
.]ΕΝΕ[. .]Κ[.]ΣΤ[- - - - - - - - - - - - | [- - - - - - - - - - - - - - - - - ] ΤΕ
ἀμελουμένου τοῦ πράγ- ματος Ω[- - - - - - - - - - - - - - - - - - - - - -] | [- - - - - - - - - - - - - - - -ζη]μία κατὰ τῶν τὸ ὕδωρ παρασπωμέ[νων - - - - - - - - - - - -] | 20 [- - - - - - - - - - - - - - - - - - -]Ν τοῖς
τοῦτο πράττουσιν καὶ κα- κ[οποιοῦσιν - - - - - - - - -] | [- - - - - - - - - - - - - - - - - - - - - - - - ὄχθαι]ς ἑκατέραις αὐτῶν ὁρισθῆναι
μ[έτρον?- - - - - - - - - - - - - - - - - - -] | [- - - - - - - - - - - - - - - - - - - - - - - - - - - χ]ρ είαν εἴς τε βαλανεῖα καὶ οἰκ α̣[ς - - - - - - - - - - -]
| [- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - ἕκασ]τον ἐνιαυτὸν τοῦ ὕδατ[ος - - - - - - - - - - - -] | [- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - ἴ]σην εἶναι δεῖ τὴν τε[ιμὴν - - - - - - - - - - - - - - - - - - - - - - -] | - - - - - - - - - - - - - - - - - - - - - - ------Notes:

Reference:
#57
Place:
Date:
Thing:
Action:
Patron Status:
Greek Text:
Reference:

This is a proconsular petition and imperial rescript concerning
water use, directed at farmers tapping into public lines for
irrigation and to water their flocks, with prescription of
punishments for offenders. Note the excellent line-by-line
observations on this difficult, important text in SEG 48.1582.
IK 60.19 = SEG 48.1582
Phrygia, Eumeneia / Işıklı
2nd century, 173 CE
Construction commemorative
Aqueduct construction
The city, with Proclus director of works
ἡ πόλις τὸ ὕδωρ εἰσήγαγεν ἔτους σνηʹ | μη(νὸς) βʹ, (ἡμέρα) ιʹ,
ἐργεπιστατήσαντος Πρόκλου τοῦ βʹ | πραγματικοῦ, γενομένης
δαπάνης | (δην.) ͵γχιβʹ.
MAMA 4.333
THIRD CENTURY:

#58a
Place:
Date:
Thing:

Caria, Stratonikeia / Panamara
3rd CE?
Inscription recording statue erection
402


**#58b**

**Place:** Caria, Stratonikeia / Panamara  
**Date:** 3rd CE?  
**Thing:** Statue erection

**Action:** Statues erected on behalf of priests, one of whom had built aqueduct to temple of Hekate  
**Patron Status:** neokorate priest, on behalf of demos [Marcus Sempronius Clemens, hiereus, his wife Tatias; for the memory of past priests, Isochrysos the priest and his wife and son, and the neokorate priest Flavius Phaidros]  
**Greek Text:** [ἱερεὺς ἐπανγειλάμενος ἐν Ἡραίοις τὸ β’, ιερατεύων κατὰ τὸ [αὐτὸ τῆς μεγίστης] καὶ ἐπιφανεστάτης θεᾶς Έκά- | τής, Μάρκος Σεμπρώνιος, Μάρκου υἱός, Κλήμης, μετὰ ιερείας [τῆς καὶ έαυτοῦ γύναικός Ἰσοχρύσου τῆς Ἀντιό- | χού Κω(ραίδος), μετὰ τὴν ἀρχιερωσύνην καὶ τὴν πρώτην ἱερωσύνην [Διὸς] Πα[να]μάρου | … κατεσκευάκότα ύδραγώγια καὶ ύδατα εἰσαγειωκχότα εἰς τὸ ιερὸν τῆς Ἐκάτης …]


**#59**

**Place:** Cilicia, Diokaisareia / Uzuncaburç  
**Date:** 3rd CE early [Severan]  
**Thing:** Inscription on south side of aqueduct bridge

**Action:** Aqueduct construction  
**Patron Status:** [Herakleides]  
**Dedicant Status:** Emperor [Septimius Severus]  

403
Reference: Heberdey and Wilhelm 1896, 90f #169

#60
Place: Mysia/Lydia, Thyateira / Ovaköy Meder
Date: 3rd cent CE?
Thing: Construction commemorative inscription
Action: Aqueduct construction
Patron Status: leitourgon, strategon, agoranomos, grain master, grammateus of the boule, grammatophylakos

Dedicant Status: Na


Reference: TAM V(2).991

#61
Place: Pamphylia, Aspendos
Date: Later 2nd – mid-3rd century
Thing: Inscription
Action: Aqueduct construction
Patron Status: Dekaprotos, high priest, demiurge, gymnasiarch, agonothete

Dedicant Status: Na

Greek Text: Τιβ. Κλ. Κυρείνα Ἐρυμ[έ]α, δεκάπρωτο ν, γυμνασιαρχήσαντα ἀλείμμασιν | ἐλκυστοῖς, υιὸν Τιβ. Κλ. | Ἰταλικοῦ, δεκαπρώτου | ἀρχιερέως, δημιουργοῦ, | γυμνασιάρχου και άγωνοθέτου τῶν | μεγάλων πενταετηρικῶν | ἀγώνων, || ἐπιδόντος | εἰς τῇ γυμνασίαν ἐν ἔτει τῆς ἡδονῆς | ἀργυρίου δισεκατομμυρίων | προῖκα

Notes: 2 million denarii for construction of aqueduct. For the office of
dekaprotos – which flourished from the reign of Nero into the fourth century, and which was responsible for collecting the wheat tax (but also undertook other tasks, like construction supervision or leasing revenues of sanctuaries, etc.) – see A. Sideris, “A Dekaprotos in Antikyra of Phokis” in Eirene 49 (2013): 54-74

Reference: IGRP III.804

#62
Place: Pamphylia, Side
Date: 3rd late – 4th CE (c. 300 CE?)
Thing: Inscription
Action: Aqueduct + nymphaeum repair
Patron Status: δουκηνάριος, ἀπὸ ἐπιτρόπων, πρειμιπειλάριος [Bryonianus Lollianus]

Greek Text: Βρυωνιανὸν Λολλιανὸν [τὸν κράτ(ιστον)] | δουκηνάριον, πρειμιπειλά[ριον, ἀπὸ] | ἐπιτρόπων, συνγενῆ ὑπατικ̣[ῶν], | κτίστην καὶ φιλόπατριν · [γερουσία τῶν] | Μεγαλοπυλειτῶν. | νηοῦ Νυμφάων σε παράσχεδον ἐστήσα[ντο] | ἡγεμόνες πυλέων, #56 Κτίστιε, τῶν μεγάλων, | τερπόμενον ρείθροι· | κτίστων τῶ σειτωνήσαντα Β' δίχα

Engl Text: …Near the temple of the Nymphs, let you r likeness be erected, | endower of the principle gate, named the Great, | Rejoicing you here by the current of the river sprung from Heaven; | For, with noble spirit you built at your cost | The unmeasurable river from its source to here

Reference: IGR 3.811 = ZPE 26 (1977): 161-171. In the ZPE, Foss suggests that the inscriptions should date to the end of the 3rd century CE, rather than earlier. On Bryonianus’s career, known from six other inscriptions, see ZPE 35 (1979): 213-224

#63
Place: Phrygia Pacatiana, Laodikeia Combusta / Ladîk
Date: Later 2nd or 3rd?
Thing: Construction commemorative, found reused in the fountain at Kurşunlu
Action: Aqueduct and fountain construction in agora
Patron Status: Agoranomos [Bassus Plutinos]
Dedicant Status: Na

Greek Text: Βάσσοντα | Πλουτίωνος | ἀγαθὸν πολεί| την ἀγορανομή || δημωφελῶς εὐ|ώνω τειμῆ τὰ σεῖτα | μετρήσαντα έν|δείας οὐσῆς ἐαυ || τῷ σειτωνή|σαντα Β’ δίχα
δημοσιῶν χρημάτων ἐπιμεληθέντα εἰσαγωγῆς ὕδατος του ἐπὶ τὸ ἐν τῇ ἀγορᾷ νύμφαι[...] ἀναλώμασιν ἰδί[...] ἐπὶ τῇ πόλει καὶ μαρτυρηθέντα ψηφίσμασιν Κλ(αυδιο)λαοδικέων ἢ βουλῆ καὶ ὁ δήμος

Notes: Note that this church system may be a predecessor or supply system for the ecclesial water features described in inscription #80 below, from c. 340 CE.

Reference: MAMA I.11 = Klio 10 (1910): 235 #4

IMPERIAL FIRST TO THIRD CENTURIES:

#64
Place: Aegean, Mytilene on Lesbos
Date: Imperial
Thing: Inscription
Action: Aqueduct construction?
Patron Status: --
Dedicant: Artemis
Greek Text: 1) — — ——ς τῶν κράνναν καὶ τὸ ὕδραγὼγιον ἀπὸ Κεγχρέαν Ἀρτέμιδι Θερμία Εὐακόω. Δίτας ἐποίησε(?)
2) ἐκ δείνα τῶν κράνναν καὶ τὸ ἐξ Αὐτομ... ὕδραγώγιον(?)[Αρτέμιδι Θερμία] {vac.} Εὐακόω καὶ τῶ δάμω. {vac.}
Reference: 1 = IG XII 2.103; 2 = IG XII 2.106; see also EAC 5 (1976) 32, #106 and SEG 26.890

#65
Place: Bithynia, Prusias ad Hypium / Düzce
Date: 1st – 3rd CE, early imperial?
Thing: Inscription
Action: Honorific mentioning aqueduct construction
Notes: patron ὑδωρ τῇ πολεῖ εἰσαγάγοντα with phyla i members Germanicus and Sabiniana
Reference: IK 27.19, compare with CIG 3797 for Hadrianopolis; cf also Pausanias 10.4.1

#66
Place: Cilicia, Iotape
Date: 1st – 3rd CE?
Thing: Statue dedication
Action: aqueduct/hydragwgion construction by honorand noted
Patron Status: prytaneis, hieronomos, liturgist [female donor Touea Distou Kanane]
Dedicant: Married couple, wife was imperial high priestess of empress
Status: Good fortune!
Greek Text: Ἀγαθῇ Τύχῃ | κατὰ τὴν δοθέαν τοῦ ὕδατος δωρεᾶν τῇ Λατορηνῶν κώμῃ ὑπὸ Γ. Ἰουλίου Πούλχρου Ποταμωνιανοῦ συνκλητικοῦ. | vacat | Τ. Φλ. Ἀθηναγόρας Κορνηλιανὸς Φουριανὸς συνκλετικὸ τὸ ὑδρεῖον τῇ κώμῃ ἀποκατέστησεν, τοῦ περὶ αὐτὸ ἀναλώματος παντὸς γεγενέμενο ὑπὸ δούλου αὐτοῦ καὶ πραγματευτοῦ Ἀφροδείσιον.
Engl Text: “To good fortune. An element of the water supply system, offered to the village of the Latorenoi by the senator C. Iulius Pulcher Potamonianos. The senator T. Flavius Athenagoras Corenlianus Furianos reconstructed the fountain/reservoir for the village, the totality of the cost was assumed by his slave and attendant Aphrodisios.”

Φοιριανός | συνκλητικὸς τὸ υδρεῖ- | ον τῇ κώμη ἀποκατέστη- | σεν, τοῦ περὶ αὐτὸ ἀναλ- | ματος παντὸς γεγεν- | μένου υπὸ | δούλου αὐτοῦ | και πραγματευτοῦ Ἀφρο- | δεισίου


#69
Place: Lydia, Dağmarmara/Karaköy
Date: 1st – 3rd cent CE
Thing: Inscription
Action: aqueduct + fountain construction [ἡ κρήνη καὶ τὸ ὑδραγώγιον]
Patron Status: Grammateus managing public funds [Menander, from village of Tempsianeia]

#70
Place: Lydia/Mysia, Thyateira / Ovaköy Meder/Medar
Date: 1st – 3rd CE?
Thing: Inscription, construction commemorative
Action: Aqueduct construction
Patron Status: leitourgon, strategon, agoranomos, grain manager, grammateus of the boule, grammatophylakos [Marcus Menander]

#71
Place: Palestine, Eleutheropolis
Date: 2nd - 3rd century CE?
Thing: Inscription
Action: Aqueduct construction, military involvement
Greek Text: (Centuria) Αὔλου Πο(- -)
Notes: Di Segni 2002, 51. Note the parallels for legionary construction at Jerusalem and Caesarea from the second century.
Reference: SEG 52.1619

#72
Place: Pontus, Amaseia / Amasya
Date: Imperial, possibly 3rd CE
Thing: Inscription, found built into wall of Yörgücü Pasha Camii at west end of town
Action: Aqueduct repair
Patron Status: Consul

FOURTH CENTURY:

#73
Place: Aegean, Samos “in Chora oppido”
Date: 4th-5th century CE
Thing: Aqueduct
Action: Construction (epigram)
Patron Status: Proconsul of Asia? [Aristo, PLRE I 107]
Dedicant: n/a
Status: n/a
Greek Text: Εἰσορόων τόδε θαῦμα — | μνιν, ἤνε<μ>υνῆ|α / πολ | [μελπ]αινέων | τείρομένων | τοῦ πριν ξηροτέροις | καί 'ρ' ὑπ' ἀμηχανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν / τὸ πρὶν ξηροτέροις | καί 'ρ' ὑπ' ἀμηχανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν / πόρον ὑπ' ἀμηχανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν / τὸ πρὶν ξηροτέροις | καί 'ρ' ὑπ' ἀμηχανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν / τὸ πρὶν ξηροτέροις | καί 'ρ' ὑπ' ἀμηχανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν / τὸ πρὶν ξηροτέροις | καί 'ρ' ὑπ' ἀμηχανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν / τὸ πρὶν ξηροτέροις | καί 'ρ' ὑπ' ἀμηχανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν / τὸ πρὶν ξηροτέροις | καί 'ρ' ὑπ' ἀμηχανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν / τὸ πρὶν ξηροτέροις | καί 'ρ' ὑπ' ἀμηχανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν / τὸ πρὶν ξηροτέροις | καί 'ρ' ὑπ' ἀμηφανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν / τὸ πρὶν ξηροτέροις | καί 'ρ' ὑπ' ἀμηχανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν / τὸ πρὶν ξηροτέροις | καί 'ρ' ὑπ' ἀμηχανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν / τὸ πρὶν ξηροτέροις | καί 'ρ' ὑπ' ἀμηχανίης εὗρε πό- | ρον ὕδασιν | καί τὰ μὲν κατέθηκεν ἐπὶ σκοπέλοις κελα- | ρύσειν /

Notes: For arguments on the identification of the patron of this epigram with the Late Antique proconsul Aristo, see Robert 1948, 66-7 or for a slightly later date AM 75 (1960 [1962]): 137
Reference: SEG 50.810 = IG XII.6.494 = IGR IV.967

#74
Place: Cappadocia, Tyana / Kemerhisar
Date: 4th CE +
Thing: Funerary inscription
Action: Circitor saburræae makes monument for dead wife
Patron Status: Circitor saburrae / praepositus
Greek Text: Βειταλιανὸσ κερκείτωρ σευούρας Σευ- | ερείνου πρεποσείτου | γενηθέντα ἐν Δακεία ζοίαν ἀτλειαν Κύζην πα- | ραλαβόντα μου | κοινωνείαν <σο> ἡμέρας δεκαπέντε αὐτὴν | ἀπώλεσα | Βειταλεια- | νός Κύζε μου σώζου
Notes: Circitor saburrae was responsible for ensuring that sand was cleared from the aqueducts

#75
Place: Caria, Tralleis
Date: 4th CE 340-350
Thing: Epigrammatic inscription
Action: Repair of aqueduct
Patron Status: proconsul/anthupatos [Caelius Montius]
Greek Text: καὶ τόδε σῆς ἀρετῆς | πανεπίφρονος ἐξοχὸν ἔργον, | Μόντιε | κυδήεις, ἀνθυπάτων | ὕπατε, | οὐδές <ἰ>ώσιν | κατ’ | οὔδεος ὕδατος ὁλκὸν | κείμενον ὀρθῶσας ἄστυ | τόδ’ ἡγλάισας, | καὶ ποταμὸν | κατεδόθης οὐράς, | δεόσις, αὐτής | Τραλλιανῶν ἐπὶ ἔργῳ | στῆσέ σε βουλή, σωτῆρα | κτίστην Μόνιον ἁζομένη.
Reference: IK Tralleis #152 = Robert 1948, 112-114 = AE (1910) 58

#76
Place: Crete, Psallida
Date: 4th – 5th CE
Thing: Cippus inscription
Action: Aqueduct construction
Patron Status: lamprotatos (consul/exconsul) [Herennianus]
Dedicant: n/a
Status: n/a
Greek Text: #1 κτίστη νέο |υ ἀγωγοῦ Ἑρεν|νιανῶ τῶ λαμπροτάτω #2 Ἐργον | Ἑρακλίου | ἔως ἥδαι
Engl Text: #1: “(A dedication) to the builder of the new aqueduct, the most illustrious Herennianus.” #2 “The work of Herakleios is up to this point.”
Notes: Herennianus is named as the builder, either from his own expense or by his order. Lamprotatos implies consular or formerly consular status, though it could be used of other.
Reference: Bandy 1970, p. 77-8, #47

#77
Place: Galatia, Ancyra / Ankara
Date: 4th – 5th CE
Thing: inscription honoring individuals connected with construction of
embolos, marble decorations, the roof, water system (donor possibly Theodotos?)

Action: commemoration of aqueduct construction/repair
Patron Status: unknown. Donor of hydragogion missing, but set in a list of buildings constructed with donors identified by their first names, without offices.

Greek Text: [— — —]σας καὶ τὰς τοῦ ὁλκοῦ καμάρας τὰς παρακιμένας τῷ Πολυείδῳ· καὶ τοὺς ἐνβόλους — [— — —] ἐρήμου ἐστίμα ὁρφώσας καὶ τὸν ὁλκὸν αὐτοῦ κατασκευᾶσας, ν περισώσας καὶ [— — —] [— — —] οἶκον τοῦ χιμερίου δημοσίου λι<π>όντα αὐτὸς ἀνενέωσεν σὺν τῇ μαρμάρῳ σ[— — —] | [— — —]σι καὶ τῷ λοιπῷ κόσμῳ κατασκευᾶσας· ν καὶ τὴν στέγην ἀπάσαν τοῦ πρὸ τοῦ παλατίου [— — —] 5 | [— — —] ἔξπεμβληθεῖς καὶ τοῦ δημοσίου φρουρίου· ν καὶ τοῦ ὑδατον σπείροι καὶ ὕδριον τοῦ [— — —] [— — —] τὴν ὁδόν τίου Θεοδότου ἄβατον οὖσαν αὐτὸς κατασκευάσει· ν τὰς ἐν Διλιμνία ν καὶ [— — —] [— — —] κατορθωσάμενος τῆς πόλεως καὶ ἔτερα κτίσματα ἐν χρόνοις τῆς υπατίας [— — —] [— — —] σὺν τῶν πλιόνων ἔργων Ἰωάννου Ε̣[ὐ̣]τυχικοῦ τοῦ ἐπίκλην Ἀνατέλλον[τος — — —]

Notes: Foss agreed with Bosch and dated this inscription to the Constantinian period, but C. P. Jones puts it in the fifth century.

#78
Place: Moesia, Tropaeum Traiani / Adamclisi
Date: 4th early CE
Thing: Inscription
Action: discovery/adduction of water
Dedicant: God [Hera]
Status: God
Greek: Οὐρή Βασιλίσσῃ ὑπὲρ τῆς εὑρησεως τοῦ ὕδατος ή πόλις Τροπεισίων εὐχῆς χάριν.
Text: Τροπεισίσιον εὐχής | χάριν.
Reference: AE (1976) 625

#79
Place: Palestine, Caesarea
Date: 4th CE 385
Thing: Construction commemorative inscription
Action: Aqueducts (2) construction
Patron: megaloprepestatos anthupatos (proconsul of Asia) [Flavius Florentius]
Status: megaloprepestatos anthupatos (proconsul of Asia) [Flavius Florentius]
Greek: Ἐπὶ Φλ(αβίου) Φλωρεντίου ( | τοῦ μεγαλοπρεπεστάτου | ί οὐρή Βασιλίσσῃ ύπερ τῆς εὑρησεως τοῦ ὕδατος ή πόλις Τροπεισίων εὐχῆς χάριν.
Text: Τροπεισίσιον εὐχής | χάριν.
In the time of Fl. Florentius, the most magnificent proconsul, the two aqueducts were renovated from the foundations.

SEG 18.626 = IEJ 9 (1959) 188-190 = AE (1961) 270

Notes:

Phrygia Pacatiana, Laodicea Combusta / Ladîk

Date: 4th cent CE 340?

Place: Phrygia Pacatiana, Laodicea Combusta / Ladîk


#80

Notes: Note that this church system may be a dependency on the earlier-established aqueduct supplying a fountain at the agora, constructed by the agoranomos Bassos Plutinos [see infra #64]

Reference:


#82

Notes:

FIFTH CENTURY:

Place: Achaia, Athens from the Kerameikos cemetery

Date: 5th or 6th?

Thing: Epitaph, inscription inside an incised tabula ansata
Action: Na
Patron Status: Decedent was architect and manager of aqueducts
Dedicant Status: na
Greek Text: [κοιμήτηρι- | ον Άνδρε- | α ύδραγου- | γού και άρ- | χιτέκτων- |
ος τών ύδα- | των.
Reference: SEG 35.189

#83
Place: Caria, Stratonikeia
Date: Later 5th CE?
Thing: Epigrammatic inscription
Action: Aqueduct repair/restoration
Patron Status: πατέρ πολέως, father of the city [Apollinarios, father of Stratonikeias]
Greek Text: Φορμίζων κιθάρῃ μελιηδεί Πίνδαρος εἶπεν γαίῆς εὑρυβόιτιο καὶ
ήρπτς ἀμβροσίοι καὶ πυρὸς ἀκαμάτοιο μόνον προφερέστερον
ἐίναι ύδωρ ἀγλαόριθρον, ὦ τίσυνος 
γενέτης Ἀπολινάριος Στρατονίκης ὅλον ὅλον νεότευκτον ἐθήκατο καὶ πόρεν ύδωρ, ἀστεοί 
καὶ ναετήρι πόρων ἄμπαυμα μέγιστον.
Engl Text: “playing the lyre sweet as honey, Pindar declared that the earth
of vast prairies, the ambrosian air and the fire indefatigable,
only running limpid water is superior, which happy men desire.
Conscientious of this, Apollinarios, father of Stratonikeias,
consecrated the new aqueduct constructed and brought water
for the city and its inhabitants, bearing a respite from their great
pain.”
Notes: Note from IK 22.1529, here at 66 describes the excavations at
the west city gate between 1977 and 1980, when Byzantine
period water pipes and bronze water distribution equipment
were discovered, in addition to Late Antique statues flanking a
fountain house that were identified as Apollinarios and his wife.
On these sculptures see also more recently, Özgan 1999, 134-
136, which confirms the tentative dating of the inscription to a
period between 450 and 500 CE.

#84
Place: Cilicia, Akkale
Date: 5th late
Thing: Inscription
Action: Bath restoration, fed from diversion of aqueduct line also
restored by Illos
Patron Status: Magister militum [Illos]
Dedicant: na
Greek Text: † (L. 1 illegible) | † Ἰλλο[υ ἀ]λεξι[κ][άκου. . .] | ΟΜΟΚ.ΝΟ[. .
λ]τρὸν καλὸν ἐλεξικ[άκον {κ} ὡς καθαροῦ | καθαρὸν †
Reference: SEG 37.1325 = Dagron and Feissel 1987, 53-54 nr. 22

#85
Place: Cilicia, Casae / Asar Tepe
Date: 5th CE late [Leo I, 457-474?]
Thing: inscription; rescript w/ edict of governor to city, inscription built into southeast wall of church on limestone blocks
Action: Settlement of dispute over concessions of land, with imperial decision (A) and prostagma to governor (B), followed by an address of the provincial governor to the city of Casae, concerning a Breviatika, which Bean and Mitford interpreted as concerning the reversion of land concessions to the city, rather than to heirs. In this case the land appears to include an aqueduct or canals for irrigation [ὑδάτων γὰρ ρύσιν]
Patron Status: magister militum? [Flavios Patrikios]
Dedicant: na
Greek Text: + Φλ. Πατρίκιος Κλ. [Ζη]νοφάης ? πᾶισι τοῖσ παλλατ[ίνο]ις?
Κόμησ[ι] τὸ ΠΡΑ ..] .. ΛΟ. ΑΡΑΙΓΡΑΜ ........... στωρ Κασ[
καὶ το[ί]σ στρ(ατιώταις) ρ' τάγματ[ος –] –––––––––––––
| τοῦ ἀηττήτοθ καὶ τροπεούχοθ …ἡμῶν δεσπότου τὰσ
μεγαλοδωρέας οὐκ ἔρ νν γῳ λόγῳ παραστῆσε δυνατὸν.
ὑδάτων γὰρ ρύσιν μιμού[αι] προφθάνουν τὸν τὴν ... ΙΡΙΝ - –
–––––––––––––- ἄπασιν? καθαρὸν ποιεῖν ὡστε
ἀπ[οφι]μῶσε τὰσ ἀμφιβολίας ἐκτέμνουσιν καὶ πυρὶ ὡς ἀκάνθας
παραδίδοσθαι, ὅπως καθαρώσ καὶ ἄνευ τινὼν πονηρῶν
βουλευμάτων ......
Reference: Bean and Mitford 1970, 51-59, nr. 31C

#86
Place: Cilicia, Elaiussa Sebaste / Ayas
Date: 5th CE
Thing: Inscription on stone
Action: Designated as an aqueduct construction, though archaeologically this appears to be a restoration
Patron Status: πατὴρ τῆς πόλεως [assumed by Elton, Hunger, Roueche to be identical w/ magister militum Illos, rival of Zeno, patron of Akkale estate]
Dedicant: na
Status:
Greek Text: † Ἐγένετο τὸ ἔργον τοῦτο ὀρχ[τ]άρια- | ο ἐπὶ Ἰλλου 
μεγαλοπρ(επεστάτου) κόμ(ητος) | (καὶ) πι?ατρὸς ἐν ἰνδ(ικτιῶν) 
iβ´ †

Notes: This aqueduct supplied, via a diversion from the main line, Illos’s fortified villa of Akkale with its bath and monumental reservoir. See below


#87
Place: Isauria, Zenonopolis
Date: 5th CE 488
Thing: Inscription
Action: Construction of aqueduct for fountain in forecourt of saint’s sanctuary
Patron Status: Bishop [Firminianos]
Dedicant: na

Greek Text: † Φιρμινιανὸς ὁ εὐλαβέστ(ατος) ἡμῶν ἐπ ίσκο(πος) ταύτης | τῆς 
λαμπ(ρ)άς) Ζηνυσσοπολιτῶν πόλεως ἐπεσκευ[α]- | σεν ξ 
όλακλήρου τὸ ὅλον ὕδραγωγίον τοῦ ἁγίου | μάρτυρος 
Σωκράτους μετὰ ὑπατίαν Φλ(αουίου) Λονγι- | νοῦ τοῦ 
λαμπροτ(άτου) ἰνδ(ικτιῶνος) ιαʹ καὶ ἔρευσεν πρώ- | τοις ἐν τῷ 
tετραστόον σὺν τῷ ἐξωύδρῳ τοῦ αὐτοῦ | ἀθλοφόρου μην 
Φεβρουαρίου· εὐχεσθαι οἱ ἀπολαύοντες ὅπως τε 
πρεσβίες τοῦ ἁγίου μάρ- | ἀρραγῆ αὐτὸ διαφυλάττεσθαι 
ἐπὶ πολλοῖς | † καὶ μηκίστοις χρόνοις† | ἠργάσατο δὲ Αὐξάνον 
ὑδραγωγὸς Πρυμνησσεύς

Notes: SEG 44.1222 gives brief commentary on this important inscription, which records the reconstruction (ἐπισκευάζειν) of the ‘aqueduct of St. Sokrates,’ with a fountain (ἐξωύδρον, elsewhere unattested) in the colonnaded forecourt (τετράστοον) of the saint’s church. SEG 44.122 is of the opinion that the ὕδραγωγίον was “probably more than a small conduit serving only the sanctuary.”


#88
Place: Pisidia, Antioch
Date: 5th cent CE
**Thing:** Epigrammatic inscription  
**Action:** Aqueduct construction  
**Patron Status:** No title [Kolobrasos]  
**Dedicant Status:** na

**Greek Text:**

[† Τοῦτο e.g. Κολόβρα̣σος ἔργον ἑῆι/ἐπ ί | [σοφίηπο]λυβούλωι | [άρχθεν ὑ]π̣ὸ προτέρων ἣνυς | [θεσμοπόλων· - - - - - -] ῥέεθρον ἀνάντα? | - -P Ν ἐς χώρους ἀγαγεῖν | [διψαλέους πρότερον.

**Reference:** SEG 6.560

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**#89**  
**Place:** Pisidia, Antioch  
**Date:** 5th cent CE  
**Thing:** Epigrammatic inscription  
**Action:** Aqueduct construction/repair  
**Patron Status:** No title [Gorgasos]  
**Greek Text:**


**Reference:** SEG 30.1505 = SEG 5.560 and Robert 1948, 64 = with an alternative reading by W. Peek, GVAK 53 #38.

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**#90**  
**Place:** Pisidia, Antioch  
**Date:** 5th cent CE  
**Thing:** Epigrammatic inscription  
**Action:** Aqueduct construction/repair  
**Patron Status:** Strategos?  
**Greek Text:**

ὁρᾶις τόδ᾽ ἔργον ἡλίκον, πῶς δας ἡλίκη | Νυμφῶν χορηγεῖ τῇ πόλει τὰ νάματα· | σοφὸς δικαστὴς 

**Notes:** “See the helikon!” This may refer to a water-raising device, built by the sophos of the strategos? patron.

**Reference:** SEG 30.1506

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**#91**  
**Place:** Pontus, Amisos / Samsun  
**Date:** 5th cent CE 435  
**Thing:** Inscription for gold statue, for donor of aqueduct  
**Action:** Aqueduct repair for use by public/private baths in town  
**Patron Status:** Spectabilis and praeclarus = magnificentiissimus comes [Erythrios]  
**Dedicant:** City commemorates achievements of donor, Erythrios
Αγαθῇ + Τύχῃ | Χρυσῶν μὲν ἔδει στηλῶν καὶ τῶν | τῶν εὐεργεσιῶν | τῆς τῶν εὐχαριστιῶν ἠμοιβαῖς κατό- | τινὶ 

Δέχου τοϊνθν, ὑπέρ- | λαμπρὲ και περιβλεπτε, τῆν 

δυνατη[ν] | παρὰ τῶν σῶν πολιτῶν εἰς αἰώνας | εὐχαριστίαν. Οὐ 

gὰρ ὁστο καὶ δήμο[σ] | ταῦτα λέγομεν, ἀλλὰ καὶ πᾶς ἐπίδη- | 

μῶν ξένοις καὶ πάσα | περιοικ[ὸς] κατό- | 

τῶν εὐχαριστιῶν ἀμοιβαῖς κατό- | τινὶ 


Dedicant: Na

Status:

Greek Text: ὁλκὸς ὅδ' ἀργυρέων ρίθρων ποταμοῦ γέμεν· οὐ θην / ἀμφοτέρω· θε νάπας αὖ διέδραμεν εὐρυθέμειλος / σεῖο μόνον νεόσαντος, ἀκοιμήτῳ ὑπὸ ἔργῳ, / Φοινίκης πολίων, / Μουσῶν <τ>ε[ίχ]σμα φυλάσσων. / ἔτους βμψ', ἰνδικτί(ώνος) / τοῦ θαυμασιώτατον Λούπο ποταμοῦ τοῦ / πρωτεύοντος ἐκ τῶν / i<δ>[ιω]ν κτίσαν(τος) / στρατηγ(ία) Σερήνου Αθηνέου.

Reference: IGLS 6.2831

SIXTH CENTURY

#93
Place: Arabia, Abila
Date: 568 CE
Thing: Painted graffito in aqueduct tunnel
Action: Channel cleaned/maintained
Patron Status: Bishop
Greek Text: 1 [ἐπι . . . . . τ] ο [ὗ | 2 ἁγ[ι]ωτάτου κ(αί) μακαρι- | 3 ωτάτου ἐπισκοπόπου | 4 ἐξύσθη ὁ αὐλῶτος ὁ ἀν- | 5 ωτερος ἐν [μην]ι σεπτε- | 6 μβρίωι ὀκτοβρίωι ἰνδ- | 7 ικτίονος δευτεράς τού | 8 ἔτους αλκ ε ηο | 9 ιθ | 10 ω ιθ
Engl Text: 1 [At the time of….] the | 2 most holy and most | 3 blessed bishop, | 4 the upper channel was cleared | 5 in the month (s) Sep- | 6 –tember (and) October, in the second | 7 indication (and) the | 8 year 631
Reference: Text and trans. from Wineland 2001, 76-78

#94
Place: Bulgaria, Serdica / Sofia
Date: 6th century, 580 CE
Thing: Inscription on stone
Action: Aqueduct repair
Patron Status: Emperor [Tiberius, nominative] + Candidatus [Julianus] and archbishop [Leontios]
Latin Text: + Imperator Tiberius Constantin(u)s Aug(ustus) | inter reliquas edes Serd(icae) civitatis | hunc aquiductum renovavit data pecunia | p(er) v(irum) magnif(icum) Iulianum candidatum, instantia | dom(ino) v(iron) beatiss(imo) Leontio archiepiscopo | m(enense) julio per (in)dic(tionem) XIV
Engl Text: Emperor Tiberius Constantinus Augustus, among the other buildings of the city of Serdica, renovated this aqueduct, having given money through the magnificent candidates Julianus, by the earnestness of blessed Leontius archbishop in the month of July, indication 14
Reference: Besevliev 1964, 2 #3

#95
Place: Cilicia, Ören Köy near intake of the Olba/Ura aqueduct on the Lamos river
Date: 6th CE 566/7
Thing: Painted inscription on red on rock-wall of aqueduct channel near the intake
Action: Aqueduct repair
Patron Status: Bishop [Kosmas]
Dedicant Status: Emperor and empress [Justin II and Sophia]
Reference: MAMA III.106 = SEG 37.1319

#96
Place: Cilicia, Soloi – Pompeiopolis
Date: 5th – 6th century
Thing: Inscribed lead pipes
Action: Pipes imply aqueduct system in use, possibly in connection to an Episcopal complex or palace.
Patron Status: Bishop [Theodore]
Dedicant Status: n/a
Greek Text: Four pipes which can be restored as, per Feissel #25 + Ἐπιθεοδώρου τοῦ ἁγιωτάτου ἐπισκόπου ἰνδ(ικτιῶνος) δ’
Notes: Theodore is adjoined to an Episcopal list from Pompeiopolis from which a Matronianos is known to have been seated as bishop at councils of 434 and 451; Theodore was probably a successor, placing him in the later fifth or sixth century
Reference: Dagron and Feissel 1987, 63, #25 = SEG 28.1288

#97
Place: Crete, Hagioi Deka / Gortyna
Date: 6th CE
Thing: Inscription on marble cymation from ruins of Odeum
Action: Aqueduct construction
Patron Status: Bishop? [Georgios]
Dedicant Status: na
Greek Text: + ὁ πρὸς εὐσέβειαν ἐκτρέχων Γεώργιος | καὶ προσεπιβάλλων τῇ πόλει τὴν ὀχετείαν? | ἐξανιστᾶ τὸν τόπον | διψή τὸ πρῶτον
Georgios who runs forth to show his piety and adds irrigation to the city as well causes the place to flourish. The city at first was thoroughly parched, unbefittingly perishing for water. He made the place new again when it lay prostrate.

Notes: Bandy identifies this Georgios as the same who cooperated in the restoration of a Πάτος or floor (of a cistern, bath, or church) in his #32, there with one Sigilius, the σκρινιαρίος and πατέρ πόλεως. Georgios is identified there as cooperating with a Ioannes and Helladios. Bandy rejects Guarducci’s suggestion that Georgios was a bishop, because of the lack of an honorific.

Reference: Trans. and text from Bandy 1970, #33 = CIG 4.8835 = I C 4.461

#98
Place: Palestine, Bethlehem
Date: 6th CE early-mid? [Anastasius or Justinian?]
Thing: Inscription, legal notice
Action: Protection of aqueduct
Patron Status: silentiarios, ktetor [Flavios Ainias]
Dedicant: na
Status: na

Greek Text: † Φλ(άουιος) Αἰνίας (sic) σιλεντια[ρί]ος κτήτορσιν, ἐγλήμπτορσιν καὶ γεωργοῖς· γινώσκετε, ὡς ὁ θιότατος καὶ εὐσέβ(έστατος) δεσπότης ὅλης οἰκουμένης ἐθέσπισεν μὴ ἐξεῖνατι ἀπὸ ιεποδῶν ἐξ ἑκατέρου μέρους τοῦ ὑδραγωγίου· κατὰ τὰς θίας διατάξις ἐπὶ τὰ ἔσω μέρη σπίριν ἢ φοιτεύειν. Ἐ(ἰ δέ τις τοῦτο ἐπιχιρήσῃ ποιῆσαι, κεφαλικὴ ὑπομένια τιμωρίαν καὶ τὸ κτήμα αὐτοῦ δημεύετε. Τὸ δὲ μέτρον τοῦ ποδὸς 15 ύποτέτακται τοῖς τύποις †

Notes: This is a repetition of an order forbidding seeding or planting within 10 ft of an aqueduct [CTh. 15.2; CIC 11.43; CIC 11.43.6.1]. Note the argument of Jones 2007, who reads Procopius of Gaza’s panegyric account of aqueduct construction at ‘Hierapolis’ to refer not to Syrian or Phrygian Hierapolis, but rather to Jerusalem. Jones adduces this inscription as potential evidence for his argument, though the inscription has traditionally been accorded a Justinianic date.

Reference: SEG 8.171 = SEG 52.1617 compare repetitions of the same order from SEG 53.1785; SEG 57.1829

#99
Place: Palestine, Scythopolis / Beth Shean
Date: 6th CE 521-522
Thing: Mosaic pavement inscription; on urban Silvanus Street; found re-employed in pavement parallel to amphitheater, covering pipes

Action: Construction of conduit

Patron Status: Very magnificent count with clarissimus count and principalis as supervisor [Flavius Orestes with Silvanus son of Marinus]

Greek Text: (B) Ἐπὶ Φλ(αουίου) Ὀρέστου μεγαλοπρ(ε- | πεστάτου) | κόμ(ητος) καὶ ἄρχ(οντος) τὸ περιβόητον ἔργον | τῆς πλακώ- | σεως μετὰ κ(α)ὶ τοῦ νέου | ὑδρίου ἐγένετο, προνοησαμένου II | Σιλβίνου Μα- | ρίου λ(αμπροτάτου) κόμ(ητος) | κ(αὶ) πρώτ(ου) | ἐν ἰνδ(ικτίωνι) ιεʹ, | ἔτ(ους) επφʹ vacat

Engl Text: “Under Flavius Orestes, the very magnificent count and governor, the important work of the pavement with a new water conduit was completed under the supervision of Silvanus son of Marinus, the clarissimus count and principalis, in the 15th year of the indication, the year 585.


#100

Place: Pontus, Trapezus / Trabzon

Date: 6th cent CE 542

Thing: Aqueduct construction

Action: Aqueduct construction

Patron Status: Emperor + bishop [Justinian + Ouranios]

Dedicant Status: Christ

Greek Text: Ἐν ὀνόματι τοῦ δεσπότου ἡμῶν Ἰησοῦ | Χριστοῦ τοῦ Θεοῦ ἡμῶν · αὐτοκράτωρ | Καῖσαρ Φλ(άβιος) Ἰουστιανὸς | Αλαμανικὸς | Γοθικὸς Φραγνικὸς Περαμακίκος Αν- | τικός | Ἀλανικὸς Οὐανδαλικὸς Αφρικὸς | εὔσεβης εὐπρεπῆς ἔνδοξος νικητής | τριπεπυχος ἀεισήβαστος Ἀγγελοւστός | ἀνενέωσεν | φιλοτιμία τὰ δημόσια | κτίσμα τῆς πόλεως σπουδῇ και | ἐπιμελεία Οὐρανίου τοῦ θεοφιλεστ(άτου) | ἐπισκόπου ινδ(ικτίωνος) (’’ἐτους ὑπ’

Notes: This is the Tabakhane inscription from the east gate of the city, which no longer survives. While this inscription dedicates the aqueduct to Christ, it may be the same aqueduct that named for St Eugenios that was mentioned by Procopius, De Aed. III.7.1

Reference: SEG 42.1158 = Procop. Buildings 3.7 = Feissel in BCH 116 (1992): 383-396 = CIG 8636 = Bryer and Winfield 1985, 182 and 190 [for the Zagnos Köprüsü in the Middle City that might be related to this system], along with SEG 36.1160 and 36.1173. See also Vasiliev 1930, 385-6
#101
Place: Syria, Bostra
Date: 6th cent CE c. 540
Thing: Inscription
Action: Aqueduct construction [agwgws]
Patron Status: Emperor + bishop, with city notables from gold and silversmith guilds entrusted with supervision/funding [Justinian + Ioannes]
Dedicant Status: na
Engl Text: From the generosity/charity of our Christ-loving despot Justinian, accomplished [with intercession] by John the holiest metropolitan bishop, built by Dousarios and Job, who provided gold advanced on behalf of the people. Year 540.
Reference: IGLS 13/1.9129

#102
Place: Syria, Bostra
Date: 6th cent CE c. 540
Thing: Inscription
Action: Aqueduct construction [agwgws]
Patron Status: Bishop + silversmith [Ioannes + Anastasios, son of Marnas]
Dedicant Status: na
Greek Text: ✞ ἐκ φιλοτιμ(ίας) τοῦ δεσπ(ότου) Ἰουστινιαν̣[οῦ] | παρασχηθίση[ς ἐ]κ πρεσβί(ας) τοῦ ὁσίου | ἀρχιεπισκ(όπου) Ἰωά̣ννο̣ ὁ ἀγω- | [γ]ός δ(ι)ά Ἀναστασίου τῶν Μαρ[ .]ας ἀργυρο(ποιοῦ) | — — —
Engl Text: From the generosity/charity of despot Justinian, offered by John of the rank of holy archbishop, the aqueduct was repaired with Anastasios of … the silversmith
Reference: IGLS 13/1.9134

SEVENTH CENTURY

#103a
Place: Cyprus, Salamis
Date: 7th CE between 616 and 642 [Mitford prefers a date after 628]
Thing: Seven inscriptions, plus one known only from a manuscript of Cyriacus of Ancona.
Action: Aqueduct construction
Patron Status: emperor + bishops and governors [Heraclius; archbishops Plutarchos and Arkadios]

Dedication: imperial acclamation for Heraclius


Notes: Note that Heraclius is credited with ten arches near the hippodrome. See SEG 48.1812 for questions about the reading of the indiction years (read there as dated between 616 and 642 CE).


#103a
Place: Cyprus, Salamis
Date: 7th CE between 668 and 685?
Thing: Seven inscriptions
Action: Aqueduct construction


Dedication: imperial acclamation for Constantine (IV? r. 668-685)

Greek Text: A.1 X(ριστ)ὲ φύλαξον ἡμᾶς | [c.6 . ] + II[ . c.7 . ] [ά]μην. {(|(i)έ| π(ού) θ(εο)ῦ]. θ(έ)δ(ο)ις μεθ’ [ήμ]ῶ[ν] ἔστω.
B.1 Χ(ριστ)ὲ ὁ θ(εὸ)ς | ὁ σωτὴρ | σκέπασον κέ διατήρησον | τὸν δοῦλο(ν) σ(ον) | Νικόδημος κ(ε) | π[ά]ντα τοὺς ὑπὸ τὴν χεῖρα αὐτοῦ]. +
C.1  Φωνὴ Κυρίου ἐπὶ τὸν υδάταν | Βαρνάβας | ἀπόστολος στίρηγμα ἡμῶν.
D.1  Κύριος ἐπὶ υδάταν [πολλὸν] | Ἐπιφάνιος ὁ μέγας [ἐπ]αρχος ἡμῶν.
E.1  Ὀ(όμηθι)σον | Κο(ν)σταντῖνος τὸ σίγνο(ν) σο(υ). +
F.1  ἐλησεοῦ φωνή· τάδε λέγι | Κ(ύριο)ς | ζ’ | + ήαμε τὰ ὅδε | ταῦτα. +
G.1  Κύριε βο<ε>ὴθε | ὁ στ(αυρὸ)ς νικᾶ.
Notes: F.1 is a paraphrase of the Psalms 29:3, “the voice of the Lord upon the waters”
Reference: Texts from Salamine XIII.238

#104
Place: Phrygia, Pepouza / Cilandiras in the Ulubey Canyon
Date: 7th-8th century CE (616, 661, 706, or 751 by indiction)
Thing: Inscription/graffito on wall of aqueduct channel; found in situ adjacent to Roman/repaired aqueduct bridge over the Banaz river, immediately above the pipe-track.
Action: Repair commemoration
Patron Status: None [Resos]
Dedicant Status: Imperial acclamation [emperor not named]
Greek Text: ΔΗΗΑ | ΡΗΣΟΣ | ΔΗΣΑΣ | ΝΗΚΑ | ΜΕΡΟΣ | + ΒΑΣΗΛΗΟΣ | ΑΝΙΣ
Engl Text: Trans 1 – “(Indictio) 4, (month) 8, (day) 8, a Sunday. | Resos | although he (in the past) was far from it, | is victorious. | He restor(ed) | the emperor’s | part (of the aqueduct). Trans 2 – “(Indictio) 4, (month) 8, (day) 8, a Sunday. | Resos | after having bound (leaks in the aqueduct’s pipes) [or after having prevented (leaking water)] | is victorious. | The region | of the Emperor | stands up [or revives] [anis(tatai)]
Reference: Tabbernee and Lampe 2008, 117
See the panorama photo of the bridge at http://www.360cities.net/image/cilandras-bruecke-usak-turkey
Appendix F: Water systems in Late Antique cities of the eastern Mediterranean

A brief note for Appendix F: I have given greater weight to a synthesis for those sites which I have visited and which are relatively poorly published (e.g. those which have been published only with yearly notices of excavation results), and to those which constitute closed categories of cities (like metropolitan or military capitals), with a bias against such sites as have benefited from comprehensive published assessments of their water infrastructure development (e.g. the truly visionary publications concerned with water from Sagalassos or Miletos).
Throughout, I have made reference only to scholarship published before 2014, and even so I fear that my work is inevitably incomplete though I have tried my best to capture both the allusiveness of sites that are poorly known but evocative, and the breadth, nuance and excitement of the best new research before this date.

Note: metropolitan cities are marked with a single asterisk (*), while military capitals that emerged after the later seventh century are marked with a double asterisk (**).

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ACHAEA, ATHENS

Hadrian’s aqueduct survived the Herulian attack of 267, and was put back into service in connection with a series of reservoirs and cisterns underground along the Panathenaic way. Frantz suggests that these were maintained in service until at least the fifth or sixth century. Wells and rainwater capture systems proliferated in Late Antique houses in Athens, as visible outside the new Acropolis Museum, which were still viable in the eighth century. Portions of this system were revived for the modern water supply of Athens, after an abortive later nineteenth century attempt to rebuild the entire system.

Frantz indicates that cisterns in the area of the Agora were sunk during the first century CE and in use until 267, before a brief period of disuse marked by fills of earthen debris, only to be renewed with inhabitation from the fourth century to the sixth century. Frantz concluded that some went into disuse with the closure of the philosophical schools in 529, while others were maintained until the Slavic invasions of 580s. A large rainwater cistern was built into the west end of the Parthenon basilica, and another huge cistern was built against the inner face of the Herulian wall in the sixth century, related to the earlier Klepsydra complex; after an unclear period of abandonment or disuse, it was reopened in the tenth or eleventh century.

Many wells, for instance those in the houses of the Areopagus, were maintained throughout Late Antiquity. Frantz indicates that, in the seventh century, of 15 wells known from the sixth century, only four continued to be used after the seventh century, however.

More recent excavations, for instance in the neighborhood of the new Acropolis museum, have confirmed the abandonment of some drainage and supply systems at the end of the fourth century, perhaps coincident with Alaric’s sack, while other installations were maintained into the Middle Byzantine period – large cisterns around clusters of houses under the Acropolis museum were built anew in the early seventh century. A primary question about this complex, arising from the present author’s inspection in June and July 2014, is whether or not the gutter systems of these houses that led to rainwater storage were organized collectively, with multiple houses contributing to the storage of larger individual cisterns, rather than runoff from individual houses feeding into private, smaller cisterns as was typical in the Roman period.

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884 Leigh 1998.
885 Leigh’s 1998 dissertation relied on records from this construction in the later nineteenth and earlier twentieth century; see also Kaika 2005.
886 Frantz 1988, 254.
887 Frantz 1988, 29.
888 Frantz 1988, 120.
**ACHAEA, CORINTH**

Corinth was the metropolitan capital of the Roman province of Achaea which Hierokles later called eparcheia Hellas, before the city became the capital of the theme of Hellas between 685-97, and of Peloponnesos after the early ninth century.889 The city’s bishops have a lineage carrying back to the Apostolic period, after Paul visited the city: their successors were present at most of the major councils after 431.

The evolution of Corinth’s water system in Late Antiquity squarely fits into the paradigm of settlement denucleation – Corinth sits in one of the driest regions of Greece, receiving some 40cm of rainfall annually on average, though it is blessed with a wealth of springs and relatively soft limestone and travertine geology that facilitated the carving of tunnels for the conveyance of water, a technique practiced since the sixth century BCE to create “one of the most extensive underground water systems in the ancient world.”890 At least twenty-four springs are known within the classical walls of the city.891 "More than 500 ancient and medieval wells, manholes, and cisterns have been recorded at the site, and most of those from the central excavation zone, which represents only a small fraction of the city’s total area"; though these have not been surveyed or catalogued analytically.892 In such a fashion, the city thrived for centuries before Hadrian’s construction of an aqueduct, which carried water without siphons over 85km, from the springs at Tsepi that fill the Stymphalian lake, through tunnels and over bridges, and into the city from the southwest.893 The distribution and integration of the aqueduct into the city’s water supply remain poorly understood, even after the recent work of Lolos and Landon. Lolos notes a variety of repairs – primarily buttressed piers in opus incertum – that he associates, for lack of firm dating evidence, with repairs made before or after the fifth century, perhaps in association with earthquakes of CE 365 and 375.894 Lolos assumes that the aqueduct “fell into ruin during the course of the fifth century,” though more recent work has pointed to the continuity of baths in the city into the seventh century (see below).895 Especially important for any consideration of the city’s hydraulic evolution in Late Antiquity is the way in which a wealth of smaller springs in this area structured the denucleation and ruralization of the Late Roman cityscape, into città ad isole around these smaller water sources.896

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889 ODB s.v. “Corinth” 1: 531-3.
890 Landon 2003, 43; for the sixth century BC date of modifications to the Peirene spring system, see Robinson 1962, 128; for Corinth’s geology and water generally see Crouch 1993, 129-150.
891 Landon 2003, 47 and see the map Fig. 3.1.
892 Landon 2003, 54; Landon refers to the most comprehensive catalogue of such features to date in a study of Hellenistic pottery that needs revision and updating, see Corinth VII.3, 188-235.
893 For the course of Hadrian’s aqueduct at Corinth see Lolos 1997, 273-9.
895 Lolos 1997, 298.
896 Pettiegrew 2008, 259 considers how, in the Roman and Late Roman periods, “ex-urban settlement [in the Eastern Corinthia] is both more continuous and complex than previously
Biers has worked extensively on the baths of Roman Corinth.897 Corinth’s Great Bath was built in the late second or third century CE, with continuing modifications throughout the third to sixth centuries. The Great Baths were industrialized and subject to encroachment after the sixth century, with diminished but not extinct use of bathing facilities. Modifications included the industrialization and dismantling of some parts of the bath, even as other areas in the bath complex continued to be used for their intended purpose, and new water-dependent features were added to its colonnaded courtyard.898 A latrine and water channel was built at the court colonnade’s south and a new service area for the bath was added at the east, though around the same time debris began to accumulate in the court (group 14), a limekiln was installed and blocked up the west entranceway (group 27) from the Lechaion road, and a house was built into the north half of the colonnade.899 The vaults of the bath (excepting Rooms 1, 2, and the south apse of 3) collapsed in an earthquake between the later sixth/seventh and 11th centuries.

Similarly, the Small Baths on the Lechaion road were replaced c. 400 with “structures interpreted as a private house and glass-maker’s quarters occupied throughout the rest of Late Antiquity.”900 Smaller scale baths continued to be built at the South Stoa,901 the nearby Zevgolatio bath,902 the short-lived Panayia Field baths [built end of fifth, out of use by mid to late sixth,903 and three other poorly published baths that are thought to be Late Antique. Five baths at Corinth were built and used in the Byzantine period or later: the South Baths (10th-12th c.), North Baths on Lechaion Road (Middle Byzantine), baths south of Temple east (Roman-Late Antique or 11th-12th c.?), the baths at the southwest corner of the South Basilica (medieval/Turkish), and a Turkish bath at the Asklepeion.904 An understanding of the water supply of Corinth’s baths “is so far almost nonexistent,”905 apart from Brown’s conclusion that the Small and Great Baths on the Lechaion road were both supplied by the Peirene Spring, rather than by the city’s aqueduct.906 Broneer suggested, however, that a heavy mass of

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897 See Biers 1985 and 2003.
898 Biers 1985 32-3.
899 Biers 1985, 12-3.
901 Biers 2003, 309. The south Stoa baths were dated by Broneer to c. 300 [Corinth I.4, 145-155], and redated by Biers to c. 400-450. The south Stoa baths were out of use by the mid-sixth century, as indicated by a hoard of Justinianic coins found in the bath’s hypocaust.
902 The Zevgolatio Bath was dated by Ginouves to the third or fourth centuries, and recently redated to the sixth by Sanders 2003, 395.
903 Sanders 1999 and Biers 2003, 310.
904 Biers 2003, 305.
905 Lolois 1997, 280; see also Landon 2003, 56.
906 Brown 2008, 136; and see Robinson 2014, 291 for a consideration of the late (6th century?) and finely constructed marble channel that carried water from Peirene in the direction of the
masonry against the northwest corner of the South Stoa baths probably supported a westward extension of the Hadrianic aqueduct, possibly with consequences for its supply.  

Corinth has a wealth of church architecture: we should mention several important associations with water features.

The giant Lechaion basilica (220m long with atria) was built from c. 450 to the early sixth century on the west jetty of the Lechaion harbor, a few kilometers north of Corinth’s city center. Because this is the only excavated basilica in Corinth not situated in a cemetery, it is possible that the Lechaion served as the city’s cathedral. (Another possibility is the unexcavated basilica just inside the Kraneion gate, with an octagonal structure that might be identified as another baptistery.) The Lechaion had a number of water features supplied by external sources, in addition to wells: the narthex was preceded by a semicircular atrium equipped with a large rectangular fountain basin on a 9x4m socle (presumably externally supplied), beside which was a well. This semicircular atrium was preceded by another larger, rectangular court surrounded by arcades and flanked by large basins possibly for ablutions; smaller basins were distributed throughout the basilica itself, including inside the apse (identified as a thalassidion for washing liturgical vessels by Pallas). Additionally, a large octagonal baptistery was built at the narthex’s north – its size exceeded that of contemporary baths in the city. A nymphaeum 1km to the northeast, elaborately reconstructed in the sixth century, has been connected to the church by virtue of the marbles and impost capitals that match those found in the basilica.

The Kodratos basilica was set on the north edge of the north terrace outside the Late Roman walls: this three-aisled basilica (37x20m) saw extensive use from the Early to Middle Byzantine periods as a cemetery church. At the east end of the south aisle was an hagiasma, which supplied water via a terra-cotta pipe from a spring emerging from the north terrace: this spring had been used in

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Lechaion baths, which ceased to be used coincident with the removal of sculpture from the court and the introduction of burials in the Peirene triconch after the late sixth century.  

Caraher 2003, 465 with references. The argument for a later fifth century date is predominantly made on the basis of architectural sculpture and capital-types; while Sanders 2005, 292 on the basis of ceramics states that “it is likely that the basilica was not constructed before ca. 525,” with a destruction date not before c. 600 rather than sometime in the sixth century as previously thought.  

See Caraher 2014, 149.  

Pallas 1977, 168.  

On the comparison between baths and baptisteries, see the point made by Caraher 2014, 149 and Fig. 8.2; on the nymphaeum nearby, see his 150.  

Most recently see Brown 2012, here at 216-7; with earlier summary in Pallas 1977, 161-3. For full bibliography see Caraher 2003, 461. The Kodratos basilica is usually dated to the sixth century, “despite a funerary inscription built into the floor which seems to date from the late 4th/early 5th” see Caraher 2003, 20 citing Feissel / Philippidis-Braat 1985, here at 295, no. 35.
Roman times by “farmers, travelers, and [for] burial needs.” the latter function becoming especially important after the fifth century when burials began to penetrate the neighboring Asklepeion.

Finally, we should mention two of Corinth’s springs, Lerna and Peirene. Lerna is located just outside the city’s northern Late Roman walls, appearing to spring out from the north terrace when in fact its water is carried underground from an unknown location to the S. Lerna’s spring house was adjacent to the Asklepeion, which was damaged and abandoned in the course of the fifth century, around the same time that the Lerna court below became a center for burial and night-time cult activity. Such activity is attested by the deposit of more than 4,000 fifth-sixth century lamps at the so-called Fountain of the Lamps, immediately to Lerna’s W. The cemetery surrounding these springs extended to the east, into which area the Kodratos basilica was built and maintained well into the Middle Byzantine period.

Similarly, the Peirene spring – the subject of a superb recent monograph by Robinson – persevered in Byzantine cultural memory for centuries, as attested by its inclusion on the tenth-century Pola casket’s scene of Pegasus and Bellerophon, where the Peirene appears as a water vessel with ripples next to a female personification. The Peirene spring’s Roman court was upgraded with a triconch around a hypaethral basin in the fifth century, with a number of modifications that included two aqueducts to port away its water to the north and southwest, before the triconch court’s statuary was (violently) cleared out and burials were introduced there in the later sixth or early seventh century. Besides functioning as a space for burial, water from the spring continued to be used, however, and a one-aisled chapel was built into the court’s north narthex in the later tenth century.

The Acrocorinth was [re-]fortified sometime after the Late Roman walls were built during the early fifth century in the town below. This fortified refugium, high above the Corinthian plain, took its supply of water from a spring located just inside the fortifications’ west gate; another in the enclosure’s south (the so-called

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914 Brown 2008, 150.
915 See Landon 2003, 48 n. 22; the original publication is de Waele 1935.
916 See principally Corinth XIV and Brown 2009, 237.
917 See K. S. Garnett 1975 for analysis of the lamps.
918 On the Peirene’s representation in the Pola casket, see Robinson 2011, 303.
919 See Robinson 2011, 251-85.
920 Robinson 2011, 293-301.
921 For the early fifth century date of the lower Late Roman walls, thought to be a reaction to the sack of Alaric in 396, see Gregory 1979; he notes slight differences in the building techniques of Acrocorinth’s walls when compared to those in the lower city, and suggests a slightly later date, perhaps contemporary with the sixth-century church partially preserved on the summit.
Upper Peirene spring);\textsuperscript{922} and an immense (200m\textsuperscript{2}), double-barrel-vaulted brick-built reservoir, under the later mosque.\textsuperscript{923}

\textbf{ACHAEA, MONEMVASIA}
Monemvasia is a fortified enclosure / refugium on a sharp Aegean peninsula, which was entirely dependent on large-scale rainwater collection systems. The city was legendarily founded as a response to Slavic raids in 587/8, though archaeological evidence from before the Middle Byzantine period is distinctly lacking.\textsuperscript{924}

\textbf{ACHAEA, TIGANI}
Tigani is a Late Antique refugium site, built on pre-classical fortifications situated on a peninsular enclosure off the coast of the Mani, which was entirely dependent on rainwater collection systems, centered on a church with \textasciitilde{}100m\textsuperscript{3} capacity cisterns.\textsuperscript{925}

\textbf{AEGEAN, ANDROS}
Epáno Kástro was a fortified refugium and community occupied between the 7\textsuperscript{th} and 13\textsuperscript{th} centuries, which was supplied entirely by rainwater collection in large cisterns.

\textbf{AEGEAN, AEGINA}
A temple was converted for use as a cistern near Byzantine houses in Aegina.\textsuperscript{926}

\textbf{AEGEAN, NAXOS}
The area around Mýli is rich in karst springs, and was the origin of a 5\textsuperscript{th} century BCE aqueduct that supplied the city of Naxos. This was a built channel, refaced with stone probably in the imperial Roman period. Its later history is unclear; the system has not been studied or published to my knowledge. Mýli’s name also indicates its importance for mill works here.

\textbf{AEGEAN, PAROS}
The baptistery in the Church of Ekatonaplyiani – originally a fourth century

\textsuperscript{922} See \textit{Corinth} III.1, 31-60 for Richard Stillewell’s discussion of the Hellenistic spring house and its successor structures at Upper Peirene on Acrocorinth.
\textsuperscript{923} For the “vast subterranean storage cistern or reservoir, massively built of brick in a series of huge barrel vaults,” see with references Landon 2003, 54 n. 42-3, following on \textit{Corinth} III.1, 30 (source of the quote) and III.2, 257-9 with fig. 212-3 for plan and photo. Bon (in \textit{Corinth} III) postulated two phases of construction for the reservoir, both sixth century, the earlier during Justinian’s reign and the latter sometime after the Avar invasions, but without much proof. Perhaps better, to judge from the reservoir’s form and vault technique, is to hypothesize an originally Roman construction with barrel vault, that was replaced after the sixth century with the squared-off vaulted cells that compare well with Hagia Eirene in Constantinople, for instance.
\textsuperscript{924} Kalligas 1990 and 2010, with Klaus 1981.
\textsuperscript{925} Caraher 2003, 484.
\textsuperscript{926} Felten 1975.
apsidal basilica with Byzantine improvements – may have been installed in the city’s gymnasium, the site of a local martyr’s death.\textsuperscript{927}

**AEGEAN, TINOS**

At the southwest corner of the Sanctuary of Poseidon and Amphitrite are Roman baths supplied by water from a spring just a few meters away, which also fed into a nymphaeum in the temple complex’s northwest corner.

**AFRICA, CARthAGE**

Wilson’s study of water supply in ancient Carthage gives indications for the establishment of wells in elite residences of the fourth century BCE, followed by the installation of cisterns in the third century BCE. Roman Carthage reused these installations wherever it was possible, in addition to utilizing large, paved public spaces as impluvia for rainwater sources, which was apparently preferred to groundwater. Wilson points to comparable arrangements at Bararus (the forum), Dougga (the Temple of Saturn and a public building known as Dar el-Acheb), and the temple/forum porticoes at Sabratha). A number of monumental cisterns and reservoirs helped meet the city’s water consumption needs, at Bordj Djedid, Dar Saniat, and La Malga. La Malga was included with the Theodosian walls, which suggests its continued function; the fact that it was cut by Gelimer in 533\textsuperscript{928} indicates that it continued to function throughout the Vandal period. Coincident with the apparently intentional destruction of the Antnoine baths in the fifth century CE, when its frigidarium vault collapsed and a hoard TPQ 425 CE was sealed in the rubble, the main outlet of the Bordj Djedid cisterns was blocked for service of an elite structure nearby. Later, the cistern was retooled for use as a rain-water cistern, which would indicate that the aqueduct was no longer functional. However, the aqueduct was restored during after 533, its source was fortified for protection, and the Antonine baths were brought back into more limited operation, while streets and their supply/drainage systems were repaired throughout the sixth and seventh centuries (Wilson 1998 and Lézine 1969). The cistern was relined with ceramic-bearing waterproof mortar into the Islamic period, before the aqueduct was cut again during the siege of Carthage in 698. It was brought back into service for Tunis in 1267 before being cut and repaired several times more into the early modern period; the French repaired this system in 1859 and the Bordj Djedid cisterns still function today.

**AFRICA, LEPTIMINUS**

Leptiminus was a military center with productive areas within the city; one was a group of pottery kilns installed in a retooled bath complex. Aqueducts here remained functional into the mid-seventh century at least, even after the conversion of the baths for industry.\textsuperscript{929}

\textsuperscript{927} Μητσανη 1996-7
\textsuperscript{928} Procopius Wars 2.1.2.
\textsuperscript{929} Stirling 2001 and Leone 2007, 220.
ARABIA, AZRAQ
Azraq is a major spring site, built at the northwest entrance of the 300km long Wadi Sirhan to the fort’s SE. Several smaller military sites can be found nearby, with water supplies impounded behind small dams in wdis. The earliest epigraphic date from Azraq is Severan; other inscriptions date to the Tetrarchy or early 4th century. Tabari relates in anno 744 that Umayyad caliph al Walid II had residence here. Little is known of the settlement during the intervening 5th and 6th centuries, Kennedy suggests that the site may have become unoccupied by c. 400.

Azraq Duruz is an early Roman building reminiscent of the Masada and Machaerus siege camps; no traces of internal structures visible in old aerial photographs of > 100 x 125m =1.25 ha area. The main fort, on the west side of the north pool at Azraq, shows signs of rebuilding after the 13th century. Kennedy describes a well tapping into the pool water from rm 27 in one of the fort’s towers.930 Intra muros in the courtyard is a separate building housing a small row-type bath. Gregory suggested that the present fort is a Tetrarchic rebuilding of an originally Severan construction; inscriptions from nearby date Severan, Aurelianic, and Constantinian.

Azraq Shishan is the main oasis. Kennedy argues that the reservoir west of the south pools at Azraq (Shishan), and the long walls encircling part of the pools and marsh, are probably Early Islamic, even if the southern pools were probably policed by a detachment from el Azraq in Severan period.931 This was confirmed when Vibert-Guigue identified carved basalt blocks in the walls of the south pool reservoir not as spolia, but as original Umayyad reliefs with water and hunting motifs like the water horse, siren, and griffon or senmurv.932

Qasr Ain es-Sol is 2km northwest of Azraq; Reeves notes a linear type bath (100-200 m²) at a “homestead or small agricultural estate,” with hypocaust and flue pipes.933

ARABIA, BETHANY BEYOND THE JORDAN / WADI AL KHARRAR
Mkhjian’s excavations at Bethany have revealed two rectangular (3.8x3.0 and 4.3x2.3m) pools on a hill overlooking the north church. Under the northeast pool was a a circular well that dated early Roman to late Byzantine periods, built 2.1m in diameter of sandstone ashlars, with a depth of 10m to reach all the way down to the aquifer on the level of the Jordan valley. A third pool was on the hill’s south slope, 5.3 x 3.7m, with stairs on its east side extending the whole width of

930 Kennedy 2004, 58.
931 Kennedy 2004, 62.
932 Vibert-Guigue 2006.
933 Reeves 1996, 225.
the pool. Near the church, water was carried by ceramic pipes through settling basins, before depositing into a large (~100m$^3$) cistern and a sort of well shaft, 3.25m in diameter and 5.4m deep (with capacity ~45m$^3$). The cistern was cut into the marl subsurface and lined with ashlars, vaulted, and covered with white mosaic on its upper exterior.

**ARABIA, EL-FEDEIN**

Kennedy reports that the ruins in Mafraq consist of a spring and reservoir, a prehistoric tell and ‘fortress’, a church built inside the latter, a Byzantine-Umayyad house and an Abbasid ‘palace.’ A literary source describes it as the location of a monastery in the sixth century and it is named as an Umayyad palace in the mid-8$^{th}$ century.

**ARABIA, GADARA / UMM QAIS**

The Hellenistic acropolis at Gadara was supplied by 4 springs and 75 cisterns. After the Pompeian conquest and the beginning of Hasmonean rule, the north theater was built atop a massive cistern fed by the lower tunnel, a rock-cut channel contemporary to theater construction. Gadara was connected, probably in the second century CE, to a 150km long tunnel system that carried water from south Syria to north Jordan. Later, the city’s nymphaeum opposite the agora was donated by the astynomos Aurelios Diophantes in the second half of the 2$^{nd}$ century CE.

Considerable modifications and expansions to Gadara’s water system were made during Late Antiquity. An upper aqueduct, begun but never completed, was intended to carry water through a rock cut tunnel under the acropolis to the forum by the centralized church (5$^{th}$/6$^{th}$ century, with south basilica added in 7$^{th}$; was the church’s destruction by earthquake coincident with the end of tunnel construction?). New baths were built in the fifth century. The late Roman Tiberias gate’s south tower was modified for use as a castellum, carrying water that supplied a fountain immediately adjacent to and north of the five-aisle memorial basilica (4$^{th}$ century).

**ARABIA, GERA / JARASH**

See the full report infra, Chapter 1.

**ARABIA, EL LEJJUN / BETTHORUS**

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935 Mkhjian 2005, 405-6 and figs. 8-11.
941 Meynersen 2004.
The legionary fort, dated by Parker’s excavations to c. CE 300, was equipped with an angular row bath (223m²) along its northeast walls.⁹⁴² Cisterns at the northwest were fed by a short aqueduct carrying water impounded behind a dam at the spring, c. 300m west of the fortress.⁹⁴³ Another very productive spring runs extra-muros some distance to the north.

**ARABIA, HAUARA / HUMAYMA**
The 206x148m fortress here was built with Nabatean spolia in the early Roman period, probably in the reign of Trajan. Kennedy and Oleson identified the fortress’s aqueduct as an originally Nabatean construction, feeding a large reservoir extra muros and to the southwest of the fort’s later location. When the fort was laid out, a secondary line was diverted from the older aqueduct to supply an intra muros reservoir.⁹⁴⁴ Inscription records vexillatio/detachment of Legio III Cyrenaica here in the 2nd or 3rd century CE,⁹⁴⁵ while the *Notitia Dignitatum* (Or. 34.26) and the Beersheva Edict (frg. 5) indicate Late Roman military presence here as well.⁹⁴⁶ Though the fortress was abandoned in the Early Byzantine period, Humayma later became the home of the Abbasid revolt in the mid-8th century.

**ARABIA, MA’AN/MA’IN (AMMATHA), EL-HAMMAM AND EL MUTRAB**
Ma’an is an important spring town that supported an oasis and agriculture on a node of the ancient caravan and medieval Hajj routes. Early Islamic writers referred to it as a Byzantine stronghold and home to a governor.⁹⁴⁷ Today its archaeology remains little explored.⁹⁴⁸ Kennedy notes only that visitors have identified elements of a water system in the wadi just east of town and at as-Samiyye 2km north, with a long ramified aqueduct running through the whole area.⁹⁴⁹

A 61x51m fortress at nearby al Hammam was bulldozed in the early 2000s, but a substantial extra muros reservoir remains just northwest of its former site. Aerial photographs analyzed by Kennedy revealed the trace of a long ramified aqueduct carried into the area from the west, headed straight for the square reservoir (67 x 67 x ~6m, with two sets of steps).⁹⁵⁰ This aqueduct survives in sections as a retaining-wall type structure with rubble masonry. Another line, perhaps secondary and to judge from well-spaced pits in the aerial photographs, a chain-well, supplied the fortress from its northwest corner. Field boundaries with irrigation ditches and pits for fruit trees are also visible. Khirbet Samra 3.7km

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⁹⁴² Reeves 1996, 209.
⁹⁴⁵ Oleson 2002.
⁹⁴⁶ *Notitia Dignitatum*, Or. 34.26 and the *Beersheva Edict*, frg. 5.
⁹⁴⁷ Musil 1926, 247.
⁹⁴⁹ Kennedy 2004, 185 and Stein 1985, 295-301.
⁹⁵⁰ Kennedy 2004, 185 and Stein 1985, 296.
east of el-Hammam, is a 50x50m rectangular enclosure that lies on the north aqueduct. The dates for all these installations are unclear, though the reservoir and some of the enclosures perhaps compare best with early Islamic examples. However, very preliminary indications from field survey at these sites east of Ma’an – al Hammam, Khirbet Samra, and el-Mutrab – identified prominent late Roman wares within a small sample. Strengthening the argument for a late Roman date for Ma’an’s channel installations is D. Genequand’s discovery at Ma’an of a Roman mill, which he compares with another known from late 3rd or 4th century Chemtou, as published by Wilson.\footnote{Genequand’s 2003 and Wilson 1995.} Musil gives notice from the Jihan-numa of Hajji Khalfa that Sultan Suleiman I (1520-66) built an aqueduct for Ma’an; its relation to the remains considered above is unclear.\footnote{Musil 1926, 428.}

An inscription records the construction of a bath / pribaton under a clarissimus and spectabilis tribune and topoteretes at Ma’in, in the reign of Justinian.\footnote{IGLS 2.162.}

**ARABIA, MADABA**

Madaba was a major town that had Nabatean military presence before the Roman annexation, with a Greek inscription\footnote{IGLS 21.117.} recording the presence of a centurion from the Legio III Cyrenaica later in the Antonine period.\footnote{Kennedy 2004, 134.} Rainfall in Madaba averages c. 350mm annually.\footnote{Bikai 2004, 231.}

No aqueducts are known from Madaba, though the area around the Madaba Archaeological Park encompassing churches and streets includes a centralized sewer system and numerous cisterns and reservoirs, some with inscriptions.\footnote{Piccirillo 1981.} Bikai notes that the etymology of Madaba may be derived from “ma’” meaning water, and “dabba” meaning “to seep”; compare with “ma’daba” or “meydaba” in the OT, Numbers 21:30 to describe a place where water seeps from rock.

A Roman built reservoir in Madaba called el-Birkeh measures c. 117 x 100 x 10m (117,000m$^3$). An inscription in an arched/vaulted cistern was noted by scholars in the 19th century, and published by Piccirillo, indicating that the cistern was renovated by Justinian for the people of Madaba.\footnote{Bikai 2004, 232 and Piccirillo and Denton 1996, 43.}

The Church of St Theodore contains a series of very interesting Greek inscriptions centered around hydraulic installations that deserve comment.\footnote{SEG 31.1475.}

One inscription is dated 575-76, set in a large cartouche in the mosaic courtyard.
of St Theodore. Some of its lines are poorly preserved, due to later work on the mosaics, but it may be restored as follows: “All, in glorifying, say ‘cistern in cistern, o the marvel/thauma’. Lord, remember your servant the bishop Sergios, under whom was made this beautiful work with the pure fountain. This was made the year 470 of the province. Lord, remember these who brought their offerings and who provided their labor, whose names you know.” The cistern here is glorified as a *thaumos*, or miracle, a term normally reserved for monumental imperial construction that was applied to smaller scale hydraulic constructions in Late Antiquity, as noted by Robert960 and Piccirillo.961 Another inscription, Piccirillo’s #136, is a tabula ansata set into a mosaic court preceding the cathedral, which quotes 2 Kings 2:21 “I am the purifier of waters, said the Lord” in reference to a miracle of Elijah. Piccirillo relates it perhaps too specifically to an episode in the *History of John Bar Aphtonia* in which John writes on paper that is put in a stone box and thrown in brackish water in order to purify it; this sort of purifying episode is hardly unique, however.962 Piccirillo’s #137 was an inscribed pavement near another cistern: “…cistern within a cistern, the water which gushes forth to Madaba,” using a Greek transcription of the Aramean ‘goubba’ (cistern) for “λακκός ἐν λακκῳ.”963 The four rivers of paradise are also represented in the church’s interior mosaics.

Eight more cisterns in Madaba excavated during the 1990s by ACOR were used until recently. They are rock-cut or masonry built and usually vaulted. Most are difficult to date because they have been in continuous use since antiquity, but Bir el-Rayes is northwest of St George, and features a Byzantine painted inscription at vault level with a cross and the words “Jesus the Savior, Alpha and Omega.”964 Harrison’s survey recorded more than 100 cisterns in the modern city; Bikai speculates that the city actually had 500 or so in total.965

Two Umayyad dams are also known from the area of Madaba.966

At nearby Khirbet Massuh, Piccirillo noted Byzantine cisterns and rainwater installations, along with wine presses, in the area of a Christian cemetery.967

**ARABIA, MEFAT / UM ER RASAS**

Kaстрон Mefaа was built as a rectangular fortification (158x139m = 2.2ha) at the end of the 3rd or beginning of the 4th century, which developed into a town over the course of the 5th-6th centuries.968

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960 Robert 1948, 64-6.
962 Piccirillo 1981, 311 citing Nau 1905. 35.
963 SEG 57.1774.
965 Harrison 1997.
966 Bisheh 1986b, 7.
967 Piccirillo 2005, 390.
St. Stephen’s was equipped with cisterns in a small northeast courtyard and in an adjacent insula at south, excavation of which provided evidence for a final abandonment of the area in the 9th century. A pre-existing cistern was covered over by the church’s mosaic program. At St Paul’s, a large cistern was built into the courtyard between the main church and a subsidiary chapel at the southwest.

The large open courtyard to the south of the double church – two separate but twin churches erected over the course of the sixth century – was equipped with two wells.

**ARABIA, PELLA**

The city’s forum and baths were constructed around a significant warm thermal spring, which is still used today for local supplies by a pump facility. Baths here were multi-phase, early Roman and Byzantine, but because of problems with elevated water levels, only a small portion of the Roman phase was recovered in excavation. Talmudic texts indicate the continuity of the baths into the third or fourth century at least, while the expansion of agriculture in the surrounding valley led to the acceleration of siltation processes and the gradual elevation of the water table, to the detriment of the forum area of Pella, which was no longer usable by the early seventh century. The last use of the baths here cannot be dated precisely. Notably, the west church had been constructed in the same area but on a platform several meters above the forum and baths, and so continued to be occupied into the Umayyad period. In the sixth century, water shortage issues may have encouraged the disruption of drainage systems flowing into the wadi, and the construction of a deep and large vaulted cistern on the west church’s southeast side, with volume of approximately 300,000 liters. Another church, the so-called west church, was also outfitted with a large cistern (approx. 300,000 liters), whose construction was dated by pottery to the sixth century. The cistern filled with pottery dating mid- to late-seventh century, in addition to a burial contemporary with the pottery. Because the cistern’s vaulted roof was intact, indicating that an earthquake was not responsible for the end of its functionality, and the coincidence of the cistern’s construction with Stephen of Byzantium’s statement in the *Ethnika* that Pella’s water was unhealthy, the excavators concluded that there may have been some problem with Pella’s spring water supply during this period in the sixth century.

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970 Piccirillo 1991, 335.
971 Piccirillo 1997, 303.
972 Bujard 1996, 173, fig. 3.
974 Smith 1973, 57-58, citing the Jerusalem Talmud 6.1.
975 Smith 1973, 8.
976 Ibid., 65.
and that the abandonment of the cistern perhaps indicated some return to normality, given the further occupation of the site after the seventh.  

**ARABIA, PRAESIDIIUM / KHIRBET EL-KHALDE (HISMA)**
Präsidium is a fortified site along the Via Nova Traiana route to the Red Sea, known from the Peutinger Map, which is hypothetically related to the ruins at Khirbet el-Khalde. C. 800 m southeast from the fort is a spring (Stein 1985, 312), which connects via aqueduct to a reservoir on the interior of the fort, which is a 50x32m enclosure with square projecting towers. The fort interior is divided into two courtyards: the larger one contains a 6.4m square, plaster-lined reservoir; the smaller one features a bath with hypocaust. An ancient caravanserai is located almost immediately next to the fort; cisterns can be found along the course of the aqueduct from the spring in the wadi, which are probably agricultural. Coins and milestones reported as strays here are Tetrarchic and early-fourth century, though Kennedy favors a Nabatean date for substantial portions of the complex, with Trajanic and/or Diocletianic alterations including heightening of the walls and the addition of the second, larger/eastern courtyard on a 32m square core, which resembles the fort at Quweira.

**ARABIA, QASR ASEIKHIN**
Qasr Aseikhin is perched on the summit of a cone in the Jebel Aseikhin, a 23m sq fortlet. Dated sherds recovered range from 1st to early 4th, then mid 6th-7th; a Nabatean presence is also possible. The fort is associated with a range of agricultural installations, probably Byzantine or Early Islamic in date. Hydraulic installations outside the fortifications include: a ghadir below the fortlet that drained rain water off the upper cone; a dam; and basalt rock piles and corrals.

**ARABIA, QASR EL BAI’J**
The site is little known, but the Princeton Expedition identified the 40x40m enclosure (with later addition of extended walls and corridor leading to the older complex, with a new cistern and chapel on the south flank) as originally fifth century with no older remains, on the basis of the architectural evidence and a Greek inscription for construction of a kastron/castellum by a dux in the year 411/412. Cisterns carved out underneath the fort, and under a later external development, supplied the occupants with water. Gregory notes abundant Umayyad pottery found in scatters here. Kennedy raises the possibility that

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979 See Alt 1936, 101-3; Savignac 1932, 585-7; Glueck 1939, 15-19; Parker 1986, 108-9; and Kennedy 2004, 199-201.
982 Compare with Nevo 1991.
983 Parker 1986, 24-6.
984 PPUAES II.A.2: 80-3; III.A.2: 42-44.
985 Kennedy 2004, 92.
this was a small castellum appropriated as a monastery before agricultural reuse in the Umayyad period, but investigation of the site remains for future work.

ARABIA, QASR EL HALLABAT
Near Hallabat is a major spring that today provides for a mineral water collection and bottling plant.

Kennedy recognized that the 146 blocks carrying Greek inscriptions, most dated from the reign of Anastasius, were brought to the site as building material and thus cannot be used as an argument for its date. This consideration may also apply to the Greek inscription for restoration of the kastron (ἀνενεώθη τὰ κάστραν) under the consul and dux Flavius Anastasius in 529 CE. Arce proposes a piece-meal development for the site over several centuries, contrary to Bisheh who surmised that the area of Hallabat developed strictly in the Early Islamic period when an extra-muros mosque, agricultural enclosures with elaborate sluices, a large reservoir, and cisterns were introduced, in addition to the basically contemporary bath and fortlet, Hammam al-Sarah, 4km distant.

The reservoir southwest of the qasr was excavated by Ghrayib – at 8107m³ in capacity, it was mostly carved out of bedrock, and built of rubble core walls with limestone blocks and hydraulic mortar. Some blocks have decorative elements indicating reuse. Two wells were built just to northeast as drains for surplus from reservoir. A carefully-planned system of ramified channels collects and carries rain-water to cisterns and wells in the houses on the hill, though the houses themselves are not laid out orthogonally but rather follow the topography of the site. Evidence of an Early Islamic date for the reservoir southwest of the qasr may be provided by Bisheh who noted Umayyad sherds in the mortar between stone courses, indicative of a repair if not an original date. Arce disagrees, recognizing Umayyad improvements but preferring a Roman date for the reservoir. Noteworthy also are two cisterns dug within the castle and seven found on the north and west slopes of the hill on which the castle was built. These are all rectangular, plastered, and covered, in one instance supported by a large square stone pier (compare with Negev examples from the Nabatean period, e.g. at Oboda or Mampsis). The cisterns were fed by conduits on the slopes of the hill that collected rainwater. 400m to the west of the qasr is another walled enclosure of irregular shape, 270m², surrounded by wadis that

987 Kennedy 1982, 39f.
988 PPUAES.III.A.2: 22-3 no. 18.
990 Bisheh 1993.
992 Ghrayib 2003, 70.
993 Bisheh 1980, 70.
994 Arce 2007, 964 n. 88.
were divided into agricultural plots by check dams. The enclosure itself was divided by two mounds that, according to Bisheh, served to channel runoffs into plots within the enclosure. Near the enclosure’s southwest corner was a sluice gate that may have acted to channel water from the wadi to the west. The area is today called Huwaytah or Ha’it, meaning cultivated area, and soil conditions plus the discovery of a large stone vat led Bisheh to conclude that the area was used as an orchard.996

Arce clarified the history of Hallabat, revising Bisheh’s conclusions that the water systems here were Early Islamic.997 Arce’s conclusions may be summarized as follows: A small 17.5x17.5m Roman fort on the Via Nova Traiana from Bosra to Aqaba was enlarged into a quadriportium 38x38m and given corner towers and an extra muros reservoir, probably during the Tetrarchy, then damaged in an earthquake (possibly 551 CE), only to be transformed into a palatium or praetorium linked to a monastery with chapel and wine installations by the Ghassanids. The Ghassanid space was further appropriated and modified by the Umayyads, who added the extensive mosaic programs and also undertook refurbishment of rural agricultural installations with new wine presses around the palatium, and built the extra-mural mosque and the nearby bath at Hammam al-Sarah.

At the entrance to the qasr, Arce noted probably Umayyad traces of a round platform that that he identified as a container of water, similar to the one found at the entrance of Khirbat al-Mafjar, a descendant of the Byzantine phiale, and an antecedent of the medieval sabil and of those domed fountains built within mosque courtyards.998

Arce concedes that the dating of the hydraulic and agricultural complex is not clear999 but points to the record of the History of Ahudemehe for monks tending a “garden filled with goods for the entire country where the monastery was situated.”1000 Resafa, as home to the Ghassanid phylarch al-Mundhir, is another good comparison, in addition to Umm el Jimal. Additional examples of Ghassanid palace complexes with monasteries include Jabal Says and Qasr al Hayr al Gharbi.1001

**ARABIA, QASR EL UWEINID**

A Severan building inscription found at Qasr el Uweinid has been connected to a bath complex here, though Kennedy prefers to locate the Severan fort and bath

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998 Arce 2006, 156 n.32.
999 Arce 2006, 159 n. 41.
1000 Also cited by Fowden 2004, 150 n. 7
1001 Arce 2006, 166.
at Azraq. Reeves gives the inscription as follows: “("Castellum et <s> praesidium Severianum . Vexillatio leg(ionis) III Cyrenicae (sic) baln(eum) Mucia(no) et Fab(ian) o (co)(n) s(ulibus) extruxit.” Reeves also doubted that a bath was ever here, and suggested that the inscriptions may have been brought from elsewhere.

**ARABIA, QASTAL**

Remains of a qasr here were once thought to be Late Roman, but are now firmly dated to the Early Islamic period: contemporary to the qasr by virtue of their construction technique are the site’s hydraulic installations, including a dam and reservoir, in addition to a mosque. The dam could have contained over 2,000,000 cubic meters of water (or 2 billion liters), and was built with over 21,000 cubic meters of masonry, extracted from the northwest birkeh which was originally opened as a quarry. The birkeh (4000m$^3$) was fed by “water collected on the upper part of the hill by two canals running from the southeast and southwest corners,” and notably contained an Umayyad water-gauge. The lowest levels in the fill of the northwest birkeh were also Umayyad. Inside the qasr was an 11.2m deep cistern at the center. A bath was situated outside the complex, as at Hallabat.

**ARABIA, QATRANA**

Qatrana is an Ottoman fort with a large reservoir believed to be Roman in date.

**ARABIA, UDRUH**

The Tetrarchic fortress at Udruh is almost identical to El-Lejjun, and shares its quality of site in an area watered by numerous perennial springs. The fortress itself possessed one such spring in its southeast corner. It is not known whether the fortress had a bath, as at Lejjun.

Three reservoirs are known between Ma’an and Udruh; they were studied by Lindner and Abudanh, who associated them not with springs but with qanat systems. Birket Udruh is 50x50m and of unknown depth, lined with hydraulic mortar and equipped with a settling basin. Abudanh adduces pottery to suggest an originally Nabatean date, though utilization continued into the Ottoman period until today. Birket al Fiqiyy 1.5km to southeast is 33x40m and supported

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1004 Carlier 1984, 343-4.
1006 Carlier 1987b, 113.
1007 Idem.
1010 Kennedy 2004, 179 and fig. 17.4.
irrigation. Two birkets at Jabal al Tuhuna were in an enclosure with settlement architecture, built of hewn limestone blocks and lined with hydraulic mortar. It was used for irrigation, and supplied by a qanat system to west of Jabal al Tahuna.\textsuperscript{1012} Ceramics associated with these cisterns are predominantly Late Byzantine and Early Islamic.\textsuperscript{1013} Remains of a mill in the wadi were associated with Roman ceramics.\textsuperscript{1014}

A channel system is also known from Udrugh, which was found at the site’s southeast and dated to the Late Byzantine or Early Islamic period by ceramics.

**ARABIA, UMM EL JIMAL**

After Butler’s survey in 1913,\textsuperscript{1015} and brief work on the Julianos Church by Corbett,\textsuperscript{1016} Bert DeVries began survey and excavation at Umm el Jimal in 1972.\textsuperscript{1017} De Vries traced a presumably 4\textsuperscript{th} century aqueduct into the wadi north of site, from whose slopes rainwater was dammed and collected into a channel, and carried several kilometers into the town.\textsuperscript{1018} Water entered through the city walls at the east – an installation mistaken for a city gate by Butler – and thence distributed into a group of reservoirs associated with churches and large residential complexes. This system – along with the houses – survived into the Umayyad period and after the 748/9 earthquake, though some buildings like the Barracks fell into ruin and were not rebuilt.\textsuperscript{1019} The large reservoir at the center of town (40 x 28.5 x 3-4m) was rebuilt with US AID money in the 1950s; it is still in use and popular as a swimming hole. In the 50km\textsuperscript{2} around Umm El Jimal, and at nearby (unexcavated) Umm Es Surab, several reservoirs, dams, and foggara/chain wells are known.\textsuperscript{1020} The city walls are built of crude basalt boulders; pottery suggests mid-2\textsuperscript{nd} – 4\textsuperscript{th} century construction. Kennedy gives references for a Severan building inscription indicating construction or renewal of the ramparts between 177-180 CE.\textsuperscript{1021} A fort against the city’s east wall is dated by 2\textsuperscript{nd}-4\textsuperscript{th} century pottery and Constantinian coins in the foundation levels; it is abutted by the city walls and so therefore precedes it in date of construction.\textsuperscript{1022}

**ARABIA, UMM EL QUTTEIN**

Umm el Quttein is a small Roman fortlet probably implanted into a Nabatean settlement, built 26km southeast of Azraq on the primary south-north / Azraq-
Bosra road. The fort was built in the 2nd-3rd century, to judge from its form and an undated Latin inscription for a cohort here; it was supply by two large extra muros reservoirs of unknown date. The settlement might be identified with Diafenis in the *Notitia Dignitatum*.

**ARABIA, WADI KAIFRAIN**

Probably a Herodian double-fort reused in the Roman period, with early Roman to early Islamic found in scatters there. The forts are positioned around the modern Kafrain dam that spans the wadi; a hot spring mid-slope has been used for millennia. The al-Habbasa fort 1 km south of the dam and just east of the hot spring is supplied by a water channel from the east with five cisterns along its length.

**ARABIA, ZIZIAH/JIZE**

The massive Roman reservoir here – 128 x 100 x 5.3m = 68,000m$^3$ – is basically all that remains of the Late Roman – Early Islamic town with two castles and possibly an earlier Roman fort. Indications of these structures can be gleaned from the 19th century travelers like Brünnow and Domaszewski as well as WWI aerial photography analyzed by Kennedy, which revealed how the settlement stretched southeast of the giant reservoir, and included check dams in the wadi of unknown date. The *Notitia Dignatum* places Equites Dalmatae Illyriciani, Ziza here around 400 CE, while an inscription records reconstruction of an unknown building here in 580 CE under a dux, by a local archon and lamprotatos, Christogonos.

**ARMENIA, MELITENE / MALATYA**

Melitene, near the Euphrates, was capital of successive provinces of Armenia (after divisions by Theodosius and later Justinian). It was later sacked and occupied by the Rashidun caliphate, at which point it became a significant base for military incursions into Byzantine Cappadocia and beyond. No information about its Roman or Late Antique water system was available at the time of composition, nor its episcopal complex.

**/[**ARMENIA, SEBASTE / SIVAS**

The archaeology and water distribution of Sebaste, metropolis of Armenia II and military capital of Sebasteia by 911, are poorly known before the Seljuk period.

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1023 Kennedy 2004, 81-86.
1024 MacAdam 1989, 303.
1025 Prag and Barnes 1996.
1026 Kennedy 2004, 123.
1028 Kennedy and Riley 1990.
1029 Kennedy 2004, 130.
1030 On the monuments of Sivas, see especially Gabriel 1934, 2: 131-189.
Ephesus was the metropolis of province Asia. Its aqueducts have been admirably studied by Wiplinger,\textsuperscript{1031} its baths and fountains by Auinger and others.\textsuperscript{1032} A very brief description of Ephesus’s water management in Late Antiquity would consider six phenomena.

1) the longevity of the aqueducts: according to recent work by Wiplinger, the Değirmendere aqueduct no longer functioned after the beginning of the fourth century, though part of the line was repaired and extended for a new branch, diverted from north of Kalafat towards Scala Nova in the thirteenth century.\textsuperscript{1033} Repairs to the aqueducts outside the city are difficult to date, but careful examination of the contexts of water pipes and phased changes to water-consuming buildings around the city indicate that the Marnas/Throessitica aqueduct (which supplied the Upper Agora and the Embolos) and the Kaystros/Selinus aqueducts (which supplied St John’s, the area around Marienkirche, and the Arkadiane) remained functional at least into the seventh century, if not later.\textsuperscript{1034} Coins of Constantine V found in the drain of a latrine built under the Domitian’s temple terrace could also indicate eighth century functionality for the settlement ad isole that developed around sg. Lukasgrab and the Upper Agora.\textsuperscript{1035} Recent study has determined that the flowthrough from the city’s aqueducts – which drained down the Arkadiane into the Inner Harbor – was critical for replacing water in the harbor and channel. When the aqueducts stopped working, the harbor began to silt up more rapidly.\textsuperscript{1036}

2) Gradual industrialization of the city was facilitated by the deliberate adaptation of existing Roman water infrastructure in the city, which was coordinated by the city’s proconsular elite after the fifth century. This is particularly visible in the relationship of new water mills, built into the Upper Agora’s south Fountain/Der Fontane and on the Celsusplatz, which were both situated immediately adjacent to new administrative complexes built on the remains of Domitian’s temple, and in an audience hall south of the Celsus Library/Nymphaeum, respectively. Elsewhere in the city, water supplies were coordinated with industrial activities, in addition to new or maintained fountains and baths.\textsuperscript{1037}

\textsuperscript{1031} Wiplinger 2009 for a general overview of Ephesian aqueducts, and 2013 for the Değirmendere aqueduct.
\textsuperscript{1032} Recently see Auinger 2011 with extensive references.
\textsuperscript{1033} Wiplinger 2013, 108.
\textsuperscript{1034} See Pickett, forthcoming.
\textsuperscript{1035} Vettors 1972/5, 314.
\textsuperscript{1036} Delile et alii 2015.
\textsuperscript{1037} Pickett, forthcoming.
3) The baths and fountains of Ephesus continued to be prime locations for new sculptural displays, of private families and proconsular elites in addition to emperors, after the fifth century.\textsuperscript{1038}

4) Widespread abandonment of Hellenistic wells and cisterns was coincident with the introduction of aqueducts into Ephesus after the first century AD; cisterns and wells began to be reintroduced between the later fourth and fifth centuries, when the city’s aqueducts were still at maximum functionality.\textsuperscript{1039}

5) As discussed above (sec. 3.14), Ephesus provides important evidence for the reappropriation and redistribution of water that had previously been directed to temples, after the end of sacrifice and their closure was mandated by Theodosius in 395 AD.

6) A well-organized and city-managed ramified system for water distribution was maintained until at least the sixth century; this is indicated by an unpublished distribution installation (see above sec. 3.10) that drew water into numerous pipes, which pierced the walls of the Selinus/Sirince line as it passed by the Hippodrome.

7) Despite the good integration of the city’s water system with the episkopeion and bath of the first cathedral, the Church of Mary, it is perhaps surprising that there is no evidence for a supply-pipe in its baptistery (rather, there is only a drain).\textsuperscript{1040}

\textbf{ASIA, MILETOS}

See the comprehensive work on water at Miletos by Tuttahs.\textsuperscript{1041}

\textbf{ASIA, Pergamon}

Pre-aqueduct supplies: Henning and Fahlbusch note the presence of 149 rain-water cisterns on the acropolis, with an average volume of 27m$^3$ and a total near 4000 m$^3$; these are nearly evenly divided between the Upper Acropolis and the so-called Wohnstadt.\textsuperscript{1042} An additional 1500m$^3$ of water storage was added with two Roman period-reservoirs. There was also a spring at the foot of the acropolis, in addition to the Selinus / Bergama Çayı river that runs through town.

\textsuperscript{1038} On the city’s fountains and baths, see most recently Auinger and Rathmayr 2007 and Auinger 2011.
\textsuperscript{1039} Pers. observation 2013-2014. The city’s wells and cisterns have yet to be studied \textit{in extenso}. The author hopes to accomplish this work in 2016. Late antique cisterns were installed under the Domitian’s temple on the Upper Agora; in the Hestiasaal of the Upper Agora sometime after that building’s obsolescence in the fifth century (see Vetters 1972-1975b, 249); in the theater’s cavea after the late fourth century (see \textit{JOAI} 68 [1999], 25-7); just east of the capellina and skeuophylakion at the Church of St John (Russo 2010, 45).
\textsuperscript{1040} Personal observation 2013-2014.
\textsuperscript{1041} Tuttahs 2007.
\textsuperscript{1042} Henning and Fahlbusch 2004, 187.
in the vicinity of the Red Basilica and the Roman substruction bridge.

Between 400 BCE and 200 CE at least eleven aqueducts were built. Following Garbrecht and Fahlbusch’s classifications and descriptions, they are:

1 F/G) On the slopes of Geyiklidağ west of Pergamon are two branches of an aqueduct that supplied the Asklepeion and the west part of town, via a ceramic pipeline. This system is thought to be Hellenistic or late Roman.

2 B) The Demophon aqueduct is a double pipe system with a 36m deep siphon, which terminated at the Demeter sanctuary fountain on the Acropolis, and dates to 190-180 BCE.

3 C) The Apollonios aqueduct is a triple pipe system “diente warscheinlich der Versorgung eines bedeutenden Tempels,” and also dates to 190-180 BCE.

3 D) Near the Roman theater and the west city is a double-pipe conduit, above 3C, which is early or middle imperial.

3 E) This conduit served the west part of the city: a 13cm diameter pipe-line is thought to be Roman, while a 24cm diameter pipe-line is thought to be Late Antique.

4) Madradağ line: Built by Eumenes II to supply the Königsstadt at the top of the rocky acropolis of Pergamon, the Madradağ line is 45km long and features a 3km long inverted siphon.

5) Madradağ extension: Built under Marcus Aurelius c. 170 CE, the Roman extension of the Madradağ line followed roughly the same course as its predecessor, but added two bridges to cut distance. It terminated at the Demeter sanctuary fountain, and also supplied the new bath complex. Garbrecht argues that the Madradağ extension bridge was heavily damaged in a devastating earthquake in 178 CE, after which time it was rebuilt to full height. After the earthquake of 262 CE however, the Madradağ extension bridge was not repaired to full height, and a four-pipe conduit was installed on the lower arcade. Garbrecht associates the installation of a twin open-channel conduit on the lowest course of the Madradağ extension bridge with damage incurred in any of the earthquakes between c. 358 - 368 CE. In the late fifth or sixth century, again possibly in relation to earthquakes of 467/8 or 526/8, a four-pipe system from the same spring was installed, following the contours of the hills to avoid

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1044 Garbrecht 2003.
1045 Ibid., 127.
1046 Idem.
the necessity of bridges.\textsuperscript{1047}

6) Kaikos line: Built in the early 2\textsuperscript{nd} century, the 54km long Kaikos line originated near Gurnellia (94m ASL) and included more than 40 separate aqueduct bridges that account for 7.5km of the total length, in addition to 6 tunnels, the longest of which is 1.6km. The bridge over the Karkasos is 550m long and 40m high. Daily output in its second century state was estimated at 10,000 m\textsuperscript{3} water / day. Garbrecht (2003) argues that the Kaikos bridge was heavily damaged by a devastating earthquake in 178 CE.

7) The Aksu line was a modification of the Kaikos aqueduct line after the 178 CE earthquake, at which time the Kaikos line was rebuilt to its full height. Garbrecht (2003, 129) suggests that this line was damaged but repaired after the 262 and c. 360 CE earthquakes.

**\textsc{Asia, Smyrna / Izmir}**
The Smyrna system is little studied, but was composed of two separate lines (a) the antique “Karapinar system,” conveying the water from Karapinar springs in the upper reaches of Arapdere creek on southern slopes of the Nif mountain, east of Izmir, and reaching the Kadifekale castle (Mount Pagus) by crossing Melez creek through a stone-pipe inverted siphon; (b) the antique “Akpinar system,” conveying the water of Akpinar springs near Kisikköy, south of Izmir, and reaching the temple Zeus Akraios near Bayramyeri, where a series of ancient/medieval water mills were established.\textsuperscript{1048}

\textbf{\textsc{Asia, Troy}}
The ancient city of Troy, controlling the pass through the Dardanelles, was supplied by an aqueduct and qanat that fed to the city’s Roman fountain and bath, and in Late Antiquity were maintained for industrial activity (namely, glass production) that were facilitated by these same water supplies, which continued to be led into the city after devastation in the 260s, due either to earthquake or Gothic invasion (compare with the situation at Ephesus, in the Hanghäuser). After antiquity, the city disaggregated towards a smaller spring source, at the so-called Spring Cave.

Ilion’s single aqueduct conveyed water from the source to the city over nine bridges, through a system of ceramic pipelines from the source – somewhere near Kayalı at 440m ASL and c. 15km distance – that became a mortar-lined and stone-covered earthen channel as the supply approached the city from Gökçalı.\textsuperscript{1049} The largest bridge along the aqueduct’s path is at Kemerder, an

\textsuperscript{1047} Ibid. 2003, 128 and Garbrecht 2004a, 193.
\textsuperscript{1048} For this information, see the Izmir water department’s webpages, at http://www.izsu.gov.tr/Pages/standartPage.aspx?id=175; note also the Trajanic inscription for a supply of water terminating at the Zeus Akraios temple, Appendix D.21
\textsuperscript{1049} Aylward 2002 and Aylward 2006, 111.
arched bridge of travertine blocks and mortared rubble built across the Kemer/Thymbrius river. Its source of water is unknown but possibly comes from southwest of Kayalı Dağ near Çamlıca. Its date cannot be fixed by inscription, but rather is indicated by water-consuming buildings in town which have opus reticulatum and pebble mosaics, that incline Aylward towards a late Hellenistic/Republican or early Imperial date, though Rose prefers a Hadrianic date, to connect its construction with the city’s baths. Aylward identifies similarities of the Troy aqueduct’s construction with other clay pipeline and bridge systems at Ariassos, Cremona in Pisidia, Oinoanda, Pergamon and Sagalassos, as well as the Pollio bridge at Ephesus or the Caligulan bridge at Antioch, which would all suggest the earlier date. The location of the aqueduct’s entrance into the city walls – which were built in the later 3rd century BCE – is unknown. Aylward points to a round structure on a rise in the east trace of the city on Dörpfeld’s plan that could be a pressure tank. If this is correct, it would indicate that the aqueduct probably was not able to ascend to the acropolis. Aylward reported a 1.3m thick layer of sediment in the underground channel; he relates this deposit to the gradual demise of Ilion’s aqueduct, on whose final date he does not speculate.

Further detail about the city’s water system and its operationality in Late Antiquity can be gleaned from a look at the west agora bath, where the construction of a large apsed room replaced an earlier room with mosaics in the third century, after some late Severan devastation (in the 260s, due either to a Gothic invasion or an earthquake, compare with the situation of the Hanghäuser at Ephesus). The bath was dysfunctional by the fourth century, and had been robbed out by the fifth or sixth century (compare with Patara or Anemurion). Coincidentally, a glass workshop with water channels was created in the fourth century, around the time that the bath went out of use. These channels likely indicate the survival of the city’s aqueduct after the problems of the 260s; with the bath’s obsolescence, its waters were now diverted to a new more utilitarian function, to the industry that spread throughout the lower city. The silicate sand required for glass working was an especial local resource, available on the banks of the Scamander river and in the foothills of Mt. Ida.

By the sixth century, the lower city had been abandoned to industry with the agora in use as a cemetery, and remaining residents had settled in the acropolis, where the northeast gate was blocked by a spolia wall, and new circuits were

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1050 Aylward 2006, 112.
1051 Rose 2014, 253.
1052 Aylward 2006: 111
1054 Rose 1992, 55-6; Rose 1997, 102-3; Rose 1998, 101-2; and Rose 1999, 52-4 for the industrial quarters in the lower city, conceivably a component of the city’s reconstruction in the middle fourth century that also included a monumental arch and a statue of Constantine II. These may have coincided or followed Constantine I’s recorded visit to the city, see Rose 2014, 266.
added on the south side of the acropolis, where coins finds indicate activity at least into the seventh century. There is no evidence that the temple of Athena was converted into a church, or that any other churches were built on the acropolis.\(^{1056}\)

Apparently long after the eventual collapse of the aqueduct (fifth/sixth century?), there is evidence that the city disaggregated and shifted towards a smaller perennial water source at the Spring Cave near the old West Sanctuary, on the western side of the Roman residential district. Houses in this area were occupied until the fifth century; thereafter, there is (surprisingly) no evidence for occupation until the thirteenth century when a graveyard covered the area.\(^{1057}\) However, there may have been earlier Transitional Period or Middle Byzantine activity in this location, which is for whatever reason invisible.\(^{1058}\) Ilion/Troy also had considerable supply from wells,\(^{1059}\) in addition to at least one qanat,\(^{1060}\) which were filled and abandoned in the devastation of the 260s.\(^{1061}\)

**Bithynia, Nicaea / Iznik**

Previously an important ecclesial center and a major city of province Bithynia, Nicaea was elevated to the status of military capital of Opsikion by 680.

Nicaea’s water supplies may be briefly described as follows: An open-channel aqueduct runs just outside the city’s east gates along the course of the decumanus, past a tübbe and carefully maintained Ottoman cemetery. The aqueduct is constructed as a low retaining wall in opus mixtum with large brick fragments, set with a mortar-lined channel on top, and brick arches on thick mortar beds. Immediately adjacent to the aqueduct’s south side are extensive fields used for the irrigated cultivation of olives. The aqueduct itself may be differentiated by its masonry into several sections – while the whole of the work is in opus mixtum with brick, the intensity of the brick fragmentation differs visibly, with more frequent use of brick fragments [occasionally arranged into cloisonné] and spolia as one approaches the city gates, where an arch over a NS street has been frequently repaired in the Ottoman and modern periods.

The date of the aqueduct’s foundations remain a matter for speculation – do they stretch back to Hadrian’s aqueduct known from inscriptions? The Trajanic and Hadrianic inscriptions commemorate the construction of ὑδραγωγίου γεφύρας. Both of these inscriptions were found not near Hadrian’s triumphal arch, later

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\(^{1056}\) Rose 2014, 269.

\(^{1057}\) See also Rose 1999, 57 and 60 for the use of the area as a cemetery. The Spring Caves had earlier been used as fish pools in the Flavian period, set in an area used for quarrying.

\(^{1058}\) Rose 1994, 274 compares activity at the Spring Cave in Troy with evidence of regional activity, namely inscriptions for Michael III’s construction of fortifications at Nicaea, Smyrna, and Ankara.

\(^{1059}\) Tekkok et alii 2001, esp. 363-72.

\(^{1060}\) Korfmann 2002, 20-23 for the qanat.

\(^{1061}\) Rose 2014, 263.
incorporated into the 3rd century circuit’s north/Istanbul gate, but in towers 43 and 42 at the east/Lefke gate, immediately adjacent to the existing aqueduct.\footnote{Schneider 1936: nrs. 10 and 18.} Their location may indicate that Hadrian’s line also entered into the city through the same East/Lefke gate – the inscribed architrave nr. 18 is probably from a fountain at the aqueduct’s terminus in this area. Procopius (Buildings 5.3) also describes a pre-existing aqueduct, likely Hadrian’s, as totally ruined or παντάπασί τε διεφθαρμένην, and indicates that Justinian restored it. (Justinian also restored baths of the Veredarii, βαλανεῖον ἐν τῷ καταλυτηρίῳ τῶν βερεδαρίων, besides building churches and monasteries, as well as a bridge to the west of town, whose predecessor had been swept away in a flood.)

None of the opus quadratum typical of first or second century CE aqueducts survives here. This phase of the aqueduct’s use might be connected with the double strands of pipes that cross under the late third century city walls, just north of the inner east gate, which is discontinuous with the line of the present aqueduct, whose bridged channel enters the city directly through a roughly cut opening in the curtain walls south of the gate. From here, the channel is funneled into a late Ottoman çesme just inside the inner wall’s east gate. Machine mixed mortar on the channel, inside and outside of the city walls, indicates that the çesme has recently been in use – a local informant suggested that the çesme worked as recently as the 1970s.

The present aqueduct is most likely a Middle or (perhaps better) Late Byzantine effort, with heavy Seljuk and Ottoman repairs. Such repairs, from a very late date, are visible in the fourth or fifth arch out from the wall, where an inscribed Ottoman tomb stone has been incorporated into the fabric. The build of the aqueduct as a whole is a closer match for the outer walls erected by John Vatatzes (r. 1222-1254), for instance around the outer East/Lefke gate (e.g. between towers 40-70) or around the outerworks on the southwest side of the city (e.g. Tower 108). They are a more imperfect match for the neat stretches of brick and stone work in tower 97 of the Byzantine walls of the city, dated to the reign of Michael III (r. 842-867),\footnote{Foss 1996, fig. 6.} or to Tower 88, probably built by Andronicus II in 1290.\footnote{idem, fig. 14.}

This would fit with the speech of Theodore Laskaris in praise of Nicaea, in which he refers explicitly to an aqueduct that crosses into the city through its walls. Laskaris compares “full-flowing waters, easy to cross, and easily carried by the opportune construction of the city wall [referring to the aqueduct], and also potable and most transparent, having their outlet above the level of one’s head, and poured in a circle round all the city (referring to a moat around the city walls).” Laskaris also refers to the presence of springs inside the town itself, as he says that “Never will one native inhabitant enjoy the water more than another,
for everyone has a fountain in his own house: never will a foreigner envy the natives, for the supply of water is overflowing.” 1065 He also praises the city’s vegetation and numerous vineyards, which were possibly supplied by the city aqueduct, just as modern olive farmers repaired the line for the same purpose until recently. One Byzantine spring house survives intra muros, the so-called Bocak hagiasma. Wells within Nicaea were noted by Ibn Battuta, 1066 who visited Nicaea in 1335. 1067

*BITHYNIA, NICOMEDIA / IZMIT*

Nicomedia was a Hellenistic town founded as capital of Bithynia by Nicomedes I in 264/3 BCE on the Izmıt / Astacus gulf, and was later incorporated into the Roman empire after 74 BCE. After 29 BCE it was a center for the imperial koinon cult of Rome and Augustus. Nicomedia was a Tetrarchic capital before the establishment of Constantinople; Diocletian was acclaimed emperor here in 284 before making the city his residence. 1068 With bishops since the second century, and the site of a major cult site for St Panteleimon near to the west, Nicomedia remained in Roman hands until its conquest by the Ottoman Orkhan in 1328. 1069 Nicomedia was an important center for marble quarrying in the Roman period and, after the 11th century, for glazed tile production.

Nicomedia’s water system is primarily known from the abortive attempt to build an aqueduct there, owing to problems with leveling and substructure stability, as recorded by Pliny the Younger’s letters to Trajan. 1070 The epigraphy here, otherwise extensive, yields little concerning water infrastructure. 1071 Remains of an aqueduct(s) were observed on the hills east of town by Ainsworth, 1072 but little more than fragments of the system have been studied, owing to very sporadic urban archaeology. 1073 Libanius says that the city was well-watered in the later fourth century, 1074 and Procopius records the work of Justinian around the city, with restoration of the collapsed Antoninus bath and a bridge across the river Sangarius. 1075 Pope Constantine I saw fit to visit Nicomedia in 711. 1076 The acropolis at Nicomedia was fortified and re-fortified multiple times, with an occupational history easily extending from the Hellenistic to the medieval periods. 1077

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1065 Both quotes are lifted from Foss 1996, 147
1067 Foss 1996, 160
1068 Neue Pauly, s.v. Nicomedia and RE 17.493f.
1070 Pliny the Younger, Epistles X.37-9.
1071 For inscriptions here see the dissertation by Şahin 1973.
1072 Ainsworth 1842, 1: 25.
1073 But see the recent work on the agora and a bath, Çalik-Ross 2007 [non vidi].
1074 Libanius Or. 61.7.18.
1075 Buildings 5.3.8-10.
1076 Ekonomou 2007, 272.
1077 Foss 1996
The Kertil and Acısu springs near the city are reportedly brackish; sources for city water were taken from further out, at Paşasuyu near Topalli, where there are remains of ancient water channels.\footnote{Güney 2012, 45 n. 167.} Paşasuyu’s springs are used by the modern Izmit water system, which have been rebuilt repeatedly since the Ottoman period. Several fairly recent Turkish publications are concerned with the historical Izmit water system, written primarily by engineers concerned with the sources and output of the system based on channel dimensions; these were unfortunately not available to me at the time of writing.\footnote{E.g. Aksoy 2001; and Galitekin 2006 [both non vidi].}

**Bulgaria, Pliska**

No artifacts or structures that can be dated before the mid-8th century have been found at Pliska. Aladzhov noted that excavations in the outer city yielded, at several places, the routes of water mains dating between the 8th and the 10th century, with drainage facilities near the large basilica dating to the same period.\footnote{Aladzhov 2010, 118 citing Miatev 1940-42, 80 and Dimitrov 1995.} Several dozen pipes were found, of lead and ceramic, in addition to wells. The water mains supplied a round reservoir of stone and bricks that was later converted into hypocaust baths (late 8th-9th century), while another tiled rectangular reservoir was built near the citadel’s west wall with another set of three-room baths immediately to its south.\footnote{Miatev 1940-42, 122 and Georgiev 1982, 4-21; note also Georgiev 1993 with Rashev and Dimitrov 1993, 67-8.}

**Bulgaria, Preslav**

Late Antique settlement (6th century) at Preslav is indicated by the discovery of three early Byzantine churches in the space enclosed by the outer fortress, which is likely contemporary with an inner-enclosure dated to the first quarter of the 9th century. Water mains dating to this latter period were found in a southwest extension, along with cisterns, while a small bath was constructed between the northern barracks and the residential building of the inner enclosure.\footnote{Aladzhov 2010, 129.}

**Cappadocia, Alışar**

Excavations here in 1930-1931 revealed a one-aisled Byzantine church (dated to the 7th century by its excavators) set immediately adjacent to several houses and a small bath building, built on the foundations of a Hittite tower.\footnote{TIB 2.139 and Von der Osten 1933, 30.}

* **Cappadocia, Caesarea / Kayseri**

Apart from the Justinianic circuit of fortifications (Procopius *Buildings* 5.4.7-14), basically nothing of the antique metropolis’s layout is known, which regretably
includes the location of its episcopal complex or the nature of its water supply. Basil of Caesarea famously built a suburban xenodocheion (the so-called Basileias) outside the walls, which included a hostel, poorhouse, and hospital, but probably also water-consuming support structures like baths and kitchens or bakeries.\footnote{See Brown 2002, 35 and Sozomen HE 6.34.} Goblot records the existence of a qanat that supplied the city with water until 1955. A modern dam north of town, built in the 1950s, may have captured another source suitable for use in the antique city.\footnote{See Goblot 1979, 126 and Cooper and Decker 2012, 64.}

**CAPPADOCIA, KOLONEIA / AKSARAY**

Little is known of the archaeology of Koloneia, which became a military capital by 842 or 863. Michael Ballance reported the discovery of a qanat some 80km from Konya running NNE, in the direction of mod. Aksaray – Cooper and Decker suggested that this may be part of a qanat system supplying Byzantine Koloneia.\footnote{Cooper and Decker 2012, 64}

*CAPPADOCIA, MOKISSOS / HELVADERE*

Procopius (Buildings 4.15) records Justinian’s construction here of “public baths and all the other structures that are the mark of a prosperous city,” which presumably would include an aqueduct, though such systems if they were ever built have left no trace. The positively Bronze Age look of the city’s remains, apart from the churches and fortifications, might suggest that the attribution of such patronage to Justinian is a fabrication. Listed as a polis by Hierokles, Mokissos was elevated to the rank of Metropolis of Cappadocia Secunda by Justinian, coincident with its eponymous renaming as Iustiniupolis.\footnote{TIB 2.238-9.}

The city occupies a basin surrounded by low hills on the north slopes of Hasan Dağ. There are no active springs in Mokissos today,\footnote{Berger 1998, 366.} and no remains of an aqueduct.\footnote{An aqueduct was reported by Karatza 1985, 66 though Berger 1998, 366 disagrees.} Cisterns and wells undoubtedly played an important role in the city’s supplies of water. Church 2, on a low ridge above the basin’s west side, has a masonry built cistern on its southwest side that measures approximately 9.2 x 3.4 x 2.9m (=90m$^3$); lined with hydraulic mortar up to the springs. Its intake is at the north facing the church, on the interior (flush with the north wall) and the surface (flush with the ground) as a blocked up rectangular channel in small ashlars. Set back from the church by several meters, it was probably filled from rainwater carried over the sloping ground or from channels set into the walls of the church’s auxiliary buildings.\footnote{Author, pers. observation 2013} Berger reports two other similarly built cisterns without reporting their dimensions: one is associated with Church 1,
another on the northeast hill top could be associated with Church 4. Probably because of rising ground levels, cisterns associated with houses were not visible at the time of the author’s visits in 2010 and 2012.

*CAPPADOCIA, TYANA*

Tyana, famously the home of Apollonius of Tyana, became metropolitan of Cappadocia II after the province was divided under Valens in 372. Tyana was on the trunk route for pilgrims from Constantinople to the Holy Land, and was visited by the Bordeaux Pilgrim and Helena. It is not certain, if likely however, that the city was sacked by Isaurians around the time they appeared outside Kayseri in 404-406. Mokissos briefly became metropolis of the province under Justinian, before the title returned to Tyana. The city was captured and destroyed by Harun al Rashid in 806, who built a mosque there, with new additions including an 18km round city-wall after 831.

Several hot springs are known in the surrounding area, at Xanxaris and Asbamaion.

Probably in addition to wells, the city was supplied by a 4km long aqueduct – with distinctive bossed masonry piers – which entered into the city from the northeast, where at Kösk Höyük in Bahçeli a 20x60m spring catchment reservoir is today the center of a pleasant public park. Recent excavations directed by Rosada for the University of Padua identified an early third century construction date, on the basis of coins found in the outflow canal of the main pool. An early third century date was also postulated by Rosado for the aqueduct-supplied bath in the southeast part of town. However, the relationship of the aqueduct to other water installations, including a recently excavated but isolated baptistery, remains unclear. Interestingly, there are numerous stone-block pipes, such as would be used in an inverted siphon, both around the pool and in the town proper – though appears to have been no need for an inverted siphon due to differences in elevation (Figs. 3.30-32). No churches are known in Tyana, though a church dedicated to John the Baptist is noted in funerary inscriptions. Berges and Nollé speculate that a large round building, whose best comparison is the church on the tell at Beth Shean in Palestine, may

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1092 *IK* 55.2, 493.
1093 *TIB* 2.298-9.
1094 See their respective entries in *TIB* 2.
1095 This is yet to be confirmed by archaeology, though it is suggested by the relatively high water table in the region.
1096 *IK* 55.1, 36-64 on the aqueduct.
1098 For the bath see *IK* 55.1, 65-80 and *KST* 27 (2006): 435-44.
1099 For the baptistery see *KST* 26 (2005): 513-528.
1100 *IK* 55.2, 493 for the St John church dedication.
originally have been a temple dedicated to Zeus.\textsuperscript{101} A fourth century or later inscription (see Appendix E.74) records the erection of a funerary monument for the wife of a \textit{circitor saburrae}, or a man who cleaned sand from the aqueduct.

Components of the aqueduct system at Tyana are still used by the modern municipal water service.

\textbf{CARIA, ALABANDA}
This system has been briefly studied as a technological artifact, but needs further work to integrate it into the city’s historical development.\textsuperscript{102}

\textbf{*CARIA, APHRODISIAS / GEYRE}
Aphrodisias was metropolis of province Caria after 301-305 CE. The Aphrodisias aqueduct system, composed of at least 6 separate aqueducts or conduits, has been extensively traced outside the city (including to presumed extra-muros consumers at villas and farmsteads), but water’s distribution within the city remains poorly understood.\textsuperscript{103} The area around Aphrodisias – on the south side of the Maeander – is unusually well watered with springs and a high water table.\textsuperscript{104} Drainage here was always more of a problem than supply.\textsuperscript{105} Like Hierapolis / Pammukale, because there were numerous springs in addition to supplies drained off from the river, settlement at Aphrodisias after the seventh century was easily dispersed to smaller and independent sources nearby, but outside of Aphrodisias proper. Intense drainage issues shaped the urban core, where the city was focused on pools that drained water into both the south and the north agoras. In addition to the natural constraints of drainage problems, archaeological intention must also be considered. Whereas a wealth of archaeological information pertaining to pipes and water is known from nearby Sardis, for instance, where early excavators were intent on finding Lydian rather than Roman remains, the sculpture-chasing proclivities of Erim’s earlier excavations at Aphrodisias (before the R. R. R. Smith NYU / Oxford years and the beginnings of field survey) contributed to a knowledge of the site that is comparatively skin-deep, and rarely scratched below the Roman or Late Roman street surfaces in excavation. Complicating matters further is the fact that both primary aqueducts – the Timeles and the Isiklar aqueducts – entered into the city from the same north gate.

\textsuperscript{101} \textit{IK} 55.1, 70-1.
\textsuperscript{102} See briefly Edhem Bey 1905, 443-54; Özis 1991, 106-113; and Tannriover 2002.
\textsuperscript{103} Commito / Rojas 2012 and see also the forthcoming article by Commito in the proceedings of the \textit{De Aquaeductu atque Aquae Lyciae} conference, as a Babesch Suppl. / ÖAI Sonderschrift (2015/6); for the older literature see primarily Weber 1904, 91-2.
\textsuperscript{104} See for instance the small site, formerly Byzantine and agricultural but today being converted into a “spring-water bottling facility” according to local residents, recorded by Dalгиç 2012, here at 389.
\textsuperscript{105} See Chaniotis 2008, 61-79 here at 74-6 and MAMA VIII.449 on the dedication of water facilities by Adrastos during the reign of Domitian, which probably included ὕδατα or drains and gutters.
Inscriptions and other evidence provide some interesting details, however, for the state of water distribution at the seat of Caria’s metropolitan bishop during Late Antiquity and the Roman period alike. The epigraphy at Aphrodisias is especially rich. Besides evidence for the foundation of water supply systems in the time of Domitian and Vespasian, an important inscription records a letter of Hadrian to Aphrodisias in which he allows for a replacement subscription, for high priests who wish to donate money to the aqueducts instead of the gladiatorial games, as had been customary. Later, epigraphy suggests that the aquatic festival of the Maiouma was celebrated in the large pool by the baths and agora at least till the later fourth century. Dedications and renovations continued at the Hadrianic bath complex into the fifth and sixth century, which was presumably still fed by the aqueduct at that time. Aphrodisias also had a πατὲρ πολέως, "who undertook public works with civic funds in cooperation with governors."

The city’s cathedral, which was installed in the converted Temple of Aphrodite, was equipped with a well “placed prominently in its center,” preserved from its earlier use as the temple of Aphrodite – this well is situated directly in front of the synthronon, behind the ciborium in the east end. Integration of the church complex with the city’s aqueduct was limited to a phiale in its atrium, as the line passed from north-south alongside the Cathedral’s west side to supply Hadrian’s Baths until at least the sixth century, when the dedications there run out. The bath’s history is currently the subject of a PhD dissertation by Allyson McDavid from NYU.

CARIA, IASOS / ASINKALESI
Tomasello has studied the structure of the Iasos aqueduct in fine detail. Only about 500m long, the aqueduct began in the middle of a plain, from which water must have been pumped up to the level of the arcades. Its distribution cannot, however, be traced inside the walls of the city on the isthmus. Rather, the line of the aqueduct can be followed from a castellum at the north past a late imperial

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1107 SEG 50.1096.
1109 Contra Wilson, forthcoming – Wilson excavated near the south agora pools in 2014 but reportedly disagrees that the Maiouma was celebrated here; he apparently will suggest an alternative location. For dedications at the south Agora pool see Roueché 1989, xxv for, among others, the private benefactor Albinus restoring the west portico of the south agora.
1110 See Smith 2007; this bath is currently the subject of a PhD dissertation by Allyson Mcdavid at NYU/IFA. Nothing was published at the time of writing, but see https://nyu.academia.edu/amcdavid; and http://www.dukewire.org/project-archive/hadrianicbaths/ for an interactive website, besides the inscriptions from the baths prepared by Roueché and accessible at http://insaph.kcl.ac.uk/.
1111 Roueché 1989, xxv and #38-41.
1112 For the wellhead and the quote see Hebert 2000, 43 and for the church generally Cormack 1990, 26-41 and Cormack 1990b.
villa rustica,\textsuperscript{1113} an imperial-period mausoleum (the so-called Balık Pazarı), over the north gate\textsuperscript{1114} and under the south gate,\textsuperscript{1115} and thence to the city walls. Architectural evidence combined with a sondage on a public street indicated that the aqueduct was constructed in the latter part of the first century CE and was maintained until sometime in the fourth century, though the road was kept cleared until the latter seventh century as indicated by a follis of Constans II (r. 641-668).\textsuperscript{1116} Such repairs, though hard to date, seem to be indicated by Guidi, who noted spolia embedded in the arches.\textsuperscript{1117} Churches inside the city around the agora were supplied by wells,\textsuperscript{1118} while the acropolis basilica was built over a vaulted cistern (5.35 x 4.6 x 3.2m = 78m$^3$).\textsuperscript{1119}

\textbf{Caria, Kibyra}

Kibyra was first bishopric in the eparchy of Caria, under the metropolitan of Stauropolis/Aphrodisias. The city was first explored by Spratt and Forbes (Spratt and Forbes.\textsuperscript{1120} Two aqueducts are reported at Kibyra, though their distribution inside the city as related to the numerous finds of water pipes and other system elements, remains unclear.\textsuperscript{1121} The system has a terminus ante quem given by an inscription from 169-177 or 180-192 CE, which was concerned with the illegal diversion of waters both inside and outside town, especially for illegal irrigation by local farmers.\textsuperscript{1122}

Petersen and von Luschan noted the conduit’s dimensions, with masonry 0.7 x 0.9m squared framing a channel 0.5-0.6m wide, in which were laid 0.18m diameter pipes.\textsuperscript{1123}

Özüdoğru and Dökü identified a multi-phase system of five strands of water pipes on the first terrace of the upper agora, which are thought to date from the second half of the 2\textsuperscript{nd}/early 3\textsuperscript{rd} to 6\textsuperscript{th}/7\textsuperscript{th} centuries.\textsuperscript{1124} In front of Gate 1 by the west Stoa, another set of pipes were found in addition to a 0.6m deep brick/hewn sewer that ran under the street, along with oil lamps and coins from the fifth to seventh centuries.\textsuperscript{1125} Along the exterior side of a western terrace wall at the stadion, built after the destruction of a portico from the stadion’s primary phase of use, a small building with dry rubble masonry was erected with a piped in

\begin{footnotes}
\item[\textsuperscript{1113}] Tomasello 1991, 113-119.
\item[\textsuperscript{1114}] ibid. 22-4.
\item[\textsuperscript{1115}] ibid. 53-61.
\item[\textsuperscript{1116}] ibid. 54.
\item[\textsuperscript{1117}] Guidi 1922, 355-6.
\item[\textsuperscript{1118}] Serin 2004, 38 and 43.
\item[\textsuperscript{1119}] Ibid. 109.
\item[\textsuperscript{1120}] Spratt and Forbes 1847, 1: 253-60.
\item[\textsuperscript{1121}] Petersen and Luschan 1889, 2: 189 and Ekinci et alii 2007, 23.
\item[\textsuperscript{1122}] \textit{IK} 60.19 = SEG 48.1582.
\item[\textsuperscript{1123}] Petersen and von Luschan 1889, 2: 189.
\item[\textsuperscript{1124}] Özüdoğru and Dökü 2010.
\item[\textsuperscript{1125}] Özüdoğru and Dökü 2011, 40.
\end{footnotes}
water supply, which supported iron smelting activities during Late Antiquity. It seems quite possible that this industrial site with its water supply functioned simultaneously with the church basilica immediately to its south, which may have been equipped with a fountain (compare with Beth Shean, Jarash, Messene, Philippi, Hierapolis). Late repairs to the water system were found in this area, with a half pithos used to join several sections of pipeline. Other evidence in town suggests active leather-working, pottery, as well as iron production activities. Waste-water pipes were also found aligned under the rows of seats in the stadion.

Though this system is as yet not very well understood, preliminary indications of these changes during Late Antiquity could indicate that the aqueduct system was at least partially repaired after the earthquake of 451, for industrial and ecclesial purposes.

Caria, Labraunda
Labraunda was a Hellenistic spring-sanctuary, which was converted to a residential settlement with industrial installations in Late Antiquity, which took advantage of its perennial sources. An external supply of water was provided by a 1.4km long conduit carrying spring water down the mountain side terminates at several bath complexes.

The West Church was built on a platform immediately below the South Baths, in a converted late classical stoa in continuous use since the imperial period. In a second phase, a parekklesion was added to the south side of the church, with a lined basin at the center of its apse that was monumentalized with spolia marble steps and mosaics. Though the intake does not survive, there is a drain at the center of the basin, and an outflow on the southeast exterior of the building that connects the basin to a larger drainage system.

The East Baths are located outside the temenos of the Zeus Labraundos sanctuary. They were built in the first century CE, as attested by an inscription, and partially converted to ecclesial use at the end of the 4th/early 5th century, according to its excavator Jesper Blid, though this seems early by comparison to other bath-church conversions in Anatolia. The hypocaust immediately south of the church seems to have gone out of use, while the blind-arcaded space used for the nave was probably the old apodyterium, comparing well for instance with the Grand Termi at Hierapolis. Blid also indicates that the church was destroyed.

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1126 Ekinci et alii 2009, 33.
1127 Ekinci et alii 2007, 27 fig. 8.
1129 Ekinci et alii 2009, 34.
1130 Akyüz and Altunel 2001
1131 Blid 2012, 60.
1132 Ibid. 62.
fairly soon after it was built.\textsuperscript{1133}

However, Blid also records the interesting discovery of a water feature in the east end of the church that would suggest continuity of the water supply system after its use as a bath was discontinued: Inside the apse was a rectangular cutting, in which were found 156 glass fragments from cup bottoms and windows panes. The cutting was filled with water via a terra cotta conduit that ran east-west under the marble flagstones of the church’s floor. The cutting was drained via a channel 55cm deep and 40cm, which carried out of the rectangular pit and penetrated the apse’s east wall, bending from there to the south to follow along the church’s exterior wall.\textsuperscript{1134} The feature as a whole is suggestive of an okeanos, as also found at Bosra, and known from Jarash by inscription.\textsuperscript{1135}

\textbf{CARIA, MAGNESIA AD MEANDRUM}
Magnesia was supplied with an aqueduct that carried water in from the southwest, but very little remains and the system is poorly known.\textsuperscript{1136}

\textbf{CARIA, MYLASA}
Mylasa’s most prominent aqueduct led into the city from 2.5km east of town – its internal distribution within the walls is unknown, though its terminus might speculatively be connected to a Roman bath complex near the east gates, the sanctuary of Zeus Osogoa (a Hellenistic temple with Roman embellishments on a podium in the town center), or the Temple of Augustus. Schneider suggested that this aqueduct was contemporary with the city walls and gates, and that it dated to the second century, not to the early Byzantine period as per Akarca.\textsuperscript{1137} This aqueduct has never been extensively studied. Its Western section is mostly fallen, but the east is preserved to full height, with two superimposed rows of arches. Its arcades are 2.35m wide and thick. Stretches of the aqueduct show repairs to piers and arches, and are littered with spolia – Ruggieri followed Hamilton, noting white marble, bits of trabeation, stylobtes, and marble columns (perhaps from a bath?) embedded in the repaired fabric. This probably suggests a Late Antique rather than Severan date for repairs. Ruggieri also observed three types of mortar, one of which he compares to Byzantine buildings in the area that date end of 6\textsuperscript{th} to mid 7\textsuperscript{th} at the earliest. Ruggieri would like to connect this stretch of aqueduct to a local LA domus with mosaics, a water basin, and polygonal apses found at Alakışla and Ashağı Mazı.\textsuperscript{1138}

A second aqueduct approaching the city from the direction of spring-rich Beçin was noted by Rumscheid, inferred from a building 50m north of the Milas - Mugla

\textsuperscript{1133} Blid 2008.
\textsuperscript{1134} Blid 2008 and 2012.
\textsuperscript{1135} For the Jarash okeanos, see SEG 7.873.
\textsuperscript{1136} Humann 1904, and Çiftçi 2001.
\textsuperscript{1137} Akarca 1954.
\textsuperscript{1138} Ruggieri 2003, 162-8, 181-3, and 237-241.
road with 1m thick walls that he interpreted as a collection tank or a distribution box. Rumscheid suggested that this system was for irrigation rather than a municipal supply.\textsuperscript{1139}

A third conduit entered the city via ceramic pipeline, following \textit{under} the line of the Roman aqueduct bridge. Thus it must pre-date the imperial Roman bridge, and is presumably Hellenistic or very early imperial/Augustan.

Much later, springs east of the city may have been directed towards the walls at the Şeyh Dede türbe.\textsuperscript{1140}

One bath is recorded by an inscription from the end of the first century BCE.\textsuperscript{1141} A row-type bath complex, about 50m long and 30m wide, was found at Baltalikapı in Şevketiye, near the aqueduct’s entrance into the city on its east side.\textsuperscript{1142} This complex had six rooms, a long and brick vaulted apodyterium at its west, and several columns inscribed NIKH outside its east entrance.\textsuperscript{1143}

\textbf{CARIA, PANAMARA}
Sanctuary aqueduct. Little is known of this aqueduct system other than two impotent inscriptions that attest to private donation for a dedicated, non-urban temple supply. The aqueduct supplied the temple-sanctuary of Hera at Panamara, near Stratonikeia. Sometime between the 1\textsuperscript{st} and 3\textsuperscript{rd} centuries CE, the neokorate priest Tiberius Sempronius Clemens “conducted the hydragogia and introduced abundant to the temple at their own expense” on behalf of the demos. See the inscription with comments, infra Appendix E.58.

\textbf{CARIA, STRATONIKEIA}
See the inscriptions infra Appendix E.58 and E.83. Ruggieri suspects that a church here was implanted into an older gymnasion.\textsuperscript{1144}

\textbf{CILICIA, AKKALE}
Fortified villa context, associated with baths, massive reservoirs and a rare example of a lighthouse (compare with the larger Neronian example at Patara). The site has been studied for generations but never excavated, so some aspects remain tentative – nevertheless the sum of epigraphic and architectural lends itself to the interpretation that the group of buildings at Akkale was a fortified elite residence during the fifth and sixth centuries.\textsuperscript{1145} A central question is whether or

\textsuperscript{1139} Rumscheid 1995, 82.
\textsuperscript{1140} Rumscheid 1996, 127.
\textsuperscript{1141} SEG 39.1130 = EA 13 (1989), 5.
\textsuperscript{1142} Rumscheid 1996, 138 for plan.
\textsuperscript{1143} Ibid. 127 and Rumscheid 1997, 394-5.
\textsuperscript{1144} Ruggieri 2005, 97-100.
\textsuperscript{1145} Edwards 1989, Eyice 1981 and 1986, Hild et alii 1984, 306-8; for the inscriptions see Dagron and Feissel 1987, 53f nr. 22 and Hunger 1986; the aqueduct inscription is reproduced above, Appendix E.84.
not Akkale should be associated with Illus, the rebel and competitor to emperor Zeno.\textsuperscript{1146} This hypothetical association of the site’s patron with a rebel is significant, because it would signal that Akkale is an index for resources and territorial authority held by state-empowered bureaucrats, who were nevertheless acting explicitly in self- rather than state-interests.

Hild and Restle assumed that the Lamos-Elaiussa-Korykos aqueduct line also supplied Akkale by a diversion – this was confirmed by Murphy, with reference to the open-channel conduit (probably once slab-covered) that can be observed descending into the site from the north, just a few meters west of the present gravel road.\textsuperscript{1147} A broken bit of inscription from over the door of the bath names Illos as patron for its construction. Illos is known from another inscription which states that he restored the aqueduct of Elaiussa – Elton argued that this is probably the same Illos known as a rival of the emperor Zeno.\textsuperscript{1148} Besides a possible lighthouse, a mill and a horreum, and apparently no private or residential rooms, there is also a small bath complex – which notably features pendentives in its dome, in another early bath-appearance – but the most impressive structure on site is arguably the reservoir.

The reservoir was published by Eyice, who described and drew the plan but did not explain why such a massive amount of water in storage was needed at the site. However, we might propose that the likely function of the reservoir was to integrate the estate’s patron into the maritime economy. Troop transport is another possibility, owing to the scale and plan of the large multi-story complex to the west, which could have housed dozens, if not a couple hundred men. Ships and people needed food and water, and Akkale was clearly provisioned to support these need, giving bread from the mill and horreum, as well as water in skins, barrels or baths to sailors visiting the site’s small natural harbor, or soldiers disembarking here. The site may well have been originally built as a Late Antique port and horreum run by the state, which only later passed into Illus’s hands in the course of his duty as \textit{magister militum}. Thanks to the inscription there is no doubt as to the involvement of Illos at the site, the question is which Illos, and if it is the rebel, then whether or not Akkale’s fortified port and accumulated resources (incl. water) served in his rebellion. If an earlier (perhaps late fourth or early fifth century) date were favored, Akkale might be included as part of the development of a network of Late Antique ports that emerged or were aggrandized along the Cilician, Lycian, and Ionian coasts after the designation of Constantinople as capital.

\textbf{CILICIA, AMUDA}
Fortified/rural context, Amuda is a fortified place 70m above surrounding territory and just a few kilometers west of nearby Hierapolis Kastabala, on a road above

\textsuperscript{1146} Elton 2000.  
\textsuperscript{1147} \textit{TIB} 5.1.165-6 and Murphy 2013.  
\textsuperscript{1148} Elton 2000.
the Pyramos river valley. The TIB editors note that this place appears in a document dated 1212, in which Leo I king of Armenia minor granted to the German Order properties around Amuda a parte Simonaglain (Simanaklay, 10km northeast of Amuda) tendit usque ad antiquum adaquarium, ubi due sunt arbores salices et modo factus est laccus; dehinc usque rostrum de rocha media juxta gastinam (gastina = unbuilt land) que est de territoria Adidy. A gastina illa superius ascenditur usque ad Quilli quo dicitur latine meta de Gammassa. Alia division inter Gammassa et Amudayn tendit ad cavam, ubi est arbor dicta chaisne spinosa et abbacia Chalot et agger vine de Mechale, et extenditur meta usque viam. This is indicative of the survival of at least traces of the old aqueduct system, in the early thirteenth century, that had supplied old Kastabala. Besides adducing the remains of the aqueduct, adaquarium, as a property boundary, the descriptions of fields in this passage suggest that the aqueduct system was likely also being used (at least in sections) to irrigate vineyards (a water intensive type of agriculture), even into the thirteenth century.

*CILICIA, ANAZARBUS / ANAVARZA

Anazarbus was metropolis of province Cilicia Secunda. At Anazarbus, an aqueduct is associated with a temple, municipal baths and/or, later, an episcopal complex. There were definitely two aqueducts, and perhaps as many as three – these were mostly destroyed after earthquake in 1945, though a few arches of the bridges survive near the city walls. The aqueduct’s source was likely at the headwaters of the Sombas Çayi near Bekircepinari and Alapinar, though according to Hild and Restle the line is only traceable so far as Hacilar. Water was conducted through pipes before approaching the city on a massive bridge. G. Bell (1906) made the first study of the aqueduct, along with three churches around town. While Davis Asiatic Turkey noted 32 arches, in 1950 M. Gough recorded only 21 arches from the bridge of the aqueduct, and since then most of these have also been destroyed. Piers (3x3m set 6m apart) and arches are built of large squared blocks. An inscription from the period of Domitian records the circumstances of the bridge’s original construction, though whether it was financed by the city or the emperor is debated. The terminus of the aqueduct may have been a bath, and/or a temple for Domitian ‘Dionysos Kallikarpos’ erected simultaneously, dedicated in 92-93 CE. It is not clear if the water channel itself (width 0.49m, in brick) is from the first or second phase of its use. The channel is heavily sintered. About 550m north of the city wall, this aqueduct changes course and construction-technique, to resemble more-so the second aqueduct – spoliated cornices are incorporated into this section. The second aqueduct, which dates from the Byzantine period according to Gough and Verzone, should be connected to a spring near Hamamköy, where at one time water mills were found. A single pier remains on a base 3.1 x 2.63m, standing to around 3.1m tall with inter-pier distance of around 3m, and small squared

1149 TIB 5.1.176-7 and RRH I.229 #859.
1150 IK 56.1, 30 #21; compare with Domitian’s temple at Ephesos.
1151 TIB Neue Forschungen 129.
stones set between three courses of bricks, which compares well to building techniques used at the so-called Felskirche church in Anazarbos that can be dated by an inscription to 516. It has been suggested that this aqueduct was constructed, therefore, before the earthquake known to have affected Cilicia in 517 CE. Construction of the Byzantine aqueduct might also be connected with a renewal of the city walls in the sixth century, by a clarissimus praeses, Flavius Claudianus.

**CILICIA, ANEMURION**

The cape of Anemurion is one of the closest points between Cilicia and Cyprus; after early explorations by Beaufort, the city remains an enigmatic and evocative site even after survey by Rosenbaum and excavation James Russell in the 1970s and 1980s. A monograph was never published, but relatively detailed reports appeared regularly in the Turk Arkeoloji Dergisi (TAD) between 1970-1986, with briefer but still helpful summaries also published in *Anatolian Studies*. Anemurion became the most important port in the region, taking over from Nagidos, as late as the 1st century BCE. Anemurion apparently suffered grievously in the 260 CE Sassanid raids that terrorized the Cilician coast. During the period of the Isaurian rebellions (which ended 408 CE, cf. Zosimus 5.25), in 382 CE we have notice of a Legio or vexillatio I Armeniaca present in the city, under the command of a Comes Matronianus. Matronianus gave instructions in verse to build new circuit walls: the sea-walls at south and land-walls at north probably belong to this period. After the Diocletianic provincial reorganization, Anemurion belonged to Province Isauria, Metropolis Seleukeia. The first known bishop here, Iakobos, is listed at Chalcedon in 451; subsequent council attendees are known at least until Trullo in 692, when a bishop and priest/presbyter are noted. Many buildings in the city were apparently abandoned c. 660. Bishops from Anemurium continued to be included on conciliar lists into the 12th century. The site was re-occupied especially by the Armenians after the 12th century, from which period dates the bulk of its fortifications at west of the Roman/Late Antique city.

We offer notes on just a couple of the structures insofar as they relate to the water management of the city, and its gradual industrialization during Late Antiquity.

Two aqueducts supplied the city: the upper aqueduct II 2 W, runs north-south

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1153 *TIB Neue Forschungen* 129.
1154 *IK* 56.1, 32 #22-24.
1155 Beaufort 1817, 195-201.
1156 Rosenbaum et alii 1967.
1157 Alföldi-Rosenbaum and C. P. Jones 1972, dated to 382 CE by the appearance of a similarly-named individual in *CTh* 9.35.7
1158 *TIB* 5.188.
along the slope and supplied the citadel with water – this line may have been reconstructed by the Armenians after their reoccupation of the site in the 12th century. The lower aqueduct II 4 W runs parallel to the upper aqueduct, through the necropolis and the area south of the walls. Where the lower aqueduct intersected with the city walls, it fed into a masonry-built, barrel-vaulted, above-ground cistern just south of the wall, which was lined with thick pink mortar.\textsuperscript{1159} The lower aqueduct carried on through the city, with a diversion into the sizeable five-celled barrel-vaulted and masonry-built cistern that supplied the ruined bath building II 7 A (fourth century?), from which it is separated by a narrow paved lane.\textsuperscript{1160}

The Exedra II 12 E is a large apsed structure to the west of the Large Baths III 2 B. Though Exedra II 12 E was originally thought to be a fountain, the structure acquired this function only in its second life. Originally, the Exedra was the eastmost apsed tribunal at the end of an imperial civil basilica, comparing specifically with Xanthos or Termessos, by which comparison it might be dated to the early third century. Like the Large Baths III 2 B, the basilica was apparently never completed. Some time in Late Antiquity, the bath’s supply line was fitted with a secondary branch that fed into the central niche of the Exedra – Russell notes explicitly that this was not an originally planned feature of other structure.

The Large Baths III 2 B is an imposing Severan complex, whose palestra was later converted to industrial use after the fourth century, with oven and hearths installations at northeast, as well as lamp moulds that would indicate pottery production.\textsuperscript{1161}

Bathing did not end at Anemurion with the conversion of the Large Baths to industrial and domestic occupation – it merely changed forms and locations. Just as encroachment in the Large Baths picked up in the early fifth century, the Small Baths were built just east of the original imperial bath complex. a mosaic pavement inscription is fragmentary but indicates a patron with the rank of strategos. The Small Baths were themselves converted to industrial use – again pottery production – around the turn of the seventh century, before their eventual abandonment c. 660 as indicated by coins. Russell connects this transformation of the complex with the dereliction of the aqueduct, possibly due to earthquake around 580 CE.\textsuperscript{1162} The date of this conversion appears to parallel the domestic encroachment subjected on the Seaside Church.

At the Necropolis Church, inscribed mosaic panels set in the pavement recorded the donations of eleven individuals to the church: the only donation that was specified was the grant of a water supply, probably the well in the north rooms of

\textsuperscript{1159} Rosenbaum et alii 1967, 1.
\textsuperscript{1160} Ibid., 4-9.
\textsuperscript{1161} Williams 1975, 1977, and 1989.
\textsuperscript{1162} Russell 1987, 21-2
the church annex.\textsuperscript{1163}

**CILICIA, BAHÇEDERESI KÖY**
Rural/village context, adjacent to system supplying H. Thekla aqueduct. 3km southwest of Seleukeia/Silifke. The TIB editors note a small settlement without clear date, with limestone building elements, cisterns, and foundations.\textsuperscript{1164} Evidence for a connection to the aqueduct is unproven by excavation, but the community here was nevertheless well positioned topographically to benefit from a diversion from the adjacent aqueduct system for purposes of irrigation or consumption.

**CILICIA, BIRENE / ÇAKILLIKOYAK TEPE**
Rural/village, near spring source for the Lamos aqueduct line that supplied Akkale, Elaiussa Sebaste, and Korykos, and which was restored in the later fifth century CE by Illus, Zeno’s competitor (see Akkale, above). The TIB editors describe Birene as a small ancient settlement with numerous cisterns, no clear sign of churches, and a small kale, as well as 17\textsuperscript{th}/18\textsuperscript{th} century türbes.\textsuperscript{1165} In nearby Viranköy/Örenköy was the source and an inscription for the Olba aqueduct, which was repaired in the later sixth century (Appendix E.95).

**CILICIA, DIOCAESAREA / UZUNCABURÇ**
The Hellenistic city of Diocaesarea was at the head of a vast temple estate focused on the cult of Zeus, whose temple (later converted into a church) stands today in the town of Uzuncaburç, surrounded by rich and undulating, terraced farmland. The city was supplied by a Roman aqueduct, which fed into a nymphaeum by the temple.

The aqueduct carries water over 36 km distance from a source north of Sariyaydin (where the Susama and Aksifar rivers join) to Uzuncaburç, with three channels of three types: rock-cut galleries, rock-cut or mortared wall open-air channels, and underground tunnels. 1.5m high, 1.0m wide with inspection holes every 50-60m.\textsuperscript{1166} Probably dated second century CE, the aqueduct had its terminus at a tank feeding into a columnar-façade fountain/nymphaeum on the colonnaded street in Olba.\textsuperscript{1167} Note that the Hellenistic constructions (tower and temple of Zeus) are not associated with any water features, and so the aqueduct is unlikely to be originally Hellenistic. Also, the church installed in the Temple of Zeus had a baptistery in its northeast corner chapel, though this was outfitted with neither intake nor out-flow pipes.\textsuperscript{1168}

\textsuperscript{1163} Russell 1989, 1632.
\textsuperscript{1164} TIB 5.1.206.
\textsuperscript{1165} TIB 5.216 and AST 6 (1988): 396.
\textsuperscript{1166} Özbay 1998
\textsuperscript{1167} Richard 2012, 280
\textsuperscript{1168} For the fountain in town and the temple-church’s baptistery, see AA 2005.1: 117-165, with an illustration of the baptistery at fig. 58.
CILICIA, DOMÜZTEPE
Domüztepe is the site of a Late Antique villa rustica, which was supplied (either for domestic use or irrigation) by an aqueduct. Domüztepe is located on the east bank of the Pyramos/Ceyhan over Karatepe, 22km southeast of Kadirli, situated on a conical hill above the Ceyhan Lake with a settlement whose late Hittite roots extended into the Hellenistic-Roman period. It was excavated in the 1980s in preparation for construction of the Aslantaş dam. 1km east of Domüztepe proper are the foundations of a villa rustica with over 20 rooms covering 4000m², with a ceramic sequence that stretches from the 1st cent BCE/1st CE to the 7th century CE, though Carter’s more recent excavations have suggested that the complex continued to be inhabited in some fashion, with modifications, until the 11th century. Bossert’s excavations here in the 1940s identified a Roman conduit of ceramic pipes that came from Pinarözü, 2km east of Çerçioglu, where was also found an early Byzantine basilica (26x15m) with animal mosaics and an inscription.

CILICIA, ELAIUSSA SEBASTE
Elaiussa Sebaste is a Hellenistic-Roman city that was served as a sacred temple precinct for the city of Korykos, which was elevated to the status of metropolis of Cilicia in the second century. The city was sacked in 260 by Shapur I, and taken by the Isaurians in 479. Bishops for the city are noted only in councils of the fifth century. The intake for the Elaiussa Sebaste - Korykos aqueduct line was located on the Lamos river by Bent, near “a large house or fortress.” This building was later visited by Heberdey and Wilhelm, who clarified that it was built of hewn stone and had carved crosses above its doors. They interpreted this building as a monastery, though the crosses on its doors cannot by themselves guarantee any more than a Late Antique date. The aqueduct then turned towards the area of Elaiussa Sebaste before progressing to Korykos (cf below). During Late Antiquity, several changes may be identified along the length of the system, as it progressed towards its ultimate terminus, the immense Late Antique reservoir built outside of the walls of the nearby city of Corycus. Equini-Schneider identifies three phases for its use: construction between the late first or early second centuries for baths and domestic use, repairs in the later fifth century as indicated by the Illos inscription (see infra Appendix E.84-5), and protracted repairs in the sixth century, including the pylon aqueduct bridge (built of spolia) that runs south of the theater, and which connected to a large above-

1169 TIB 5.242
1172 Bossert 1950, 70.
1173 TIB 5.1.400-1
1174 Bent 1891, 206.
1175 Heberdey and Wilhelm 1896, 47.
1176 TIB Neue Forschungen, 123.
The most interesting component of the water system in Elaiussa is undoubtedly its giant cistern (22 x 13.5 x 12m), called Merdivenlikuyu: it is cut from the rock of the hill next to the theater, composed of three aisles divided by rows of five heavy pilasters, topped with pseudo-capitals. Equini Schneider suggests that the cistern was fed by rainwater, but given its epic proportions and immediate proximity to the aqueduct, this must be doubted even though an intake has not been located. The incorporation of spolia into its walls and piers suggests a Late Antique date. Additional cisterns were built into the blocked up scaena of the theater, as indicated by coins and ceramics in the first half of the fifth century, probably fed by a lead pipe in the southeast corner rather than collected rainwater. The so-called Harbor Baths on the island were reused for industry after the first half of the fourth century. The church near the theater, built over the city’s agora, incorporated older Roman fountains whose supply may have been reused for the baptistery.

**CILICIA, EPIPHANEA**

Epiphaneia is a Hellenistic-Roman-Early Islamic city in a poor state of preservation. A late Roman or Early Islamic city wall surrounds colonnaded streets and theater on the side of the acropolis, where may also be found a large three apsed basilica (36x24) with imperial-period temple spolia. An aqueduct carried water from the east-south-east into the city, from the direction of Erzin and tributary springs known at nearby Ilica: the aqueduct appears to lead to the theater and acropolis hill. The long aqueduct bridge is built of neatly squared basalt masonry on cement cores, with dimensional stone in the piers that resembles work from Anazarbos, and would suggest a Roman rather than Hellenistic date for the system.

**CILICIA, HACILAR**

Hacilar is near the probable source of the Anazarbos aqueduct, the latter city lying just 4km southeast of Hacilar – mosaics were reported here (at Karahoroz) that may be associated with either a domus or a Late Antique church.

**CILICIA, IOTAPE**

An aqueduct supplied the Hellenistic/Roman port city of Iotape: it is probably associated with the baths here. The city was mapped by Rosenbaum’s survey in

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1177 Equini-Schneider 1999, 83-4 for the aqueduct and 91-2 for the cistern.
1178 Ibid., 84-90 for Merdivenlikuyu.
1179 Ibid., 89.
1180 Idem.
1181 Ibid., 210.
1182 Equini-Schneider 2003, 258-9 and 311.
1183 For the fountains and baptistery, see Equini Schneider 2010, 297-9.
1184 See TIB 5.1.249-251 and TIB Neue Forschungen 127-8.
1185 TIB 5.1.265 and AST 10 (1992): 177.
the 1960s.\textsuperscript{1186} In the city core is an Early Byzantine church (10x8m), a second with frescoes dated by donor inscription (George Stratelates) to the twelfth century.\textsuperscript{1187} The aqueduct enters the city from east through the necropolis, where it supplies two small round cisterns (75cm and 160cm diameter) built next to a small building (Rosenbaum’s N II 22), then continues southwest (13W) into the city before turning north to cross over a small wadi to join with another line coming from the N. At the south end of the aqueducts are remains of a 5.5x4m cistern which was the aqueduct’s terminus. The aqueduct, now disturbed by modern road construction, must also have crossed further east and south to supply the baths in the city (5B), immediately south of which was built a small one aisled church (#7), and building #6 which has pipes protruding from its vaults into spaces belows. In the northeast corner of the bath building (#5B) is a 5.5x3.0x4.0m cistern, without a preserved intake, though another channel connects this structure to another cistern at the W. Drainage in the city was accomplished by means of a wadi that was vaulted over as a street, with the sewer running in the wadi below, into the sea. Dating remains here is problematic because of the similarity of building materials and techniques, used across different periods.

**CILICIA, KASTABALA/HIERAPOLIS**

On West side of the Amanos in the floor of the valley of Kazmaca, in Mahalle Nergizlik (Keris, Kertepe) leading from southeast to northwest are four aqueduct bridges near the anc. Pyramos / mod. Ceyhan river, with stone water pipes. The aqueduct crossed from the northwest through the city walls, just south of the acropolis, following the spur of the mountain up to a deep cut, through which it approached a temple (probably belonging to the goddess Cybele, whose cult was so important to Hierapolis Castabala).\textsuperscript{1188} The city’s aqueduct is also likely associated with a large arched reservoir, on the west side of the colonnaded street, in addition to an intra muros imperial-style bath complex set just east of the theater, and another smaller 3\textsuperscript{rd}-4\textsuperscript{th} century bath (brick construction and basalt vaulting) located rather closer to the aqueduct at the northwest.\textsuperscript{1189} The aqueduct’s source is in Müştek / near Amuda, some 6 kilometers to the west, where strands of two parallel pipes were found.

**CILICIA, KAYACI**

Kayaca is the source for the Elaiussa Sebaste and Korykos aqueducts, on the left bank of the Lamas river. The TIB editors observed scattered remains of settlements here, including the remains of a mill of unknown date.\textsuperscript{1190}

\begin{itemize}
\item \textsuperscript{1186} Rosenbaum et alii 1967, 91-2; see also Paribeni and Romanelli 1914, 174-83.
\item \textsuperscript{1187} TIB 5.1.275-6.
\item \textsuperscript{1188} Dupont-Sommer and Robert 1964, 47f and 94f.
\item \textsuperscript{1189} Verzone 1957; see the plan in Bent 1890, 231-5; ANMED 4 (2006): 119 and ANMED 5 (2007): 130.
\item \textsuperscript{1190} TIB 4.123 and TIB 5.1.296.
\end{itemize}
CILICIA, KORASION
Korasion was supplied by an aqueduct probably in association with a bath, as well as industrial activities. Korasion is located on the east side of the Kalykadnos river delta 4 miles west of Korykos; it was not a polis, and is known primarily from a mass of Late Antique funerary inscriptions, and in texts only from the apocryphal Acts of Barnabas (2nd cent. CE) as a stop-over point on the route to Cyprus. Today called Susanoğlu, remains here were sparse when the author visited in November 2012, though Langlois noted street porticoes and seventeen arches in an arcade for an aqueduct here, in addition to several churches. A bath at the northeast side of town was probably associated with the aqueduct; early Byzantine three-aisled churches were noted by the TIB editors on the other, west side of town. The harbor was likely dense with commercial activity, as attested by occupational funerary inscriptions from the cemetery, for a shoemaker, barber, jeweler, and gem inscribr, seller of warm drinks and soups, baker, reeder, olive seller, and inn keepers. The city was ‘refounded’ during the reign of Valentinian between 367 and 375 CE by a λαμπρότατος ἄρχων τῆς Ἰσαύρεν ἐπαρχίας, which may have coincided with repairs to the city walls and aqueduct; but little is known of this system. Because Korasion was not a polis, it never had a bishop and is not found in the Notitia or conciliar lists.

CILICIA, KOROPISSOS / DAĞ PAZARI
Koropissos was a fortified town with city status after the reign of Septimius Severus, with a bishop known in the conciliar lists after the fifth century. The aqueduct is poorly known, but it entered the city on its southeast side, after crossing a small river bed by a bridge built of neatly quadrangular ashlar blocks that probably date its construction to the first century (compare, for instance, with Xanthos and Pataara). Near the point of the aqueduct’s entrance into the city was a large vaulted cistern of unknown date, though perhaps Late Antique or early Byzantine (non vidi in 2014), in addition to a three aisled column basilica with court behind the apse, narthex, and a large baptistery at its north, all dated after 395-408 as per coins of Arcadius found under the narthex’s opus sectile paving. Two other churches are known on site, with mosaic dedications from the fifth and sixth centuries.

CILICIA, KORYKOS
Korykos was a Roman fortified town, which shared an aqueduct with Elaiussa Sebaste, which is associated with baths and a massive extra muros reservoir (2100m² x >3m height = 6300m³), that is today used as a soccer pitch. This reservoir was the terminus of the Elaiussa aqueduct, after the former’s

1191 MAMA III.102-117; Paribeni and Romanelli 1914, 100.
1192 Langlois 1861, 195.
1193 TIB 5.1.311-312.
1194 TIB 5.1.313-4.
1195 Hill 1979 and Forsyth 1957, 233-236.
construction during Late Antiquity (fifth century?). The extra-muros Late Antique churches, studied by Hill,\textsuperscript{1196} were outfitted with vaulted cisterns,\textsuperscript{1197} but at elevations too high to permit their supply by the aqueduct introduced from Elaiussa. Rather, these were supplied by rainwater collected from the rooftops of the church: there are fragments of lead pipe embedded in the east end of the south wall of the Tomb Church (H) at Korykos, which presumably led water into the cistern under the apse.\textsuperscript{1198} Another well head at this church was located in the atrium of the Tomb Church, just outside the narthex;\textsuperscript{1199} with a third cistern located on the south side of the church, in which Guyer found fragments of a trefoil or quatrefoil marble piscina that may have been a baptismal font.\textsuperscript{1200}

A late fifth or early sixth century inscription provides for the management of the city not through the agency of a defensor (ἔκδικος) and curator (ἔφορος) but by the bishop and prominent men (κτήτορες καὶ οἰκήτορες) of the city.\textsuperscript{1201}

**CILICIA, MAMURIYE KALESI**

Mamuriye Kalesi is a fortified site, 10km northeast of Anemurion. The earliest remains on the site are antique spolia in the foundations of the walls; these probably indicate an earlier phase to remains that are otherwise 13\textsuperscript{th}/14\textsuperscript{th} century, including a short aqueduct led over a bridge into the outer kale.\textsuperscript{1202} Whether or not the medieval aqueduct is built atop an earlier Roman or Late Antique predecessor is unknown.

**CILICIA, MOPSUSTIA / MISIS**

Urban aqueduct associated with bath and brick-vaulted reservoir. Mopsuesta’s 40 ha intra-muros area, and the construction of its wall, compare with Anazarbos or Tarsos, suggesting an imperial Roman date of construction before early Islamic period improvements. The most visible remains of Mopsuesta’s aqueduct, noted by the TIB editors on multiple visits before 1989, were unfortunately destroyed by highway construction associated with nearby Incirlik airforce base in the 1990s, before they were properly studied.\textsuperscript{1203} This was the story reported by local informants over tea in Nov 2012. A more thorough survey of the area for less-visible remains would likely be profitable (see the recent preliminary surveys around Adana, including Misis\textsuperscript{1204}. A very large (13.2m in height), brick-built and vaulted reservoir was discovered by Bossert on a hüyük overlooking the town, which today is most unfortunately inside a military

\textsuperscript{1196} Hill 1996, 116-143.  
\textsuperscript{1197} MAMA 2, 109 and 136-7, figs. 108 and 141-2.  
\textsuperscript{1198} Hill 1996, 14.  
\textsuperscript{1199} Hill 1996, 132.  
\textsuperscript{1200} MAMA 2.145, fig. 157.  
\textsuperscript{1201} MAMA 3.197.  
\textsuperscript{1202} TIB 5.1.338-9.  
\textsuperscript{1203} See briefly TIB 2.127.  
installation. Bossert dated the reservoir to the early Islamic period, though the TIB editors had doubts, and suggested a Roman or Byzantine date. We would reject the hypothesis of a Roman date, because brick-vaulted reservoirs are not known in Cilicia from this period. It compares better with Seleukeia/Meryemlik, where bricks were also used extensively in cistern construction; probably better is an early Byzantine or early Islamic date. Bossert also discovered the remains of a Late Roman bath complex, recently destroyed according to local informants in 2012. A number of churches with mosaics and a sumptuously decorated Late Roman villa are also known from Mopsuestia; the latter is presently a museum. The city, as al-Massisa in Arabic, continued to have importance well beyond the eighth and into the tenth centuries, due to its position on the left bank of the Pyramos river. The city lay on a contested border for centuries, occasionally reclaimed by the Byzantines as kastron Mamista in the ninth and tenth centuries or later. New archaeological work here began in 2014 that remains unpublished.

**CILICIA, OLBA (MOD. URA)**

Olba was an originally Hellenistic settlement at the head of a Hellenistic-Roman temple-state. An aqueduct with underground rock-carved channels, mortared open-air channels, rock-cut channels with mortared covering (specus), and an expansive bridge has all been dated to the period of Septimius Severus, associated with one Herakleides, on the basis of an inscription. An intake some ten kilometers distant was located on the Lamos river near the ancient settlement at Birene / mod. Çakillikoyak Tepe, which was walled with a gate and had numerous houses and cisterns without conspicuous churches. Portions of this channel from, headed towards Ura/Olba, are still in use by farmers for irrigation. Where the aqueduct descended towards Doğu Tepesi was a rock-cut terminus tank closed with a sarcophagus lid surrounded by blocks of spolia, which directed water to the acropolis and toward work areas at the southwest. According to Erten, “it is possible to follow at places the connection of the outlet with other rock-cut canals leading to the work-areas.” This arrangement is highly suggestive of a Late Antique or later Byzantine configuration, with the stereotypical reuse of a sarcophagus as dividiculum (compare for instance Jarash). Olba was noted as a bishopric in the conciliar lists between 381 and 692.

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1205 Bossert 1957-8, 188
1206 TIB 5.1.356
1207 TIB 5.1.351-359 for the history and sources
1208 Bent-Hicks 1891 no. 71 = Heberdey – Wilhelm, Reisen 90f. Nr. 169
1209 TIB 5.216
1210 AST 6 (1988), 396
1211 Erten 2008.
CILICIA, POMPEIOPolis

Two aqueducts entered the harbor\(^{1212}\) city of Pompeiopolis (35ha) from the north: their maintenance should be connected to a rare group of inscribed lead pipes, for one bishop Theodoros, probably of the fifth century.\(^{1213}\) At the very least the bishops were claiming, in a conservative manner redolent of Frontinus’s Rome, a share of the main public supply\(^{1214}\). Inscriptions attest to the restoration of the city walls in the later fifth and sixth centuries, perhaps after an earthquake.\(^{1215}\) Tremaux’s plan shows a Roman bath and possibly a church in the south part of the city, no longer visible, near the harbor – these were likely recipients of water from the city’s aqueduct.\(^{1216}\) A colonnaded street is today visible near the port;\(^{1217}\) the TIB editors note that the uneven heights and irregular fluting probably indicate re-erection in the Byzantine period, at which time the columns were connected with arches not imposts – one was in situ as late as 1985, though only clearance and a predictably uniform anastylosis were visible in November 2012.

*CILICIA, TARSUS

Tarsus was the riperine capital of Cilicia I since the province was divided c. 400 CE (Cilicia II’s capital was at Anazarbos, see above). The city sat on the west bank of the Berdan Çayı / Cydnus river, on the Çukurova delta plain below the Taurus range.\(^{1218}\) Alluvium from the river has added continuously to extend the coastline further out into the sea from the city since antiquity, though modern dams have slowed the present rate of accumulation.\(^{1219}\)

The city is widely recorded in secular sources from antiquity into the medieval period,\(^{1220}\) though its monuments and water distribution are poorly known. A Late Roman bridge crosses the river in town, which was diverted sometime in Late Antiquity to the east, at which time Byzantine and then early Islamic remains encroached upon the bridge’s surface and stone vaults, including the mosque called Makam Camii. Sixth-century dedications to a church are known from the epigraphy of Tarsus.\(^{1221}\) Notable here also, in the holdings of the local Tarsus Müzesi, are a group of lead pipes found in excavations at nearby Soli-Pompeiopolis in 1971, which mention a bishop in relation to the water supply of a public building, possibly a church or episcopal palace, dated to the fifth or sixth

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\(^{1212}\) Boyce 1958.

\(^{1213}\) SEG 28.1288 = † Επὶ Θεοδώρου ἁγιωτάτου ἰνδ(ικτιῶνος) δ´ † d. pr.

\(^{1214}\) See Bruun 1991 a.o. for fistulae, see also Dagron and Feissel 1987, nrs. 25

\(^{1215}\) Dagron and Feissel 1987, nr. 24 for two inscriptions referring to repair of the city walls

\(^{1216}\) With references TIB 5.1.381-2.

\(^{1217}\) Peschlow-Bindokat 1975.

\(^{1218}\) TIB 5.1.428-439 s.v. Tarsos.

\(^{1219}\) Sixth century floods mentioned by Procopius probably caused the bed of the river to change, via a canal dug north of the city, to a more ancient riverbed to the E. On these changes and the geomorphology of coastal development around Tarsus see Öner / Hocaoglu / Uncu 2005, 69-82.

\(^{1220}\) Besides the TIB entry, note also Bosworth 1992 on the city’s late Roman history.

\(^{1221}\) Dagron and Feissel 1987, 78-9 #34-35.
centuries. Glass kilns were installed in a Roman/Late Antique bath at Tarsus near the Makam Camii, subsequently in use for industrial purposes between the ninth – sixteenth or seventeenth century. No churches, aside from the Church of St Paul (built 1862 over earlier remains, with a miraculous well in its courtyard) are preserved in the city.

CILICIA, TITIUPOLIS / MOD. KALINÖREN

Never excavated, Titiupolis was a small but wealthy coastal settlement 8km north of Anemur. Titiupolis was a city of the Isaurian Decapolis that gained a bishop suffragan to Seleukeia after 451, though it was subject in absentia to Cple after Seleukeia was lost in the seventh century. Water needs were met by a spring found within a kilometer to the northeast, that emerged from a hilly area that remains green even in summer. An early imperial spring house built of limestone here was probably connected by pipes to the imperial-type and Roman bath building of opus caementicium and bricks nearby, alongside which later grew up a large early Byzantine basilica with galleries.

CILICIA, VIRANKÖY

Viranköy/Örenköy was the find-spot for the 6th century inscription related to the Olba aqueduct line, recording its construction by the bishop Kosmas, and dedicated to Justin II and Sophia. Keil and Wilhelm described this inscription as immediately above the aqueduct channel itself, though Erten found it in the northeast corner of the acropolis at Viranköy. Within 1.5km of the aqueduct’s source, Erten also located the remains of four Early Byzantine structures – including two church complexes and two other structures identified as monasteries, though it is unclear why they could not also be domus. Two of these structures were within 300m of the aqueduct – including one of the ostensible monasteries and a church – and might well have been served by the aqueduct, either for consumption or irrigation/industry, as can be observed further down the line at the aqueduct’s terminus in Olba itself.

CILICIA, ZENONOPOLIS

Known only from an important inscription that records the construction of an aqueduct, which supplied a fountain in the forecourt of the saint Socrates’ sanctuary. Socrates was one of two martyrs, either from Perge (d. 220) or Tiberiopolis (near mod. Dogrugöz, Konya prov., d. 361), about whom little is known outside the martyrologies recording their feast days. See Appendix E.87 for this inscription.

1222 Ibid., 63 #25 = SEG 28.1288.
1223 Adıbelli 2013 with photos and references to earlier reports from the bath excavations.
1224 TIB 5.1.247-8.
1225 MAMA III, 157f and RE 6A/2 (1937), 1553f.
1226 MAMA III, 93.
1227 Erten 2009.
1228 SEG 44.1222.
CRETE, GORTYNA
The water system at Gortyna, well documented by Di Vita, was maintained well into the seventh century, when an elaborate system of small fountains was built across the city. On the acropolis, a basilica replaced a pagan sanctuary with a bothros, a hole or pit into which libations were poured as offerings. The one aisled basilica (25 x 10m), with a semicircular apse and narthex, enclosed the bothros at its center. According to excavators it was reused as a baptistery.

CYPRUS, AMATHONTE
Amathonte was the site of a sanctuary dedicated to Aphrodite, with early remains not previous to the 8th century BCE, and an uncertain architectural disposition prior to the Hellenistic period, at which time it was monumentalized. The site was restored in the Roman period (with the addition of a bath complex), and destroyed in earthquake during the fourth century, after which time it was dismantled. Building components were adopted for the construction of a basilica at the southeast, in addition to a large residence at the north, with a paved court between. Along the length of the walls of this ‘residence’ was a cut and cover channel with terra cotta pipes fed through settling basins before being distributed into multiple cisterns. A defensive tower was built on the paved court after the destruction of some of the other buildings, sometime in the mid-seventh century, as dated by glass, lamps, and pottery. The early Christian complex presumably benefited from the repair of a Roman water system here after the earthquake, with the aqueduct feeding into the temple’s (repaired) baths. The aqueduct is otherwise known from a number of stamped pipes (dating to the reign of Trajan and Hadrian).

CYPRUS, KARPASIA / AYIOS PHILON
In the Karpas promontory of northeast Cyprus, Karpasia was a bishopric after the fourth century. The site includes an extensive church complex, with a Middle Byzantine cross in square church set on the remains of an early fifth century basilica, at whose southeast corner was a large cistern and phiale whose supply is unstudied.

CYPRUS, KITION
Nicolaou reviews the evidence of excavations and travelers for the water system of Kition, though he acknowledges the difficulty of his project owing to the haphazard discovery of relevant bits of infrastructure at Kition. A passage in the Acts of Barnabas (5th century, referring to the life of Barnabas during his travels with Paul c. 50 CE) reads that “no one received us in the city but we stopped at the city-gate near the aqueduct and refreshed ourselves before

\[1229\] Di Vita 2007
\[1230\] Rizza and Scrinari 1968, 68-81 and Pallas 1977, 251
\[1232\] Nicolaou 1976
moving on.” One traveler, Hamilton Lang mapped the area, and noted the remains of an aqueduct with carrying water from the Stravrovouni hills. Besides a gymnasium (mentioned by Reinach, with an aqueduct supply), the harbor, and other places of consumption inside Kition, Ohnefalsch-Richter noted the presence of pipes and other hydraulic structures on the acropolis revealed at the time it was dismantled. The acropolis was the site of at least two Archaic-Roman era temples, for Herakles-Melkart and Aphrodite-Astarte. In addition to cisterns and wells, the remains of numerous pipes on the acropolis may indicate that the aqueduct was able to deliver water there under pressure via inverted siphon or at height via a bridge. Ceramic finds associated with clay pipes throughout the city were often Hellenistic, in addition to later Roman sherds, suggestive of a relatively early (read: pre-Roman) date for this system.

Cyprus, Kourion
Late Roman Kourion was excavated by the British Museum between 1893 and 1899, then by UPenn from 1934-1949, and most recently by the Antiquities Department of Cyprus. The city had no spring on the main bluff, and no traces of wells have been found – Hellenistic cisterns for rainwater were mostly infilled after the construction of the city’s two gravity aqueducts before the second century, and which were maintained until the very late seventh century.

Chief among the remains at Kourion are the basilica, set on the west side of the city’s agora, which also had a bath at its north and shops on its remaining east and south sides. The area was industrialized during Late Antiquity. Excavation of the church revealed a late third/early fourth secular basilica, which was rebuilt from the foundations after a fourth century earthquake for the use of an episcopal complex. To the episcopal complex were later added a larger precinct, grouped around an atria-courtyard with a phiale/fountain, changes which also coincided with modifications to the church’s water provision arrangements (late fifth – late sixth century). A baptistery complex at the west

Cited from ibid 143.
Ibid. 144 and Hamilton Lang 1878, frontispiece map
Ohnefalsch-Richter 1880, 62
Christou 1983 for ‘squatter occupation,’ which nevertheless continued to benefit from the city’s well maintained water system, now at the service of the church and industry.
Megaw 2007, 345-350 for the earlier remains.
Megaw 2007, 119-156 for the west end and phiale, including (126) the installation of a second or alternative supply line from a higher tank in the sixth century.
See Megaw 2007, 27-8 for a new tank in the North Alley that supplied water to the font by pipe; its predecessor was not connected via conduit, and it seems that water was instead carried by hand to the font. The older tank was filled with fifth and sixth century sherds. The new tank contained folles of Heraclius and Constans II, suggesting later seventh century use of the installation. Note ibid., 41-45 for water conduits in the south aisle that predated the construction of the church, but remained in use until the later seventh century.
took its supply from an external pipe-feed. After another earthquake before 685, the complex was cleared and quarried for spolia for use in the successor cathedral built nearby in Episkopi, a phase lasting into the eighth century.

In the agora, while some Hellenistic cisterns and reservoirs (one nearly 2800m³) were abandoned around the time the aqueduct was introduced into the city (first century CE), another group of cisterns were built contemporary with the stoa (later second to third century CE), and remained in use until the end of the seventh century. The bath here, whose Late Antique history is little known, had been restored by an agoranamos in the later second century.

**Cyprus, Nea Paphos**

Reports from the 1960s mention a number of cisterns and wells but without real phasing or firm dates – many are apparently Hellenistic, with Roman abandonment. Paphos is dominated by the House of Theseus, a rectangular block enclosing an official residence, which is the largest of its type in Cyprus. The complex included baths at its southeast (rooms 50-67), reception areas at its south, a laundry and workshops at N. During Late Antiquity, many rooms became occupied not just by lime kilns, which assisted in the dismantling of the site, but also by ovens, bronze cauldrons, pithoi, and terra cotta pipes that indicate the continuation of water supplies here, after industrialization. On the north side, a series of rooms were equipped with basins, cisterns, and channels of water evacuation – Daszweski declined to speculate on their function, though they might best be compared with the workshops of fullers and tincturers or dyers, as for instance at Jarash in the early Byzantine phases of the macellum. At Paphos, this workshop’s water features were discovered to in fact be readaptations of Hellenistic basins, even though nearby Hellenistic wells were covered by the Late Roman constructions. The whole complex drained through pipes into a sewer running under the adjacent NS street that was maintained even after the palace’s obsolescence, as indicated by its recovering with building materials reused from the House of Theseus. Coins indicate a primarily fourth century use-life for the complex (Valentinian I to Honorius), with only “rare” Byzantine coins.

**Cyprus, Salamis / Constantia**

Salamis was a major port and Byzantine center on Cyprus. Early excavation of Salamis’s city – including the Zeus temple and agora neighborhood, the

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1241 Ibid., 107-118 for the baptistery at Kourion, which was heated with a praefurnium in its later phase.
1242 Ibid. 560-1 for evidence of the church’s latest phases, including a solidus of Constantine IV (668-73) found close to the floor of the cistern in the southern court.
1243 Christou 1983, 274
1244 Mitford 1971, 186-8 #100
1245 Daszweski 1984, 298.
1246 Ibid. 1984, 300-1.
1247 Ibid. 1984, 309.
loutron or massive pillared reservoir at the agora’s north end – were started by J. A. R. Munro and H. A. Tubbs in the late 1880s, and one season of work was published in *JHS 1891*. However none of their original notebooks or records were saved. Later publications of work in 1950s-1960s by Megaw appeared in *JHS* and the Archaeological Reports Supplementary Series, as well as the *Report of the Department of Antiquities of Cyprus (RDAC)*, and by the French in *BCH*. French work continued after transition to Turkish control, while British work at Salamis ceased. New publications were continued within the last 5 years, appearing in *BCH* and as part of the 15+ volume *Salamine* series, mostly concentrating on necropolis and epigraphy, as well as the Campanopetra church complex, and the ‘Huilerie’ LA domus-cum-industrial area.

A very large, 5 aisled reservoir with vaults supported by pillars was constructed near the agora’s north end, opposite the Zeus temple, after the earthquakes of the mid-4th century (in 332 and 342, and/or 363 CE). This structure was for a time thought to be a bath, until it was properly identified as an aqueduct-fed reservoir. The reservoir was supplied directly by the Kyrhea aqueduct, which has its first phase in the 1st century CE but was restored as late as the 7th (dated by inscription to 622-632 CE, with episcopal and imperial support, see below). The temple at the agora’s south was built in the second century BCE, probably over an Iron Age predecessor, with an imperial period remodeling attested by architectural sculpture and a number of dedications to Tiberius. Argoud and Callot argue that after the fourth century earthquakes, the reservoir was constructed and the north part of the agora was converted to a closed market. In addition, a monumental ramp leading up to the temple podium was entirely rebuilt with spolia, and the cella was converted to ecclesial use. Callot dates these changes to the later fifth or sixth century. The temple-church – on whose interior pavement was found a follis from the reign of Heraclius and his father – was excluded from the enceinte built around the reservoir and the church of St Epiphanios, traditionally around 630 but perhaps as late as the eighth century.

Karageorghis also indicates the presence of two large, vaulted reservoirs (22 x 4.4m and 7.5 x 4.8m) near the south wing of the gymnasium, not parallel but set at an oblique angle to the bath, which were built on layers of debris from the

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1249 For the Salamis aqueduct, see Baur 1989.
1250 Callot 1985b: 337
1251 Argoud 1980b, 330 and Argoud 1975
1252 Callot 1985b, 337
1253 Callot 1985b, 338
1254 Karageorghis 1967, 325 for the date of the city wall to the eighth century, by excavated ceramics.
1255 Karageorghis 1963, 54.
fourth century earthquakes.\textsuperscript{1256} Similar debris was found under the latrines along the north side of the Gymnasium.\textsuperscript{1257}

The city’s aqueduct carried water from Kyrhea to Salamis, over some 25 miles distance, notably with pointed arches stemming from a seventh century rebuilding, near the church of St Sergios and as the aqueduct approaches the city at the west. Eight separate inscriptions recorded segments of this work, completed by archbishop Ploutarchos (619/20 CE, 621, 624/5, and b/w 619-627); archbishop Arcadius (627-628), and emperor Heraclios (seven arches, ‘from the hippodrome’) (624/5 or 640/1).\textsuperscript{1258}

The three aisled Campanopetra basilica was built in the first half of the sixth century, with a large colonnaded atrium centered on a monopteros type fountain, encircled by ring of columns. It is unclear whether the phiale was newly built or preexisted the church complex, though its supply is secure, from a bronze pipe attachment, that came in from the street. By the north atrium is a small bath, and a cistern converted into a chapel, accessible from stairs at east. Auxiliary buildings to northeast, include a chapel to the north with a cistern 6.6m deep and 7m in diameter, which took in rainwater through a vertical downspout, which fed into a settling basin 1.1 x 0.45 x 0.5m. The cistern was embellished with opus sectile surrounds, and may have been enclosed by chancel plaques.\textsuperscript{1259} An inscribed section of a stone water pipe was also found near here.\textsuperscript{1260} The excavator indicates the presence of bread and meat ovens or food preparation areas set onto the original ground level of the south portico of the east court, between later walls that delimited rooms under the portico.\textsuperscript{1261} Four additional ovens were found in the west court (one 2m in diameter), with different relations to the original ground level; this suggests progressive encroachment of the space for food preparation, originally in phase with the primary use of the church, before the eventual invasion of lime kilns with the church’s demolition.\textsuperscript{1262} The Cistern-Chapel at the Campanopetra church contained eight inscriptions, some of which apparently refer to the primary use of the cistern as a receptacle for water, before its conversion, including “the lord of the abundant waters. Megas Epiphanios is our eparchos” (with dates of bishop Epiphanios 368-403) and “the voice of Elijah – so said the Lord, I purify these waters,” and two inscriptions quoting Psalm 29(28).3 “the voice of the Lord over the waters.”\textsuperscript{1263}

\begin{itemize}
\item \textsuperscript{1256} Karageorghis 1967, 355
\item \textsuperscript{1257} Karageorghis 1967, 354
\item \textsuperscript{1258} See Mitford1950, 118-125 for these inscriptions, and infra above Appendix E #103.
\item \textsuperscript{1259} Roux 1998, 149-150.
\item \textsuperscript{1260} Argoud 1980b, no. 292
\item \textsuperscript{1261} Argoud 1980, 333
\item \textsuperscript{1262} Argoud 1980
\item \textsuperscript{1263} Argoud 1980b, no. 238
\end{itemize}
**Cyprus, Town of Leontius in the Vita of Symeon the Fool**

Krueger argues that Leontius, the author of Symeon’s vita, set his tale in a fictional Syrian town that was a mere prop, while the urban portrait conveyed would have been familiar to fellow Cypriots in the 620s: “the town includes an agora with food stalls, a bath complex, a glass workshop, and a tavern, and it is peopled with rich and poor, with merchants, artisans, a sorceress, a schoolmaster, and with monks. The portrait in the text is one of economic well-being, not decline. … While there are references to earthquake and plague – natural realities of life in this era – there are no references to famine or economic collapse.”

**Dacia Mediterranea, Justiniana Prima**

Justiniana Prima was built by Justinian to ennoble the place of his birth. There is no evidence for occupation of the site before the sixth century (c. 530), and the site was abandoned c. 615 (by evidence of coins). The city is traditionally divided into three zones: the acropolis at the northwest corner, the upper city which includes the acropolis but extends another circuit of walls to the south, and the lower city. Iustiniana Prima was supplied by an aqueduct from nearby Petrova Gora at the southwest (20km); it entered into the city through a distribution apparatus and cistern installed in the south-westernmost tower of the upper city circuit walls. Water from the aqueducts supplied baths, as well as a large cistern in the lower city facing two churches, measuring 50x40m in surface area though it has not yet been excavated. The aqueduct was apparently unable to supply the acropolis, for reasons of inadequate elevation; a large piscina for rainwater collection was found there, however.

**Dacia Mediterranea, Tropaeum Traiani / Adamclisi**

A church with three aisles, narthex and atrium was built by reusing the walls of a large Roman cistern. The church was surrounded by burials dated to sixth century.

**Dacia Mediterranea, Salona / Solin**

Salona became metropolitan of province Dacia, after it was re-taken from the Ostrogoths by Justinian; it had bishops since at least the early fourth century. The city was inhabited until the 630s, when Slavic invasions forced its population to settle inside the walls of nearby Split.

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1264 Krueger 1995, 10
1265 Buildings 4.1.17-27
1266 Bavant 2007, 337.
1267 Ibid., 344.
1268 Idem.
1269 Ivanišević 2012.
1270 Duval and Popovic 1980, 571
1271 ODB 3.1832.
Salona was supplied with water by wells, at least one cistern that probably dates to the later fourth century (coins of Valentinian), and an aqueduct built by Augustus that was later extended to supply Split, by Diocletian. The aqueduct approaches the city’s northeast, which is poorly studied in comparison with the northwest quarter that was excavated by Gerber, Dyggve, and Eggers in the early 20th century; the aqueduct’s elevation allowed it to supply both the Urbs Nova and the lower Urbs Vetus, however. The aqueduct was repaired in the later nineteenth century, and still serves the modern city of Split.

The episcopal complex at Salona is quite striking, for our purposes, because the basilica geminae was implanted into an older (possibly domestic) bath complex at the end of the fourth century; its baptistery is one of the few examples in our sample of metropolitans that relied on an external piped supply to fill the piscina in successive phases. Its drain was also integrated into the city’s pre-existing drainage system. The city’s Large bath continued to function in Late Antiquity, immediately across the street to the east of the church, while the north baths were converted to use as a church.

*DACIA RIPENSI, RATIARA / ARCHAR*

Ratiaria, on the banks of the Danube in modern Bulgaria, was metropolitan capital of Dacia Ripensis after the Trajanic colony was elevated to the status of metropolis in 271. In the fourth century the city contained a mint and a fabrica; Ratiaria was sacked in 442 before restoration by Anastasius and Justinian, when its walls were repaired, according to the Buildings of Procopius (4.6.24-25). A second century Roman aqueduct supplied water to the city though its consumers in town – apart from a theater and a large house with private bath (the latter dating to the fourth century) – are little known. An episcopal complex has not been located here.

*DARDANIA, SCUPI / SKOJPJE*

An 386m long, 16.5m high arched aqueduct near the village of Vizbegovo carried water presumably from a spring at Lavovec into the city from the northeast, over 9km total distance. The bridge is Ottoman in date, though it may be connected to considerably older, Roman or Byzantine, buried specus channels. How water was distributed in the urban core – which included a theater and a late fifth century basilica – remains problematic after the total clearance excavations of the earlier twentieth century. A coin hoard TAQ 583/4 was also found here.

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1273 Gerber 1917, esp. 66-74 for the baptistery and its supply; 139-146 for the canalization system in the area; and 124 for the conversion of the north bath to use as a church.
1274 Evans 1883, 150 concluded that the aqueduct is Ottoman, with note of many Roman and Byzantine architectural fragments embedded in its ogival arches and cloisonnée brickwork, and slightly more recently Petrov 1962 [non vidi].
1275 Curta and Gandila 2011-2, here at 104.
*EPIRUS NOVUS, DYRRACHIUM / DÜRRES*

The coastal city of Dürres, metropolis of Epirus Novus, which benefited from wells tapping a high water table, was also provided with an external supply via aqueduct constructed by Hadrian and restored under Alexander Severus, as indicated by inscriptions and recent archaeological surveys in the chora. The aqueduct carried water from a diversion alongside the Ululeus / Erzen river, down a 6km-long canal, through a 2.7km long rock-cut tunnel, and into the city on an arched aqueduct bridge with 960 brick-faced, rubble-core piers. Cabanes notes restoration of this system in the fourth or fifth century also, though the potential integration of the repaired system with new church complexes is impossible to surmise from surviving evidence: Apart from a Late Antique chapel with hand-filled baptismal font constructed in the vomitoria of the amphitheater, the city’s churches and episcopal complex have not been located. An oval forum at Dyrrachium was built or restored in Late Antiquity – its basket capitals with drill-work acanthus leaves and integral volutes are characteristic of the later fifth century – a stepped construction at the center may have been a fountain, while a well was cut through the pavement immediately adjacent to it.

*EPIRUS VETUS, NICOPOLIS AD ISTRUM*

Nicopolis ad Istrum, had been sacked in the 450s and reoccupied with the status of metropolis of Epirus Vetus after the sixth century. The city performed its functions as an ecclesiastical and military center without the benefit of municipal buildings, or the restored functionality of any of the four aqueducts that had supplied Nicopolis in previous centuries.

*GALATIA, ANCYRA / ANKARA*

Ancyra was metropolis of province Galatia. Ancyra was equipped with an urban aqueduct carrying water 15km from springs at Elmadağ (attached to an inverted siphon capable of supplying the citadel), a qanat/drainage gallery sourced at Kayaş and Hanımpınar, and an imperial-style bath complex. The location of its episcopal complex is unknown.

Ancyra is built at the confluence of three rivers (Hatip Çayi from east, Çubuk Çayi from north and Ince Su from south) which drain snow and rain from the surrounding fingers of the Koroglu mountain range, and together form the

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1276 See *CIL* III.709 and *AE* 1984.811-813 for a series of stamped lead pipes of Antonine date; the survey was published by Miraj / Myrto 1982, 131-156.
1277 Cabanes 2008, 255.
1278 Bowes / Hoti 2003, 380-394 on the chapel at the amphitheater; note also A. Gutteridge *et alii* 2001 on the walls.
1279 Pers. observation.
1280 Poulter 1995, 6 and 45-6.
1281 *TIB* 4.126-130.
1282 See Akok 1968 for beautiful reconstructions and plans of the bath at Ancyra.
Ankara Çayı that runs thence to join the still greater Sangarios/Sakarya river. Significant spring resources can also be found in these mountains, most proximally at Elmadağ to the southeast. A double lake (Lake Emis and Mohan göl) is also located 16km southeast of the city; the *vita* of St. Theodotus of Ancyra tells us that one of these lakes was the site of a lavatio for statues of Athena and Artemis during the later third or fourth century. In the nineteenth century, wells and cisterns still dotted the town, before the Roman pressure-fed system from Elmadağ was rebuilt after 1890. The modern city of Ankara has since tapped other spring sources, at greater distances, that were never employed to supply the Roman city.

Ancyra became chief city of province Galatia under Augustus in 25 BCE, and from the time of the Flavians onwards it was an important staging ground for the movement of troops and materiel to the Euphrates frontier, and later pilgrims between Jerusalem and Constantinople. Texts provide evidence for frequent visits or long-term stays by emperors here beginning with Constantius II in 347 and 350 and Julian in 364. Ancyra Christianized early, but bishops appear only after 314 when the first synod of Ancyra was held here (repeated in 358 and 378). After Galatia was split in 396-399, Ancyra remained the metropolis and archbishopric of Galatia I. Ancyra was the setting of a revolt by Kommentiolos, brother of Phokas, in the winter of 611/612. Ankara was sacked in 622 by the Persians, again in 654 by Arab raiders led by Mu’awiyah, and in 838 by al-Mu’tasim. Ankara was humbled but not deserted, the city retreating within the double circuits of the fortified acropolis. Ankara retained its status to become military capital and residence of the komes of thema Opsikion in the seventh century, and thema Bukellarion in the eighth. An *apotheke* or warehouse for the collection of taxes in kind, was also located here.

There were at least two external supplies for water in the Roman-Byzantine period: springs at Elmali and a qanat/infiltration gallery from mod. Kayaş district.

An infiltration gallery 25-30m long at the intersection of the Kusunlar and Kayaş valleys collected groundwater, carrying it through a masonry channel 7-8m underground for 15km to Ankara. ÖZand reports on sections of this channel that were discovered in Ankara in the 1960s, and speculated that it also received water from the Hanımpınar spring at Üreğil village. Kaytan, following ÖZand, observes that the elevation of the gallery’s source (925m ASL) was sufficient to serve the Çankırıkapı baths (870m ASL).

Fıratlı and ÖZand agreed that the inverted siphon blocks found in several places

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1284 Foss 1977, 76.
1285 ÖZand 1967, 1.
1286 Kaytan 2008, 44.
1287 ÖZand 1967, 3.
around Ankara – most prominently in the southeast corner of the citadel – were sourced from springs at Elmadağ (c. 1250-1500m ASL, 15km). The spring was connected via an open channel of limestone slabs for some 13km, before it was channelized into stone-blocks for the inverted siphon in the city. Bennett took a different view, and argued that the inverted siphon blocks belonged to an aqueduct that should be sourced in the headwaters of the Ankara Çayı. French suggested a source in the Çubuk plain. All of these sources could have supplied the Çankırıkapı baths, in addition to the infiltration gallery from Kayaş. Further uncertainty concerns the siphon’s course within the city – principally whether or not it could provide an intramuros supply for the citadel, which is assumed by Foss and Bennett. Fıratlı was also inclined to this view: based on the location and elevation of inverted siphon blocks found in the city, he postulated a header tank in the area of Mamak – Aşağı İmrahor (c. 1000-950m ASL), from which water flowed 1-2km down to Çebeci (where stone-block pipes are first known, 870m ASL), and back up to a receiving tank in Atpazarı at Hisarkapısı, at the highest elevations of the citadel’s southeast flank (c. 940m ASL). The municipality built a tank for the same purpose here in 1930, and it is still called Sutepe (“Water-hill”) Mahallesi today. Pipes and two fountains were found near Hisarkapısı at the Temple of Rome and Augustus.

A Roman dam with sluice gates was built in Hatip Çayı (870m ASL), also called Bentderesi (“dammed creek”), that was destroyed by modern dam construction in 1935 but survives in a photograph, which reveal that it had sluice gates and a construction technique that compare with the late Roman dam at Aezanoi. At 870m ASL, water impounded behind the dam could only provide water for the lower parts of the city: irrigation and flood control are likely explanations for its construction, though Fıratlı asserted that the Bentderesi dam was connected to the city for consumption via a gallery and pipeline system discovered at Dişkapı in 1948.

Apart from a fountain mentioned in an inscription, and the scant remains of two fountains around the Temple of Augustus, the primary consumer of aqueduct water known from ancient Ancyra is the massive imperial-style bath complex (160x200m), dated by coins to the reign of Caracalla, that was excavated near the city walls at Çankırıkapı in the 1940s. More recent rescue excavations have been conducted since the late 1990s. The earlier excavations revealed that a series of rooms in the southeast of the bath that were on a different plan and

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1288 Bennett 2003, 8.
1289 French 2003, 36.
1290 Foss 1977, 64.
1291 Bennett 2003, 8.
1292 Fıratlı 1951, 350-1.
1294 Fıratlı 1951, 352.
1295 Ibid. 356.
alignment than the rest of the building, raising questions as to whether or not the baths were ever completed as planned. Nevertheless, a coin sequence from the baths published by Foss runs strong from the early third century until the reign of Heraclius, with single finds of coins issued by Constans II, Leo IV, and Theophilus, before picking back up again under Leo VI (r. 886-912, with 8 finds). Because of inadequate publication, it is unclear precisely what type of occupation is suggested by the renewed ninth century coinage at the site. The southwest section of the bath was demolished by the construction of the city’s outer circuit of fortifications. As concerns the bath’s water-supply, it seems clear that the supply came from the southeast – Fıratlı, Mamboury, and Erkan argued that the Cankirikapi bath was fed by the aqueduct, while Özand suggested instead that the Roman infiltration gallery / qanat near Kayaş together with the spring at Hanımpınar were the bath’s sources.

Literary and epigraphic evidence from Ankara must be discussed separately because it is impossible to positively relate any of the mentioned buildings to archaeology. Three inscriptions are worthy of note: the first is a dedication for construction of ‘the baths’ by Tiberius Iulius Iustus Lunianus, three times high provincial priest. Owing to the debasement of this title, which was never held more than twice in the first or early second century, the inscription is dated to the late second-third century. Following Mitchell others have identified this bath with the Çankırıkapı baths of Caracalla, though doubtless other baths must also have existed in Ankara. The second inscription commemorates the work of one “John the Restorer” who restored [οἶκος τοῦ χιμερίου δημοσίου, either potentially identifiable with the Çankırıkapı baths], a public fortification of some sort [ἐπιμεληθεὶς τοῦ δημοσίου φρουρίου], and an aqueduct and fountain or reservoir [τοῦ ὑδραγωγίου καὶ ὑδρίου]. Bosch and Foss date this inscription to the Constantinian period or later on account of the simple rather than tripartite name Johannes. The third inscription, built into a bridge near Temelli west of Ankara, records its [τὸ ἐργὸν] construction under one bishop Paul, who Foss identified with the same bishop who ordained Theodore of Sykeon c. 580 CE.

**Galatia, Boğazköy**

On the ruins of the Hittite capital of Hattusa are the remains of Roman and Byzantine settlement, which include an Early Byzantine basilica and a pipe line conduit, carrying water into the city from a spring on the northwest slopes below

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1296 Foss 1977, 87.
1297 For the date of these walls, still contested 40 years later, see Foss 1977, 74 and Kadıoğlu-Görkay 2007.
1299 Bosch 1967, 369 #306.
Büyük Kale.1302

**GALATIA, HÜYÜK / ALACAHÜYÜK**
An Ottoman aqueduct here may be on the line of a Roman or Byzantine predecessor; this system has not been investigated.1303

*GALATIA, PESSIONUS*
Since perhaps as early as the eighth century BCE, Pessinus was famed as a center for the Magna Mater cult. In Late Antiquity, the cult received Julian's attention when he visited Pessinus in 362 and appointed new priests.1304 When Galatia was split in 399, Pessinus became the metropolis and archbishopric of Galatia II Salutaris. Chrysostom corresponded with a bishop from Pessinus in the late fourth century, whose successors as signatories are known after the 536 Constantinople Council and at the major seventh and eighth century councils down through the twelfth or the thirteenth century.1305

In the early seventh century, Theodore of Sykeon is attributed with a rain-miracle on the River Gallos which runs through the city.1306

Earlier Belgian excavations from 1967-72 found little Late Antique material: the location of the episcopal complex is not known. However, a fire widespread in the city core was attributed to the late third century Gothic invasions, after which time the city was rebuilt excepting the Kybele temple, that suffered final destruction in the later fourth century.1307 A canal led water from the river Gallos to the Magna Mater sanctuary for cultic purposes and was repaired in the course of the fourth century.

Frank Vermeulen, one of the Belgian scientists who conducted a field survey of ancient Pessinus between 1990 and 1996, combined this work with a geoarchaeological study of the city's water system.1308 Excavation in 1991 indicated the presence of a first century CE water system in Pessinus. As a follow-up to the excavation, DRM data was coordinated with a LCP analysis to indicate the path of potential aqueducts supplying the city. After ground-truthing, a complete north aqueduct (7km) and another incomplete aqueduct system were mapped. The north aqueduct was composed of U-shaped marble blocks that carried terra-cotta pipes to distribution reservoirs on high ground around the settlement for consumption, in addition to use for irrigation in nearby farms. Vermeulen's survey cut substantial layers of sinter from the specus of the north

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1302 Bittel and Naumann 1952, 28, 34, 123, 165; and Schirmer 1969, 11 and 38
1303 TIB 4.174
1304 Julian, Letters 81 and 84.
1305 TIB 4.214-5.
1307 Zosimos 1.28.
1308 Vermeulen 2009.
aqueduct. Its precise operational history is unknown.

**GAUL, SENLIS**  
Roman water conduits here were used into the sixth century to feed baths and a Merovingian palace.\(^\text{1309}\)

**GAUL, REIMS**  
Originally a Vespasianic construction, ceramic conduit sections were used to prolong aqueduct in an extension directed towards the Late Antique cathedral; the archbishop Rigobert ordered repairs to this line. A 60cm sinter deposit accumulated in this line in the period of its last functionality; it was eventually filled up with rubble.\(^\text{1310}\)

**/*/**HAIMIMONTUS, HADRIANOPOLIS / EDIRNE**  
Hadrianopolis was metropolitan of Haimimontus in the Justinianic period, before its elevation to military capital of Macedonia by 802. Modern Edirne is located at the confluence of three rivers, the Tunca, the Arda and the Meriç. After the Russian occupation of 1877-8 and the Balkan Wars of 1912-1913, little survives of Late Antique Hadrianopolis, apart from the spolia incorporated into the Bayezid II mosque (1484-8) or the Yildirim Camii (1360-1389). The city’s cathedral, the Hagia Sophia, stood until the end of the nineteenth century. Little is known of the antique Roman or Byzantine water system here, which was probably subject to far-reaching renovations and expansions under Sinan, funded by the patronage of Suleiman who dedicated water conduits and fountains to Hurrem Sultan in the 1550s.\(^\text{1311}\) The city’s cathedral, Hagia Sophia, stood until the end of the 19th century, though it is unclear how this complex might have been integrated with the pre-Ottoman water system at Edirne.

**/*/**HELLENOPONTUS, AMASYA / AMASEIA**  
Amasya was metropolitan capital of province Hellenopontus. The Ferhat canal is so-called because of its prominence in the epic Turkish romance of Ferhat and Shirin; it is in fact a Roman construction, which enters the city from the plain, following along the south bank of the Yesilirmak river. Sections of vaulted tunnel are also present along the canal’s length. Repair of the canal is attested by a third century inscription preserved as a spolium in the Yörü꾸 Pasha Camii.\(^\text{1312}\) The location of an episcopal complex at Amasya is unknown.

**HELLENOPONTUS, GANGRA / ÇANKIRI**  
Nothing is known of aqueducts or churches at Gangra, which lay at the

\(^{1309}\) Guillerme 1983.  
\(^{1310}\) Guillerme 1983.  
\(^{1311}\) See TI 6, 161-7 and for inscriptions relating to the Ottoman expansion of the water system, see F. Th. Dijkema, *The Ottoman Historical Inscriptions in Edirne* (Leiden: Brill, 1977), 54-6 and nr. 33-4.  
\(^{1312}\) See Nicholson and Nicholson 1993, 143-146.
confluence of the Tatlı and Acı rivers. The city, capital of Paphlagonian kings, was incorporated into Galatia as Germanicopolis in 6 BCE, and remained a Byzantine episcopate and stronghold until its capture by the Seljuks in 1071 after the Battle of Malazgirt. The Incekaya aqueduct (supplying Safranbolu in Çankırı province) was built by Izzet Mehmet Pasha in 1790, presumably on the remains of a Roman-Byzantine predecessor, though this relationship cannot yet be documented. 

*HELLESPONTUS, CYZICUS / ERDEK*

Little is known of the aqueduct system at Cyzicus, which provided the metropolitan capital of Hellespontus with a water supply from the mainland, apart from the observations of Hasluck and Bildirici. Hasluck noted the presence of a “Byzantine aqueduct across the old harbor” that he took as indication that “the site was not abandoned at once, [but] the activity of the port must have shifted [W] to Artaki, where there is good natural anchorage.” A small island just across from Artaki, called Panagia, was blessed with famous hot and cold water springs, where Hasluck saw ruins of a large Byzantine church, baths, and hagiasma. Paul Lucas had earlier seen glass mosaic on the site of the church. At nearby Kapıdağ, the medieval-early modern monastery of St George employed wells for its supply; one was dedicated as late as 1721.

*HELLESPONTUS, HERACLEA PONTICA / EREĞİ*

Heraclea Pontica is situated at the mouth of the Lycus river. Little is known of its ancient or medieval water systems, though reportedly there are ancient or medieval cisterns in the town.

*INSULAE, RHODUS / RHODES*

The water supply system at Rhodes was undoubtedly supplemented by wells and cisterns; but the remains of an aqueduct and urban distribution here is a confusing mix of Byzantine, Genoese, Crusader, and Ottoman remains that are poorly studied, though they appear to relate to the medieval city’s fortified enclosure, built by the Knights Hospitaller on a Byzantine predecessor in the early fourteenth century.

**INSULAE, SAMOS**

Samos is a deeply ancient Greek island town, which was elevated to the status of military capital of Kibyrrhaion by 697 or 720 (though this was later transferred to Attaleia/Antalya). Coincidentally, the city’s aqueduct appears to have fallen out of use just shortly before this date, if current interpretations of the archaeological evidence hold up to scrutiny.

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1313 Bildirici 2008, XXIII, 11 notes pipe dimensions.
1314 Hasluck 1910, here at 194.
1315 Ibid. 18.
1316 Lucas 1714, vol. 1, 27.
1317 Hasluck 1904, here at 30, #34.
Samos was supplied by an Archaic rock-cut tunnel fed from a spring at Ayiades, with later Roman addition of 8-15km long channel with bridges, possibly sourced in the area of Pyrgos or Myli. The Archaic Eupalinos tunnel system, named for its engineer, was originally built between 550-530 BCE, though it was used well into the Byzantine period. This system connected a major spring at the village of Ayiades (output: 400m$^3$/d), which flowed into a catchment chamber/reservoir built with fifteen rectangular piers under the Church of St John, before being carried over 2300m through pipes laid in the carved tunnel, which runs underneath and through Mt Kastro.\textsuperscript{1318} The present church above the reservoir is clearly modern, but of unknown date – a repair in 1873 is attested by an inscription above a window – the possibility that it replaced an earlier structure may be indicated by a Kämpferkapitell and portions of an Ambo built into the fabric of the church.\textsuperscript{1319} The channel was stabilized in the Roman period.\textsuperscript{1320} Vertical surface access shafts were provided along the length of the tunnel; the channel itself shows signs of widening and refurbishment in some places, including changes that have been associated with the tunnel’s later use as a refugium (see below): among these are the installation of an intermediate collection basin delimited by spolia columns and early Byzantine chancel plaques inscribed with chi-rho monograms.\textsuperscript{1321} Where the channel terminated on the south side of Mt Kastro, a 6.1 x 3.35m basin, 0.44m deep, received its waters. The basin’s south side was decorated with opus sectile. In a later phase, pipes were used to bypass the basin and carry them directly into town.\textsuperscript{1322}

A Late Antique inscription, dated around 500 CE, rather humorously attests to the continued use of the channel in the Byzantine period: ἐξι τὸ αναθεμα ... ο αφ χειτο εις το υδωρ τουτο οτι αιξ αυτον πινομεν παντες or, “I urinated in the water so that everyone would drink it.”\textsuperscript{1323} Small finds from the south part of the tunnel’s channel included a rich group of over 150 Late Antique lamps from North Africa (associated with coin finds dating them to the 4th-7th centuries).\textsuperscript{1324} Apart from earlier Hellenistic material, small finds also included a small group of imperial period coinage, but a significant collection of Justinianic and post-Justinianic coins, whose dates stretch as late as 668 CE, and which included a group of over 200 Heraclian folleis.\textsuperscript{1325} While the sixth century coins are probably related to the use-life of the channel for its intended function – around the time of the micturatory inscription – the seventh century coins have been associated with the tunnel’s use as a place of refuge during the period of the sea-borne

\textsuperscript{1318} Fabricius 1884: 171-2
\textsuperscript{1319} Kienast 1995, 21-24
\textsuperscript{1320} Ibid., 183
\textsuperscript{1321} Ibid. 58-9 and Taf. 24, Punkt 34 in plans
\textsuperscript{1322} Ibid. 81-3, Abb. 25
\textsuperscript{1323} Ibid. 195
\textsuperscript{1324} Jantzen 2004, 23-4
\textsuperscript{1325} Jantzen 2004, 144-170
Arab raids of the latter seventh century.\textsuperscript{1326}

The Roman bridge and channel aqueduct system at Samos is poorly known.\textsuperscript{1327} Based on its construction -- with small ashlar-built piers with arches in mortar and rubble core with bricks -- it may be an Antonine construction with Late Antique repairs to the arches, rather than an Augustan construction as suggested by Schram, since first century aqueduct bridges (e.g. Patara, Xanthos, Koropissos) are typically of solid polygonal masonry in the piers and arches alike. This system was supplied by a spring to the west of the city near Pyrgos or Myli, and presumably terminated near the ancient harbor, distributing water to consumers along the way. For roughly 400m it ran parallel to the Eupalinos Tunnel’s ‘Stadtleitung’ section, just a few meters to its south. Late Antique use of this aqueduct is guaranteed by its supply to the Roman bath-gymnasium (2\textsuperscript{nd}-4\textsuperscript{th} century CE), found just outside the Hellenistic city walls, which was converted for use as a church and monastery, the so-called Klosterbad.\textsuperscript{1328} The conversion can be dated by coins to the period during or soon after Justinian’s reign in the mid-sixth century. This complex used water from the Roman aqueduct in the primary phase for bathing, but continued in the second phase for the use of a baptistery, latrine, fountain, and various agricultural activities.\textsuperscript{1329} This complex is described by the authors as an episcopeion on the model of a \textit{villa rustica}.\textsuperscript{1330} The complex was repaired after an earthquake in the year 614, with the water channels still in use at that time. The complex continued to see new burials sunk into its floors until 659/665, as suggested by coins, around which time the atrium collapsed and the water channel filled up with debris, presumably due to earthquake.\textsuperscript{1331}

*/*SAURIA, SELEUCIA / SILIFKE

The Hellenistic city founded by Seleukos I Nikator (312 – 281 BCE), Seleukeia on the Kalykadnos / Göksu river was metropolitan of Roman province Isauria, after its creation by Diocletian. Seleuceia was elevated to the status of military capital by 934. The city is today 14km from the river mouth, whose growth by alluviation over the centuries has slowed since the 1950s after dam construction along the river. Just southwest of the city and its citadel is the supra-regionally important sanctuary of Thekla, whose \textit{miracula} survive and whose Late Antique cult featured spring water as a consistent vehicle through which miracles were accomplished. Water from the spring cured animals, and water from the bath was a potent cure for ophthalmological ailments. As such it was important, but not more powerful than other miraculous tools of the saint, for instance the

\textsuperscript{1326} Kienast 1995, 183
\textsuperscript{1327} Schram 2014
\textsuperscript{1328} Martini 1984 and Martini and Steckner 1993
\textsuperscript{1329} Martini and Steckner 1993, 162-4
\textsuperscript{1330} Ibid, 189-194
\textsuperscript{1331} Martini and Steckner 1993, 38-43

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miraculous soap that was manufactured on site. As such the Thekla shrine’s water compares with the miraculous baths of Cyrrhos and Ioannes, and Komes and Damian. Lead seals for bishops at Silifke are known from the eighth century that prominently display Thekla, in addition to individuals styled as hypatos, spatharios, and droungarios. The city became a kleisoura and border-defense hub in the ninth century, before it was elevated to a military capital between 927 and 934 by Romanos Lekapenos. The castle at Seleukeia thus maintained its importance for a long period, though an inverted siphon to the top of the kale for its water supply was an impossibility due to the lower elevation of the spring at its source; therefore the castle was dependent on cisterns and wells for its water.

Seleukeia was supplied by an aqueduct whose source was a spring at the west (with parts of a bridge known 6km to the west at Bahcederesi Köy). This line approached the city, whose internal disposition is poorly known apart from a reservoir (the Tekir Ambari, a massive reservoir at the foot of the Roman-Byzantine-Ottoman kale that was the military headquarters) and a Late Antique bath. One branch from the aqueduct supplied CILICIA, BAHÇEDERESI KÖY, with another branch supplying the sanctuary of Thekla, built on a hillside 1.5 km southwest of the city overlooking the Kalykadnos plain. Hild and Restle suggest that aqueduct piers surviving when they visited (not located 2012) had been restored at least once and were, according to the build technique, possibly from the fourth if not more comfortably the fifth century, and thus contemporary with the pilgrimage site. This line of the aqueduct is associated with reservoirs, a bath, a fountain, industry and agriculture on the site of the sanctuary.

Distribution within the town is basically unknown. The southward diversion to Aya Thekla from the main line was fed into a series of well-preserved reservoirs, rock-cut and brick-built, which also probably supplied a bath complex and a fountain (the latter known only from texts). There may have been older traditions for a sanctuary on this site or nearby, for Apollo Sarpedonius or Athena-Artemis.

Agricultural uses for water at the sanctuary may be suggested by the traces of a water lifting device’s platform in the baulk between side-by-side rock-cut reservoirs at the northwest (these were originally cut as quarries for church construction; pers. observation 2012). H. Thekla was in an excellent, elevated position to manage irrigation schemes in the alluvial valley below. The so-called “circuit walls” of the site, visible only cross-stream along the Kalykadnos tributary immediately to the site’s east, is probably not a defensive wall at all, but rather a stream-management retaining wall that channeled water further downstream for agricultural use (author, pers. observation 2012).

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1332 See Miracles of Thecla, Mir. 35 for the opthalmological ailment and Mir. 36 for animals cured at the spring; Mir. 26 for soap.
1333 See Miracles of Thecla, trans. Dagron 1978, esp. 67-73, with quote from 68.
1334 TIB 5.1.402-406.
**LYCAONIA, ICONIUM / KONYA**

Nothing is known of an external water supply for Iconium during or after antiquity. The city has no rivers, and is surrounded by a largely waterless plain to the north, east, and south which relies on wells for irrigation and subsistence. In Konya, the present Alaadin Camii on the acropolis incorporates a large cistern in its north courtyard, just inside reused walls from the fifth-century Early Byzantine basilica that had formerly stood on the site.

**LYCIA, ANDRIAKE**

Andriake is the port city of Myra, which – in the presence of only sulphurous springs nearby – relied on an external Urban aqueduct that was an extension of the Myra system, with its terminus in a giant Hadrianic reservoir. The system was adopted for industrial use in Late Antiquity (specifically murex shell processing for dye production).

Borchhardt established that the Andriake was at the terminus of the Myra aqueduct, because the springs in the nearby Andrakos valley are sulfurous and unsuitable for consumption – the so-called nymphaeum here is actually a bath, which was repaired in Late Antiquity. An arched aqueduct bridge (1.2m wide with a 40cm channel) connected Andriake to the originally Hellenistic, rock-cut Myra system. The primary terminus of the system was a giant covered reservoir (23.6 x 12.1 x 7m = 2000 m³) just east of the Hadrianic granary, built of identical large stone blocks and containing extensive deposits of Late Antique amphorae fragments. Eight piers and arches divide two aisles on the interior, with heavy pilasters punctuating the length of the walls; the reservoirs masonry slab-roof lent itself to the name for the area in ancient sources, Plakoma. It was accessible via draw-holes at the east and west side. Excavations indicated that this area was cleaned and carefully rebuilt during the fourth century, before which time there are little signs of occupation despite inscriptions attesting to Hadrianic construction of the area. A murex workshop was built here in the sixth century, using spolia from Church B, about the time that Church C was constructed on the other side of the granary at the W. This workshop left huge piles of murex shells, whose cleaning and processing depended on the large quantities of water drawn from the cisterns. One shop in the harbor facilities, with a coin sequence extending to the reign of Justinian, had a cistern supplied via a brick channel in its walls as well as an open channel in the floor of an adjacent

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1335 For what remains (including the late antique church and its relation to the Alaadin Camii) see principally Redford 1991, 54-74 and, for water systems in the vicinity of Konya (e.g. nearby Sille) but not in the city itself, see Bildirici and Bildirici 1997, 1115-1128.
1336 Borchhardt 1975, 71-2
1337 Borchhardt 1975, 64-5 and Marksteiner 2006.
1338 Çevik and Bulut 2011, 62.
1339 Ibidem.
corridor. The latest coins from the site dated to the reign of Constans II (r. 641-668), though their context has not been identified. Over 22,000 amphorae fragments were found in the area north of the cisterns, which dated mostly to the 6th and 7th centuries, and were thought to be waste products associated with murex production and transport.

The aqueduct fed into the city via a series of cascading mill races, whose form may be compared with the mills at Barbegal.

The Battle of the Masts, in 655 CE at nearby Finike, was a critical Roman loss to the Umayyads at sea; this battle marked the end of centuries of Roman / Byzantine naval hegemony in the Mediterranean; though occupation appears to have ended at Andriake in the mid-seventh century, perhaps in coincidence with the Battle of the Masts, occupation of Myra (which assumed operations as a port) continued for centuries thereafter.

**LYCIA, ASPENDOS**

The triple-inverted siphon at Aspendos was a wonder of Roman technological sophistication that supplied the city by means of a complicated pressurized system. Water was initially carried by gravity in an open channel from the Gökçepinar springs, some 20km north, to a hill across the valley from the oval platform on which the city sits. From this point, water was conveyed over a sophisticated bridge with two pressure towers, whose precise function is still cause for debate. This aqueduct was functional for only a short time – between a few decades and 130-150 years maximum, perhaps felled by an earthquake in the later third or mid-fourth century. There are no repairs visible to the bridge.

Kessener has argued that the bridge’s header tank – marking the conversion of the line from an open gravity-flow conduit to a pressurized line, at the beginning of the inverted siphon before its descent – should be identified with a small rectangular construction of rubble and chipped bricks a few hundred meters north of the north pressure tower, near Sarıbalı village. While admitting that the structure is likely a header tank – before its apparent reuse for domestic purposes – the building technique used in the structure in question has, however, absolutely nothing to do with the fine ashlar and brickwork of the aqueduct bridge or pressure towers. Further, the tank is not on a direct line from the aqueduct, but is some twenty degrees or more to its west. Rather than a primary component of the inverted siphon system at Aspendos, the tank is arguably a relic of the complex bridge-and-tower system’s abandonment, consequent with the salvage of the open-channel system carrying water in from the springs, for use with a

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1340 ibid., 64.
1341 ibid., 67.
1344 Pers. observation with Brianna Bricker, November 2014.
pipeline. The depth of the valley from hill to hill may have created too much force for the pipeline to climb back up to the acropolis on the other side; arguably, the new pipeline instead fed the late Roman baths that were built southeast of the acropolis, with a simple open-channel, gravity powered descent.

Blocks from the inverted siphon were reused by the Seljuks in the construction of a bridge across the Eurymedon just southeast of the city.\textsuperscript{1345}

**LYCIA, BALBOURA**

Balboula was a Hellenistic settlement, incorporated into the Roman empire as a colony, with bishops attending councils from 451 into the twelfth century.\textsuperscript{1346} Spratt and Forbes described a ‘perennial’ spring in the valley below the town, about 50m southeast of the southeast necropolis church.\textsuperscript{1347} This spring was also seen by G. E. Bean in the 1970s,\textsuperscript{1348} though Coulton reported that it was dry in the early 1990s. There may have been additional springs or wells in town, but all other springs nearby are too low in altitude or productivity to supply the city.

Two aqueducts carried spring water into town.

The lower aqueduct is 3.6km long and comes from a spring in the southeast: pipes were set behind a retaining wall that followed a ridge to the Keynaralan Dere, from which point water traveled into the city via an aqueduct bridge. Three arches (7.3, 10.5, and 6.7m wide) in massive dry polygonal masonry made the crossing, its channel at a height of some 17m above the riverbed.\textsuperscript{1349} A monumental inscription in the bridge was erected by magistrates (presbyteros and antistrategos) to commemorate construction of the aqueduct paid from their own funds, and is dated between 74-6 CE.\textsuperscript{1350} Another inscription found in the aqueduct is a spolium used for repair: its Severan date suggests a repair sometime after that, perhaps in the later third or fourth century if not later. Another copy of the Flavian aqueduct inscription was found on the architrave of a doorway cut into a hillside, near the west end of the Civic center. This inscription is close to the city baths, in addition to a third inscription that dedicated a hydreion to Caracalla and Geta. Remains identified as the hydreion are only very partially exposed and still difficult of interpretation: there are at least two phases, though how these fall between Flavian and Early Byzantine is unclear.\textsuperscript{1351}

The upper aqueduct supplied the acropolis via a 3.2km long pipe conduit, carried over two saddles southwest of town on a retaining wall of massive dry polygonal

\textsuperscript{1345} Kessener and Piras 1998b.
\textsuperscript{1346} TIB 8.2.477-9.
\textsuperscript{1347} Coulton 2012, 177 citing Spratt and Forbes 1847, 1: 270.
\textsuperscript{1348} Bean 1978, 168.
\textsuperscript{1349} Coulton 2012, 178.
\textsuperscript{1350} SEG 28.1218.
\textsuperscript{1351} Coulton 2012, 182-184.
stonework, built high enough to approach the acropolis at its own level, without
the benefit of a pressurized siphon. Coulton dates it to the post-Hellenistic period,
because its line into the city crosses through the Hellenistic city walls, which were
partially dismantled for its passage. On the acropolis is a large cistern (5.8 x 5.3 x
>3.75m = >120m$^3$) that was probably filled by roof runoff from the nearby
Acropolis Basilica, rather than from the aqueduct; Coulton proposes an Late
Roman – Early Byzantine date for the cistern.\textsuperscript{1352}

Coulton identifies post-Caracallan repairs to the nymphaeum, and suggests that
the city’s water system was kept in repair after the third century. The lower circuit
of Late Roman walls included churches (on the acropolis and at the NE), the
nymphaeum, baths and cisterns, but not the two theaters (which were never
finished anyways).\textsuperscript{1353} Coulton’s survey around Balboura found evidence for
repairs to drainage systems that he dated between the fifth and eighth
centuries,\textsuperscript{1354} while he also highlighted strong links to Cyprus and a sharp Late
Roman – Early Byzantine rise in proportions of food preparation vessels. These
trends were accompanied by a gradual rise in rural settlement after the fifth
century, with a seventh century peak and a near absence of ninth century
material.\textsuperscript{1355}

The southwest Church (26 x 15m) was constructed immediately south and
adjacent to the city baths,\textsuperscript{1356} in which Farrington identified undated repairs to the
terracotta spacer-pin system of wall-flue construction in the bath’s heated
areas.\textsuperscript{1357}

\textbf{LYCIA, BEZIRGAN}

This settlement is located on the route of the Patara aqueduct, and is the site of
a church with large reservoir, though it could not be located when the author
visited in 2014.\textsuperscript{1358} This community may have benefited from a branch supply off
the Patara aqueduct line; it continues to benefit from a Hellenistic-period
drainage channel cut through the south side of the basin, carrying water drained
from the plain towards the sea, which functions still today.\textsuperscript{1359}

\textbf{LYCIA, DONT}

In the spolia of an Ottoman palace built here, 9km east of Fethiye, the editors of
the TAM observed heavy clay pipes used for a pressurized water conduit; one
was inscribed φανίου Ἐρμίας ἐπόιε.\textsuperscript{1360}

\textsuperscript{1352} Ibid., 188.
\textsuperscript{1353} Ibid., 166.
\textsuperscript{1354} Ibid., 169.
\textsuperscript{1355} Ibid., 171-6.
\textsuperscript{1356} Coulton 2012, 194-5
\textsuperscript{1357} Farrington 1990, 61-2.
\textsuperscript{1358} Petersen and von Luschan 1889, 6; Hild 2003.
\textsuperscript{1359} Büyükyıldırım 1994, 62-6.
\textsuperscript{1360} TAM II/1.128; see also Tietz 2003, 337-339.
LYCIA, EUDOKIAS
Eudokias, formerly a dependency in the chora of Termessos, was renamed for the daughter of Theodosius II and elevated to city-status as polis, with a bishop who appears on conciliar lists between 431 and 787, in addition to an eirenarch.\textsuperscript{1361} Roman sarcophagi and temple graves bespeak economic prosperity here before the aggrandizement of the city in the early Byzantine period, with the construction of at least three column basilicas. The village’s hydraulic system carried water from the Kьrkgьz springs (13km) through an open, rock-hewn canal into the Degirmenоçagi valley near the Seljuk Evdir Han, whose area is identified as ancient Eudokias. This channel supplied water for irrigation and likely also for drinking water inside the town – it has been reactivated and functions today.\textsuperscript{1362}

Spratt-Forbes gives the following description of the aqueduct, which is memorable enough to quote in full: “The most singular feature of these ruins are aqueducts, which intersect the city in all directions, and are formed of solid walls from eight to ten feet high. These all lead off from a larger and principal duct, that must have conveyed a considerable quantity of water, judging from the breadth of the channel. We traced it out of the city to the northwards, where it passes near the khan, and our guide told us that it came from a long distance. The stream has now returned to its natural course, but from the incrusting property of the water that flowed through these conduits it may have been a portion of the Catarrhactes. The masonry is quite concealed by the calcareous matter coating the several aqueducts. The inhabitants appear to have luxuriated in their abundant supply of water...A straight canal or cistern eight feet broad, three feet high, and between three and four hundred yards long, constructed of large slabs of limestone, traversed the city. It is in perfect preservation, but filled to the brim with soil: coarse figures of fish and other animals are sculptured upon its sides. Parallel with the canal runs a flagged way, by which were ranged the principal public buildings: stone benches are placed at intervals by the canal side. The architecture and ornaments of all are in keeping with the style of the sarcophagi, and indicate a late and tasteless epoch. At each end of the cistern are two inscribed square pedestals, and a similar pair by its centre. On one of them the words ΠΟΤΑΜΟΣ ΛΑΓΟΝΩΝ occur.”\textsuperscript{1363}

LYCIA, FIRNAZ / YEŞILKÖY
A number of late nineteenth century travelers saw this section of the Patara aqueduct, the so-called Delikkemer bridge, crossing the marsh about 4km east of Patara.\textsuperscript{1364} This is the venter of Patara’s siphon, which consists of a substruction 231m long and 9.3m high of rough polygonal stones on rubble work,

\textsuperscript{1361} TIB 8.2.533-4.
\textsuperscript{1362} Büyüköydisirn 1994, 99-106.
\textsuperscript{1363} Spratt and Forbes 1847, 1: 228-229.
\textsuperscript{1364} Spratt and Forbes 1847, 1: 51; Bent 1888, 87; and generally TIB 8.2.539.
2.95m thick. The bridge’s base was pierced by two arches, above which the aqueduct’s inscriptions are still visible. The bridge carried a covered channel 0.6m wide x 0.4m deep, in which stone pipe sections were inserted. Stenton and Coulton report on repairs to this line. The original ashlar stone work of the Hellenistic or early imperial phase collapsed in antiquity and was repaired with mortared rubble and reused pipe sections, perhaps by Vespasian (an inscription from whose reign records a repair) or later.

Physical autopsy by the author, in the company of Paul Kessener and the assembled experts of the Frontinus Gesellschaft in November 2014, noted that the siphon-pieces had been reassembled at some point – with female and male ends facing the wrong directions. We speculated that the siphon-pieces may have been reassembled at a late date as the substructure or support for Late Antique pipelines, laid over the bridge.

LYCIA, HAMADIYE
This site is unstudied, except for the brief mention given in the TIB, and the revealing details that can be observed with reference to photos of the site, 1km east of Simena / Kekova, with Google Earth’s Panoramio service. The TIB’s editors mention a large three aisled Byzantine church on the slopes of the hill just above the beach, which was outfitted with a large cistern in its north aisle, whose rock-cut intake-channel was intact. Also, they suggest that a series of house remains built from small and rough stone work should be assigned to the Early Byzantine period.

In the beach below the church are at least two wells: one is rock-cut into the foot of the hill and is covered with a reused chunk of architrave; the larger is a circular construction, rock-cut with a masonry built rim, and stairs cut into the bedrock leading down to the water below. Probably not an intake, but rather an oversupply off-take channel is slipped into the rim on its south side. Its date is unclear, though its size and form is most uncommon in Byzantine Anatolia, and so should perhaps be assigned to the later medieval period. A small fortress is built on the hill above the beach-well.

LYCIA, KIBYRA / MOD. KARABURUN
An aqueduct enters the city from the northeast, after crossing a sink with an inverted siphon. The aqueduct was not built on a bridge, but rather on a thick retaining wall with large broken stones – arches were cut into it at the foot of the sink. Hild and Hellenkemper compare the construction of this aqueduct to

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1365 Buluç 1984, 142.
1368 TIB 8.2.555-6.
1369 Büyükyıldırım 1994, 199 and TIB 8.2.630.
Korykos, and date it to the Late Roman or Early Byzantine periods. Post-seventh century activity here is notable: Kibyra was a Tourma of the Kibyraiotai theme, and Tourmarchs Andreas and Theophilos as well as a Sergios are known from seals of the 8th or 9th century.

**LYCIA, KURŞUNLU**

Kurşunlu is a waterfall 4km northwest of Perge, at which may be found an Ottoman water mill used to grind grain for flour; it may be on Roman foundations. The north aqueduct for Perge begins within the confines of the park here.

**LYCIA, KYANEAI**

Kyaneai, an originally Hellenistic settlement in the uplands of central Lycia, was never supplied by an aqueduct. Perhaps more unusual is that the city was not contracted by a city wall in Late Antiquity, but rather was expanded from the circuit of its Hellenistic walls by nearly 20%, from 3.73 to 4.6 ha. The survey led by Frank Kolb in the city and its chora recorded the presence of over 700 cisterns distributed throughout the settlement, which had a largely agrarian and dispersed character for most of its occupation history. These cisterns were predominantly rock-cut, with bottle-shaped interiors, round or oval mouths, and small capacities (avg. 2m diameter), with distribution as follows: c. 215 were spread among 74 small hamlets, 130 were single cisterns at isolated farmsteads, with the remaining c. 350 found near agricultural land, terrace complexes, or along roads and paths. Many were still in use, their mouths covered in modern concrete – Kolb suggested that these were originally Hellenistic cisterns whose use-lives probably extended into the Byzantine period, before their modern adaptation and refurbishment. A further 29 rectangular cisterns, vaulted and with larger capacities (3-4m x 4-9m x 3-6m), were thought to be Roman or Byzantine. A Roman chamber tomb was also found, converted for use as a cistern.

In Late Antiquity, Kolb observed that the number of cisterns in the city by some 20% with 13 new installations including four very large vaulted cisterns, and consequently also that total water availability increased nearly 1 million liters, to a total of 2.5 – 3 million liters. A water channel leading from one of these cisterns to the little baths was repaired with spolia, presumably in Late Antiquity, and indicates that the water system was still functioning at that time.

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1370 *TIB* 8.2.629-30.
1371 Ibid.
1372 Roos 1989, 496 and *TIB* 8.2.670.
1373 Albek 1976, 290).
1375 Ibid., 324.
1376 Idem.
1377 Ibid., 384.
Churches A and B were built near or immediately above large Roman-era cisterns. In both cases their dimensions are unfortunately unclear. Intra-muros, Church B (latter 5th or 6th century, 23.2 x 15.6m) was a pier-colonnade basilica with polygonal extruding apse, built of spolia blocks above one such Roman cistern (dimensions unclear), rock-cut with barrel vaults supported by heavy masonry piers. This cistern formed a substructure for the east end of the north aisle.\(^{1378}\) A five chambered, vaulted narthex and other changes (like its eventual conversion into a one-aisled chapel) may be Middle Byzantine modifications, indicative of the building’s longevity. Extra-muros, the necropolis Church A was another pier-colonnade basilica with three aisles and a polygonal extruding apse, built from spolia deriving from the temple of Eleuthera. The church was built near the theater, whose area was excluded from the Late Antique walls, and surrounded with stone sarcophagi. A cistern was constructed de novo from spolia, and situated in the church’s atrium.\(^{1379}\)

LYCIA, MADAMPRUS / MOD. OSMANKALFALAR AT SÖGÜT GÖLÜ

With a close reading of Livy 38.15.2, Bean identified modern Osmankalfalar with ancient Madamprus.\(^{1380}\) There, the \textit{TIB} editors visited the remains of an Ottoman Turkish palace built with numerous imperial Roman spolia, including stone conduit-sections that belonged to the pressurized section of an inverted siphon.\(^{1381}\) Bean also observed reliefs of the Dioscuri and ‘Helen’, a lion’s head and two phallus-stones positioned over Ottoman çesmes.\(^{1382}\)

LYCIA, MAGYDOS / LARA MANASTIR

The ancient city of Magydos, just south of the Antalya airport, has been decimated by modern development; it is primarily known through nineteenth and twentieth century authors.\(^{1383}\) The city has Hellenistic origins, appears in the Roman Portulans, and was listed as a city of Pamphylia by Hierokles. According to their \textit{vita}, Magydos was where Sts. Konon and Heliodoros met their martyrdom. Its bishops (Pamphylia II, metropolis Perge) appear in the conciliar lists between 325 CE and the 12th century.\(^{1384}\)

Magydos was equipped with a small harbor (340x225m) lined with a massive travertine ashlar-built piers, a quay and two moles. Above the harbor, visible until the earlier twentieth century, were remains of city walls, an agora and stoa, and a vaulted building.\(^{1385}\) Paribeni and Romanelli clarified that this structure –

\(^{1378}\) ibid., 378 at Abb. 422.
\(^{1379}\) ibid., 380.
\(^{1380}\) Bean 1956, 150f.
\(^{1381}\) \textit{TIB} 8.2.700-1.
\(^{1382}\) Bean 1956, 150.
\(^{1383}\) pace Adak and Atvur 1999 for recent epigraphic discoveries, with plan.
\(^{1384}\) \textit{TIB} 8.2.702.
\(^{1385}\) Idem.
probably a bath – was composed of two large brick vaulted rooms, into which fed the city’s aqueduct.\textsuperscript{1386} Beaufort noted that in addition to the piers of the arched aqueduct, spring water at Lara – like Hierapolis/Pamukkale – laid down deposits that petrified and gradually raised the level of the water course.\textsuperscript{1387} A local fishermen warned Beaufort not to drink this water, but also reported that it was a viable cure for rheumatism when mixed with seawater, and that the sick came here to bathe. An hagiasma in the chora provided sweet water that was brought into Antalya as recently as the early 20\textsuperscript{th} century.\textsuperscript{1388}

\textbf{*LYCIA, MYRA / DEMRE*}

The aqueduct (35km) of Myra is an originally Lycian/Hellenistic construction, most prominently characterized by a long rock-cut tunnel that carried water alongside the Myros river gorge from a spring in the Dereağzi plain, north of Myra.\textsuperscript{1389} Morganstern identified Byzantine repairs to the channel, whose technique compared readily with the Middle Byzantine church and fortress (ninth century) at Mastaura / Dereağzi.

The aqueduct that supplied Myra and Andriake had its origin just north of the famous church and fortress controlling the pass at Dereağzi.\textsuperscript{1390} Local informants communicated to Morganstern that the spring began near Dirgenler, north of Kasaba in the Kibris river, which becomes the Kasaba before joining the Myros – they reported sections of a water channel that were replaced with piping in the 1970s. David French, writing for Morganstern’s volume on the fort at Dereağzi, also identified repairs to the ancient Myra aqueduct channel, which “resemble closely the mortared stone work of the Byzantine road parapets and may be coeval. If the two are in fact contemporary, the repairs to the channel can be dated to the same time as the paths and the Byzantine fort, and the channel would have been in use, serving Myra and its port at least as late as the ninth or tenth century.”\textsuperscript{1391}

Recent surveys by the Stadiasmus Patareensis group, based at Akdeniz University, have identified the remains of a series of ancient – medieval or early Ottoman water mills situated along the line of the aqueduct and the Myros river, in the area of Dereağzi.\textsuperscript{1392}

Distribution of water inside Myra is poorly known compared with neighboring Andriake, at the terminus of the Myra aqueduct line (see Appendix F, s.v. \textit{LYCIA,}

\textsuperscript{1386} Paribeni and Romanelli 1914, 77-79.
\textsuperscript{1387} Beaufort 1817, 134-5.
\textsuperscript{1388} Rott 1908, 55.
\textsuperscript{1389} Borchhardt 1975, 47-49 and 71-2.
\textsuperscript{1390} TIB 8.2.716-718, s.v. Mastaura.
\textsuperscript{1391} Morganstern et alii 1993, 90.
\textsuperscript{1392} Personal communication with Fatih Önur in 2013, survey participant and professor of Classics at Akdeniz University, whom I must also thank for his hospitality in Antalya.
Roman and Late Antique structures under modern Myra have been little excavated. However, survey directed by Çevik and Bulut identified over 100 modern wells in the city that were sunk 60-70 years ago; their depth is not mentioned, but the high water table of riperine/coastal Myra suggests the ready potential for wells here in the ancient or medieval period, too.\textsuperscript{1393}

**LYCIA, NARAS KöPRÜ**

Byzantine settlement situated next to an arched bridge belonging to the Side long-distance aqueduct system. Rott reported Byzantine walls on the north side of the bridge here,\textsuperscript{1394} while Hild and Hellenkemper added their observation of Byzantine ceramics and *Bruchsteinmauerwerk* from the same area.\textsuperscript{1395} In the Seljuk and Ottoman period, the aqueduct bridge piers were used for the construction of a bridge for foot and cart traffic.

**LYCIA, NAULOI**

This is the port city below Syedra.\textsuperscript{1396} Remains here include a Late Roman bath with hypocaust and remains of fresco and mosaic (Syedra II.1A, compare with similar designs at Anamur II.7 and III.5); a Late Roman circuit wall, and an aqueduct that carried water over a bridge from nearby Irbis Deresi.\textsuperscript{1397}

**LYCIA, OINOANDA**

There are several springs below the city and near sanctuaries of Leto and the nymphs on the west and east slope of the acropolis, respectively. Wells were also used in Oinoanda – one well 2.15m in diameter and at least 1.5m deep was adjacent to the Church Mm 3, its top fitted with reused Ionic architrave blocks.\textsuperscript{1398}

A large rock-cut cistern on the acropolis measures 12 x 7 x at least 2m deep; it was presumably rain-fed from roof tops or paved areas on the acropolis. Stenton and Coulton suggest a Late Antique rather than Hellenistic date for its use.\textsuperscript{1399}

The aqueduct traveled via inverted siphon from springs at Gök Pinar (1500m ASL), 3.5km to the south of Oinoanda. The line had no spring capture, but was equipped with silt traps, as well as header and end tanks for the siphon, which presumably supplied the city’s two bath buildings Mk 1 and Ml 1. The aqueduct broke through the Hellenistic walls of the city at their entry into town; the walls above the break were not repaired.\textsuperscript{1400}

\textsuperscript{1393} Çevik / Bulut in *ANMED* 9 (2011), here at 69.
\textsuperscript{1394} Rott 1908, 66.
\textsuperscript{1395} *TIB* 8.2.742.
\textsuperscript{1396} *TIB* 8.2.743.
\textsuperscript{1397} Rosenbaum 1967, 45f and Büyükyıldırım 1994, 205.
\textsuperscript{1398} Stenton and Coulton 1986, 15
\textsuperscript{1399} Ibid. 18.
\textsuperscript{1400} Coulton et alii 2012, 186.
The city’s Church Mm 3 was located just east of either of the two possible routes for the aqueduct’s course within the city though it depended on a well near its southwest entrance rather than any direct connection to the line. However, two distribution pipe-blocks were found here – one with three perforations at the northeast corner, the other with four perforations at the southwest corner, which should be related to the distribution of water inside town.\textsuperscript{1401}

Stenton and Coulton entertain Hellenistic origins for the Oinoanda system before settling on a first century CE date, by reference to the polygonal masonry also encountered at Balboua and Patara. As for the terminal date of the system’s functionality, Stenton and Coulton also note the presence of High empire epitaphs in sections of repairs along the line that could be related to the Christianization of the town, and the presence of a bishop in 381 CE.\textsuperscript{1402} A large cistern on the acropolis (12 x 7m x >3m = ~250m\textsuperscript{3}) probably should be dated Late Roman or Early Byzantine rather than Hellenistic, on account of its build technique: it would have been filled by roof runoff from the church and other associated buildings.

\textbf{LYCIA, OROKENDA / MOD. GÖLCÜK ÖREN}
Orokenda was an Early Byzantine town implanted in a small Hellenistic-Roman agricultural center. A minor center situated 20km northeast of Side in Pamphylia, Orokenda is identified by two inscriptions found on site, naming the priest of a local Zeus cult and the name of the city; other inscriptions place a boule and demos here. Otherwise, little is known of the city’s history. The site is overgrown today, littered with oil mills, the foundations of houses, imperial tombs and sarcophagi.

Swoboda, Keil, and Knoll first identified an aqueduct here, which carried water onto the plateau below the acropolis from east-west through an open-channel masonry conduit (sections 2.2-2.5m long, 0.35m wide and 0.2m high, with a channel 0.13m wide and 0.10m deep).\textsuperscript{1403} The conduit was set on a massive wall of Bruchstein; the TIB editors identified it as an Early Byzantine construction.\textsuperscript{1404} Contemporary is a three aisled column basilica on the west side of the plateau below the acropolis, constructed with polygonal Bruchstein and imperial-period spolia, and designed with an eastern chamber beyond the apse (compare with Cilician examples, e.g. Korykos); it was contracted to one aisle in the Middle Byzantine period.

\textbf{LYCIA, PATARA}
Urban aqueduct, 23km over an 11km straight-line distance to the source, with complex inverted siphon bridges and multiple Late Antique settlements along its

\textsuperscript{1401} Stenton and Coulton 1986, 34.
\textsuperscript{1402} Ibid. 1986, 44.
\textsuperscript{1403} Swoboda, Keil and Knoll 1935, 112-119.
\textsuperscript{1404} TIB 8.2.768.
path from Islamlar, which also supplied an aqueduct to nearby Xanthos. For the famous inverted-siphon aqueduct bridge of Delikkemer and its status in Late Antiquity, see **LYCIA, FIRNAZ / YEŞILKÖY**.

Işik has led Turkish excavations at Patara since at least 1989, with some German/DAI involvement. Frankly, because excavation records have only been published very summarily, there are serious problems of interpretation for many structures at Patara.

Patara is a problematic place, but evidence that might shed light on the terminal phases of the Roman city’s water system can be put forth quickly, as follows:

Patara was *caput gentis Lyciae* at the head of the Lycian League from the end of the first century BCE, before it became metropolis of the new Roman province of Lycia under Claudius in 43 CE. After Vespasian in 72 CE, Patara lost status when Perge became chief city of the newly doubled province of Lycia-Pamphylia – this organization persisted through the Severans and Tetrarchs, until the province was split again during the Justinianic reorganization, with metropoleis Myra and Perge.\(^{1405}\) The city’s circuit of walls were also rebuilt at this time, near the end of Justinian’s reign.\(^{1406}\) Numerous textual sources in addition to the conciliar lists attest to the city’s continuing vitality during the sixth century, though the Arab sea-raids of the seventh century likely affected Patara to some degree, and by the eighth century there are definitive signs of problems. Willibald stopped here on his way to the Holy Land in 723/4, describing it not as a city but merely a place, *locus que dicitur Patera*. The *vita* of St. Nicholas of Myra very explicitly refers to Patara as formerly a πόλις, but at the time of composition (c. 750-850 CE) merely a κώμη.\(^{1407}\) The contraction or devolution of the city apparent after the seventh or eighth century cannot be pinned on the abandonment of its aqueduct – whenever that happened, perhaps as early as the fourth century, to judge from the abandonment of the octagonal fountain near the Modestus Monument (see below). Repairs to the aqueduct line in the subsequent centuries are difficult to place and to date; the integration of the city’s water-consuming structures into the aqueduct system also remains poorly understood. The complexity of the inverted siphon must be stressed here – this was a fragile system, difficult and expensive to repair and maintain, and susceptible to earthquake. Regardless of this uncertainty, evidence from Patara shows us how Roman cities diversified their water supply and consumption habits in Late Antiquity, and re-centered activity away from the old, aqueduct-fed Roman monumental cores onto other locations in the city that were blessed with perennial sources or manageably-high groundwater. Indeed, the low-lying agora and colonnaded street by the theater seem to have been abandoned relatively early owing to drainage problems that flooded the colonnaded street. Patara was

\(^{1405}\) TIB 8.2.780-788
\(^{1406}\) Gerrit Bruer and Kunze 2010
\(^{1407}\) TIB 8.2.781
amply supplied by groundwater resources, including at least 16 wells, and an intra-muros sulphurous spring that supplied the Hafenthermen.1408 Two churches are especially important for aggrandizing the shift away from aqueduct supplies. The fifth-century Quellenkirche north of town – probably built on the remains of an older Roman water channels and a temple, speculatively identified as Apollo’s – is surrounded by both the older Roman cemetery and two distinct areas with Late Antique kilns and industry.1409 The so-called Strassenkirche near town center, south of the Harbor Baths – is a church of the “Reduced cross-transept” type whose sculpture and typology suggest a date early in the sixth century (compare with Perge Basilica A), a date confirmed by deep sondage in the church’s south side that turned up late fifth and sixth century ceramics in the foundation levels.1410 The church was not integrated into the city’s aqueduct system, but was instead supplied by a humble curbed well in a southern room off the narthex; immediately south of the nave a c. 2x2m basin was set in a peristyle and filled by groundwater infiltration. Like the kilns around the Quellenkirche, millstones were found in both these rooms at the Strassenkirche, suggestive of the industrial activity that profited from the proximity of perennial water resources in these spaces.

The famous aqueduct and inverted siphon that supplied Patara from anc. Potamos / mod. Islamlar/Bodamya (11km straight or 22km aqueduct distance) was repaired after an earthquake in 64 CE during the reign of Vespasian, but it is not clear whether the original system was in fact Seleucid or Republican (related to Patara’s role as a naval base for Antiochos III c. 196 BCE, or for Mithridates of Pontus c. 88 BCE and later Brutus in 42 BCE), or if the aqueduct was in fact a new Claudian construction, as indicated by the two building inscriptions found on the Delikkemer bridge.1411 In any case the Roman system was built under Claudius c. 48-50 and completed c. 50-55/6 CE, before it was damaged in earthquake fifteen years later and repaired by Statthaltern under Vespasian.

The entry of the siphon-aqueduct from the northeast began at the city’s castellum, which has been published only summarily.1412 A visit in 2014 revealed that the castellum has at least three phases: 1) original construction in ashlar masonry, 2) subdivision with a mortar and rubble partition that abuts the castellum’s east wall, dividing it into two chambers so as to increase pressure or facilitate distribution, and 3) conversion of the castellum into a house with thresholds cut through and laid into the west walls.

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1408 See Baykan 2014 and forthcoming for wells
1409 Işık 2011, 74-5.
1411 Şahin 2007.
1412 KST 14.2 (1993), 395 and isonometric drawing at 408.
Beside the Patara excavation house on the hill slopes east of the ancient city below the castellum, is a massive cistern, also basically unpublished. Measuring 37 x 22m and at least 2m in height, two rows of five Doric columns divided its interior into three aisles. These columns indicate that the cistern was covered, but the precise arrangements of the superstructure are unclear from an examination of the walls at their highest preserved point, at the northeast corner – the excavators supposed a wooden cover, though light spherical vaults resting on the columns are another possibility (compare with Constantinople). Long and heavy barrel vaults – that might indicate an earlier Roman date – are unlikely. The columns themselves are clearly spolia, as are various worked stones employed in the construction of the walls. Intake pipes approached the reservoir from the northeast, coming from the direction of the castellum or the aqueduct’s entrance into the city through the walls at NE. Stairs and an out-take channel gave access to water from the basin at its south side. Işkan suggested that this structure was originally Hellenistic, fed by rainwater off the hill slope, before it was connected to the aqueduct for supply of the harbor and villa urbana found in recent, also unpublished GPR work nearby to the west and south. Işik reported to the author in Nov. 2014 that the reservoir was Roman in date, because Roman ceramics were found alongside the buttresses in excavation – however, without more contextual information, this can hardly rule out a later date, because one would also expect large quantities of Roman ceramics to fill the cut of a Late Antique foundation trench. The author here favors a later date, as indicated by the form of the reservoir (both its size and division of the aisles with columns cf. Constantinopolitan examples, rather than piers or walls, cf. the Hadrianic reservoir at Andriake), and the extensive spolia used in its construction.

One line of pipes from the castellum followed the course of the late-classical north city walls in an east-west direction, and was apparently integrated to flow through the top of the Mettius Modestus monument/triumphal arch (compare with similar arrangements at CARIA, IASOS / ASINKALESI and at TYR). Pipes and remains of sinter can be found on the west side of the arch, though surprisingly there are no comparable installations on the east, from which direction the water came. Şahin follows Bowersock to identify Mettius Modestus as an official under Hadrian, who probably repaired or decorated the arch to commemorate Hadrian’s visit to the city between 129-131 CE. Şahin argues that the arch itself is likely Claudian-Vespasianic, possibly one component of τὰ λοιπὰ τοῦ ύδραγωγίου attested in the aqueduct repair inscription, for which see below and Appendix E.22. Immediately south of the Modestus monument is an octagonal fountain-piscina, which according to Işkan and signs-on-site was demolished in the fourth century. Any inclination to use this as a TPQ for the disfunction of

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1413 Pace Işkan 2013, 100.  
1414 Işkan 2013.  
1415 Şahin 2007, 100.  
1416 Işkan 2013. 101.
the aqueduct at the north end of the city is potentially counterindicated, however, by the numerous pipes that run east-west and south-north several meters above the ancient/Roman levels of the north necropolis, if these were not used to drain rainwater off the walls for other purposes (note the ceramic kilns (3rd–6th c.) around the Quellenkirche (5th–13th), just a hundred meters or so north of this area).

There are four Roman baths in Patara (and one medieval Byzantine/Seljuk bath): two are row-type constructions of Vespasianic date. Little is known of their Late Antique history. The Harbor baths southwest of the Modestus Monument are the largest in town: these baths may have been supplied by a nearby sulphurous thermal spring rather than the aqueduct. The Harbor Baths were excavated between 1992 - 2000 and 2005 – 2008 but its history is still poorly understood. During Late Antiquity, a cistern and latrine were added to the complex; the pipes running south-north exposed just beyond the western exterior wall of the bath are probably related to these changes. Along the south wall of the tepidarium, a 2.0 x 1.1m brick/pottery kiln was built into the last of the tabernae on the south street, dated to the fifth and sixth centuries. Closely associated, the round structure in the south street has been identified as a well or deep basin for clay purification. The eastern palestra was sometime encroached upon by shops, before the doorways of these tabernae were filled in later with rough stone walls; subsequent to both these actions, islands of stratigraphy preserved in the palestra indicate a serious fire above a thin occupation layer containing ARS, after which time bricks and masonry (presumably the superstructures of the tabernae) collapsed into the palestra. Lime and metal-smelting kilns also moved into the area to facilitate the dismantling of the bath after the sixth century.

Also notable are two smaller castella and a probably Hellenistic large, round cistern that is located behind the theater on the acropolis, near the temple there.

LYCIA, PHASELIS
Phaselis is an intriguing site that is also difficult of interpretation, as regards its water infrastructure and broader settlement history, which extends from the classical period until at least the ninth or tenth centuries. A quick visit in the company of the Frontinus Gesellschaft in Nov. 2014 made clear that the

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1417 Vespasiansthermen cf. Eck 2008, and the Kleines Bad, compare with the similar bath at Tlos dated by inscription to the reign of Vespasian.
1418 Işık 2011, 51.
1419 See the short reports without drawings in KST, with Alanyali and Şen 2007.
1420 see KST 15.2 (1995), 287.
1421 Işık 2011, 74.
1422 Işık 2011, 74.
1423 Author, pers. observation 2014.
1424 KST 15.2 (1995), 286
1425 Bishops are listed in the conciliar documents until the ninth century, TIB 8.2.798-802
The aqueduct showed signs of Late Antique repair, also visible *in extenso* at the city’s two Early Roman-Hadrianic bath complexes. The connections between the aqueduct and the baths are puzzlingly not at all visible, though the north baths almost abut the line of the aqueduct. Immediately south of the north baths on the west side of the colonnaded street, the aqueduct also passed by the city’s fifth/sixth century episcopal complex, which was built into the former Tetragonos agora and outfitted with a nymphaeum in front of its atrium (originally Late Antique?). Traces of the aqueduct are also visible in the south end of town. The aqueduct was fed by a spring 450m north of the site, and was entirely gravity-fed. The aqueduct was carried over solid masonry arches into the city, its upper channel rebuilt at least once in petit appareil. Schaefer’s survey work at Phaselis (which cost the lives of two workmen to malaria) documented standing remains, but has not drawn any firm conclusions about the history of settlement or the water works here beyond a conjecture that the site was probably functional throughout the seventh and eighth century period of the Arab sea raids.

**LYCIA, RHODIAPOLIS**

Rhodiapolis was probably never supplied with water by an aqueduct: piers outside of town that were identified by Murphy and previous authors as components of an aqueduct were reinterpreted by Çevik as belonging to Roman tombs, instead. The only fountain is in a valley, extra muros, just west of town, where a vaulted building with pool measuring 2.22 x 3.33 x 4.44m still collects water. Inside the city, rainwater was collected into large barrel vaulted reservoirs that were built as terrace platforms for the public buildings above them. Çevik suggests that these reservoirs were connected to one another, the overflow from one feeding another down the line. These were “barrel vaulted rectangular chambers built side by side and interconnected with arches,” built of masonry or rock-cut, with piers and vaults and arches in mortar and rubble. These averaged 600-700m³ and were distributed in the city as follows: a four chambered reservoir on the agora; a deep 4 chambered reservoir by the asklepion with an additional 2 chambered reservoir close nearby, lines from which fed the lowest reservoir in town, a four chambered structure under the palestra of the city’s baths, possibly of the second century CE (c. 4 x 270 = 1080 m³); and finally the largest reservoir (c. 1300m³), a five chambered reservoir on the acropolis.

In Late Antiquity, a basilica was built on the acropolis, with fishy relief sculpture...
that compares with **Alahan**: the basilica was surrounded with an enceinte, which also embraced the pre-existing reservoir. At the city’s baths, changes which maintained the structure’s original function were undertaken in the third or fourth century CE, but sometime later the bath was encroached upon by “dense Byzantine constructions,” that were laid upon the floor of the hypocaust, “arranged as work areas … (with) pithoi”: these changes may have been facilitated by the presence of an existing water supply in this area.

**LYCIA, SOĞUKSU KÖPRÜSÜ**
This is an aqueduct bridge 13km northeast of Antalya that may be related to the Magydos or Perge lines, and which was converted to use as a road bridge by the Seljuks, comparing well to the bridge over the Eurymedon at Aspendos.

**LYCIA, TERMESSOS**
The rhomboidal agora, with stoai built by the Attalids and in the first century CE by a local Roman citizen, was equipped with five vaulted cisterns below the pavement, which were accessed by circular mouths. The city’s Roman-period baths were also entirely dependent on a supply from cisterns.

**LYCIA, XANTHOS / KİNİK**
The Xanthos Aqueduct was a simple, fairly short 9.5km long open channel without pressurized sections. The system began at a capture gallery on the spring in Ikipinar Dere (c. 270m ASL). The capture gallery is pre-Roman, though it feeds into a Roman-period channel system. From the gallery, built of large polygonal masonry on a deep carved-rock floor, water fed into a 40x50cm mortar-lined channel. This channel was carried over four bridges before it reached Xanthos. The first bridge was replaced as late as the Ottoman period. P1 and P’1 (sic), its replacement are parallel bridges, the earlier Roman bridge remaining only as embankments in four courses of 60-100 x 40-55cm blocks. The replacement bridge has a single arch, built of large and closely fit polygonal masonry (7.0m long, 1.9m across). This masonry bears comparison not only with the earlier P1, but also with the arches of P2, P3, and P4, on the line of the antique route that continued toward Xanthos. These were all subject to varying amounts of repair – P4 for instance shows at least 4 distinct repair phases. The aqueduct finally entered Xanthos at its northeast to supply an unexcavated (2nd century CE) bath complex. From there, it likely followed west down the Decumanus toward the Roman/Lower Agora (both subject to encroachment as early as the fifth century). The aqueduct line’s elevation when it entered the city

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1432 Akyürek and Tiryaki 2010.
1433 Çevik et alii 2009, 245.
1434 *TIB* 8.2.859.
1435 Seddon 1987, 40 and 115.
1436 Burdy 1998.
1437 Ibid. 1998, 237
1438 Ibid., 244, Fig. 11.
(c. 70m ASL) was sufficient to supply the known bath complexes in town, as well as the large late Roman house behind / south of the theater.\textsuperscript{1439}

There are two sets of baths remaining at Xanthos.\textsuperscript{1440} Bath I (South Baths, 200m\textsuperscript{2}) is located at the foot of the Acropolis near the river. It compares well in form (Vespasianic parallel row-type) and construction (closely fitted polygonal masonry) with the inscription-dated example from Patara. Bath II (East Baths, 900m\textsuperscript{2}) is 50m east of the theater on a NS road connected to the Decumanus. Farrington dates it late 2\textsuperscript{nd} or 3\textsuperscript{rd} century by comparison of its type (parallel-arrangement with transverse element) and construction (unshaped mortar/rubble construction without spolia) to other baths at Idebessos, Oenoanda, Myra, Pinara, Rhodiapolis, and Tlos. Neither bath at Xanthos has been excavated, and Farrington’s work remains the only study. Their operational histories are unknown.

An inscription from the Letoon commemorates an anonymous donation in the amount of 10,000 denarii for a women’s bath and 45,000 denarii for a gymnasium with βαλανέιον.\textsuperscript{1441} The identity of the donor has been debated by Balland and Coulton: who respectively argued for and against identification with the fabulously wealthy Opramoas of Rhodiapolis.\textsuperscript{1442} One or another bath and gymnasium is also indicated by TAM II.361: found reused in the west walls, these commemorate baths by the senator Arruntius Claudianus TPQ 89 CE. Farrington identifies the Letoon and Arruntius inscriptions with Baths II and I, respectively, but this is not at all clear – more likely the anonymous Letoon construction refers to a separate, as yet undiscovered bath near the Letoon itself rather than Bath II in the city.

The East Church, excavated by Sodini and de Courtils in the 1990s and 2000s, was connected to the city’s aqueduct, which entered the complex from two lines coming from the west, via rooms on the basilica’s north side – these are situated some 1.7-1.8m above the room’s mosaic pavement. Though no direct connection remains, these may have fed into the tetraconch baptistery at the basilica’s northeast, immediately adjacent to these north rooms (the area around the baptistery was cleared when it was converted to use as a church in the Middle Byzantine period).\textsuperscript{1443} Against the west exterior wall of the tetraconch was a small collecting basin in the baptistery’s west wall, from which 4 pipes fed into the font itself. Another conduit (four pipes preserved, 12-13cm diameter) crossed under the altar in front of the apse from north to south, crossing under both

\begin{itemize}
\item \textsuperscript{1439} Ibid., 247.
\item \textsuperscript{1440} Farrington 1995, 74 and 163, plans 11 and 12.
\item \textsuperscript{1441} TAM II.496.
\item \textsuperscript{1442} Fl. c. 140 CE, for theater and agora at Xanthos TAM.II.905; also note his ancestral hall at Rhodiapolis.
\item \textsuperscript{1443} Des Courtils et alii 2001, 240.
\end{itemize}
stylobates. De Courtils observed that they were ‘difficiles à expliquer,’ and entertained the possibility that they derived from an earlier installation, before concluding that they were related to the altar table under the ciborium, perhaps in an arrangement reminiscent of the Katopoliani basilica at Paros. Another conduit ran around the east exterior wall of the apse. The church atrium was supplied from an external source at its northwest; three conduits were found here. (A) is early Byzantine, and was later replaced by two others datable to the Middle Byzantine period, related to a fresco of soldier saints (B), and a rectangular basin contemporary with mosaics (C). A terminus ante quem for (A) was provided by a lamp of sixth-seventh century date. The early Byzantine conduit A was related to a fountain in the atrium, which evacuated towards the south. The later conduits were also associated with a cistern in the north aisle of the church, that may have served for any of the four documented phases in the tetraconch baptistery’s supply. Curiously, line (C) was dated after the construction of the church’s colonnade stylobate and mosaics, apparently in the tenth to eleventh centuries, which puts it roughly contemporary with the baptistery’s conversion into a church.

A large four-celled reservoir can be found in the east aisle of the 1st century CE Civic basilica on the east side of the Upper Agora: this is just to the west and across the street from the East Church. Its date is undetermined. The space under the basilica was an original feature of the construction, TPQ in the reign of Tiberius by coins, though the construction of the reservoir is arguably Late Antique. Pipelines in the north portico of the Upper Agora are dated by ceramics to the first century CE, but these bear no clear relation to the reservoir. The space was subdivided and modified at a later date in its history: it is unclear whether these changes mark the beginning of its use as a reservoir per se, or a mere continuation of earlier functionality. Nevertheless, the civil basilica above was dismantled in the fifth century, when spolia from the porticos reappear in the East Church. The vaulted space below the civil basilica was at least partially plastered, at the time it was converted for water storage. A channel 0.2m above the reservoir floor was cut through the lateral walls so that flow communicated between the cells. Each cell was probably vaulted with tiles, found in the reservoir’s south cell which was “filled at a date to

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1444 Laroche and des Courtils 1999, 388 and fig. 19.
1447 Laroche and des Courtils 2002, 321.
1449 Laroche and des Courtils 2002, 299.
1450 Des Courtils et alii 2010, 284.
1452 Des Courtils et alii 2005, 449, compare e.g. with platform-cisterns in securely ER constructions at Termessos or Rhodiapolis; a better comparison might be the arguably late antique cistern installed in the ER vaulted space under the civic basilica at Aspendos.
1453 Laroche and des Courtils 1999, 370.
be determined by ceramics.” The cistern was accessed by a mouth cut into the west wall of the nave’s foundation in the civil basilica (suggesting that the basilica had already been dismantled?), and supplied by a pipe at the extreme north of the east portico. An external aqueduct feed cannot be ruled out here, but rainwater collection is also possible. The excavator’s concluded that the pipe was put in place to collect rainwater, but also acknowledged that the origin of the water was in fact indiscernible. Later work in the north portico of the Upper Agora revealed a series of additional pipelines, including a two-phase set leaving the south portico of the Decumanus, headed southeast in the direction of the Civic Basilica. As for other late changes to the complex, mosaics in the west portico of the atrium outside the basilica were restored sometime in the fifth century. A workshop producing colored (blue) window glass and vessels was installed in the extreme south of the basilica’s east nave, dated not before the second half of the sixth century by small finds. Comparable materials were found at the Acropolis house. A fountain and several dependent hydraulic installations were found outside the south façade of the basilica’s east nave; these were also dated to the sixth century.

In the Lower Agora can be found a large group of north-south pipes coming up or down the Acropolis hill, as well as west-east pipes on the Agora’s excavated north side. In the middle of the west wall of the Agora basilica was a water basin, whose base was composed of a reused sigma table. Another fountain was located at the Agora’s east entrance, on its north side. Notable here also is the small church built at the Agora’s southwest, whose central aisle covered a distinguished Hellenistic burial, and which was itself surrounded by burials dated by jewelry and small finds to the fifth or sixth century CE.

The Acropolis house provides interesting evidence for the continuity of the city’s aqueducts between the sixth and the eighth centuries CE: Maniere-Leveque describes the late fourth century clearance of an ancient ruined residence/temple platform, on which site a peristyle house was built in the late fourth century CE. The house had a compluvium at center and a separate, pipe fed nymphaeum at the E. Work coincident with the construction of the city circuit walls in the late fifth or early sixth century included new room expansions. Important for water in the following phase: Maniere-Leveque’s phase 5, from the

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1453 Laroche and des Courtils 2002, 299.
1455 Des Courtils et alii 2010, 278-279, fig. 2.
1459 Des Courtils et alii 2010, 289.
1460 Laroche and des Courtils 1998, 463.
1461 Laroche and des Courtils 1999, 367.
1463 Maniere Leveque 1999, 373-378.
6th-8th cent., comprised the creation of a sophisticated rainwater catchment system that now supplied both the nymphaeum and the compluvium.\textsuperscript{1464} Marble-lined reservoirs were added on the sides of the stairs, and Room 20NE was converted into a cistern, while pipe-conduits were repaired and new marble revetments laid in the original nymphaeum. The compluvium was outfitted with a \textit{crepinette}, a sculpted marble drain in the form of a pierced flower.\textsuperscript{1465} There was also probably a bath in the house’s southeast corner: older excavations encountered a hypocaust contiguous to a room covered in hydraulic mortar.

Metzger reports on the large rock-cut reservoir that can be found just inside the walls to the west of the Acropolis house, on the extent of the ruined Greek temple.\textsuperscript{1466} Cut into the rock as a trapezoid, 12.8 x 6.5 x 2.8m, the cistern was fed by a channel coming from the south: the excavators concluded that it ceased to be used “in a rather late époque, without doubt.”\textsuperscript{1467} The complex stratigraphy of the cistern deserves comment: Metzger, who did not publish a cross-section, described its contents but concluded miserably that “peut-être provenaient ils du temple ou de l’édifice E, mais nous n’avons pu tirer aucune observation valable.” He described two distinct fills: the first of “fragments de plats rouges ou noirs à décor estampillé, des lampes de divers modèles, des fragments de grosse poterie ou de tuiles de couverture, enfin quelques figurines en terre cuite.” This is plainly a very mixed early Roman fill, probably from clearance of the temple in the late fourth century CE. Second, Metzger described a fill of “très nombreuses amphores à bases en forme de pointes.” Unfortunately the amphorae forms were also not published, but the consistency of the latter deposit suggests a large consumption context, perhaps related either to industrial activity or conspicuous elite consumption. If we try to place the reservoir into the context of the other Byzantine works on the Acropolis, as excavated by Maniere-Leveque, after an informed visit in July 2013 we can suggest the following: that the aqueduct feed supplying the reservoir from the south is Late Roman. Without better details, we could suggest two dates: if the mixed Roman wares were very homogeneous, they may have been deposited into the reservoir as a sort of filter at the time of the late 4th CE construction of the Late Roman Acropolis House, as a point of supply and withdrawal for the channel that continued on down the hill alongside the theater, and into the agora (where unpublished encroachment of housing and artisans presumably dates to the fifth/sixth century?). More likely, the mixed Roman wares represent an intentional fill of refuse created by clearance for the Byzantine circuit walls in the fifth/sixth century – this would entail a relatively short operational term for the reservoir but not necessarily the aqueduct supplying it, which could have been maintained for the Lower Agora, where clusters of pipes are still visible. The secondary deposit of amphorae fragments in the reservoir came later but is undatable without further study – it

\textsuperscript{1464} Maniere Leveque 2002, 236 and Des Courtils et alii 2004, 323-325.
\textsuperscript{1465} ibid 2002: 237.
\textsuperscript{1466} Metzger 1963, 44.
\textsuperscript{1467} Idem.
probably represents industrial or conspicuous consumption-related waste contemporary with the first disuse and final closure of the reservoir.

The Basilica/Monastery on the Upper Acropolis at Xanthos is situated just inside the N-most tip of the late 5th/early 6th century circuit of city walls.1468 Surrounded by the remains of low-intensity Late Antique housing to the south and field enclosures to the north, the site was studied by Sodini.1469 The church complex is composed of a small triconch (ph. 1) with a cluster of rooms at the east of a large (c. 40 x 20m) three aisled basilica (ph. 2), fronted by a poricoed atrium at the west (ph. 3). Sodini suggested a date before 550 CE for all constructions excepting the small Byzantine chapel built within the central aisle of the church at some later date. Several water features around the church should be noted: a 2.5m wide sunked cavity in the atrium could suggest a phiale or a cistern, while two large masonry built cisterns flank or cut into the north and south poricoes of the church that run parallel to the aisles. The cisterns pre-existed the construction of the church, and were clearly filled with channeled roof-runoff from the church rather than any external source.1470 They compare well with installations at Ölüdeniz and Kidyna. Their volume is considerable (c. 9 x 9 x 3m and c. 8 x 14 x 3m), totaling more than 500,000 liters. The atrium ‘phiale’ is interesting in this respect: all that survives today is a distinctive round, rocky sink in the earth at the atrium’s center. If the structure in question was an atrium phiale/fountain, it was presumably dependent on carefully economized rainwater supplies from the church. Such a rainfed fountain or basin structure compares well with the episcopal complex at Olympos, or the Synagogue at Limyra.

At the Letoon, the probably fifth-century basilica and triconch occupies the same level as the Roman nymphaion, which is located just west of the church’s atrium. Because of drainage problems that continually threaten to submerge the site of the Letoon (which continue today), the nymphaion was necessarily still maintained at the time of the church’s functionality. Its study is complicated by the drainage issue, but the nymphaion is usually described as a Hellenistic fountain with Roman renovation/replacement, perhaps in the Hadrianic period.1471 Set in a semicircular portico with 15 columns, a Christian re-use of the fountain is implied by the irradiation of its inscriptions and decoration.1472 Christian graffiti were also observed on the southwest pillar of the Roman temple of Leto, on the platform just northeast above the fountain.

1469 Sodini et alii 1996.
1470 Sodini et alii 1996, 227
1471 Laroche and des Courtils 1999, 398.
1472 Des Courtils et alii 2007, 325.
The richly-documented water supply of Sardis is currently the subject of a PhD dissertation at the University of California Santa Barbara by my colleague Brianna Bricker, under the direction of Fikret Yegül. Consequently my remarks will be short and schematic:

Sardis is important because its early excavators were concerned with Lydian material, and therefore decided to cut well below the Roman street surfaces, under which a wealth of Roman and Late Roman pipes were found. This quality separates Sardis from its neighboring regional capital, Aphrodisias, where Erim’s early excavations only went down to the Roman surfaces, because he was primarily interested in Roman sculpture: not surprisingly, we know much less about its inner-urban water systems.

The developmental trajectory of Sardis includes several phenomena important for our purposes, which are well-dated and studied by the ongoing Harvard-Cornell expedition there. Namely, the diversification of the Bath-gymnasium during Late Antiquity: the long-vaulted frigidarium was maintained with newly installed hip-tubs; other areas were converted to industrial use (a potter’s workshop installed at the southwest, with more kilns installed in the Middle Byzantine period, as at Bath CG). Late Antique graffiti-inscriptions attest to the presence of the city’s boule and gerousia who met in the bath’s Marble Court. A flourishing synagogue was installed in the bath’s palestra after the later fourth century (with its courtyard fountain, originally aqueduct-fed but later converted for a supply from collected rainwater; this is an important predecessor later bath-church conversions in palaestrae, like the fifth-century church in the palestra of the east baths at Ephesus). Also crucial in the larger scheme of Late Antique water history are the intentional, top-down creation of industrial and commercial space in the Byzantine shops with sophisticated water supply/drainage features along the Marble Street by the Bath’s south side.

Notable at Sardis, too, are an important list of public fountains in the city, and an inscription of the fourth or fifth century naming a local decedent μανγαναρείου ὑδραλέτα, “water mill engineer.”

Important questions from Sardis include the absolutely crucial issue of the development and maintenance / abandonment of its drainage system (the Lower City is buried under at least 10 meters of alluvium); its wide-ranging domestic

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1473 On late antique Sardis, the classic is Foss 1976, but see the recent update and reassessment in Rautman 2011, 1-27.
1474 On these changes at the Bath-Gymnasium, see the classic Yegül 1986.
1475 See Yegül 1986, 51 and SEG 36.1100 for the gerousia inscription.
water features; and the still puzzling question of whether or not a larger cistern was at some point installed under the Temple of Artemis.  

*Macedonia, Stobi*

Stobi was Late Roman metropolitan capital of province Macedonia II Salutaris, an important settlement since the Hellenistic period that was incorporated into the Roman Empire after the Battle of Pydna in 168 BCE, before its elevation to a municipium under Vespasian. Stobi became capital of Macedonia Secunda after the province Macedonia was partitioned, perhaps in 386 CE. The Emperor Theodosius stayed here in 388, before it was sacked by Theodoric in 479, rebuilt, and then struck by an earthquake in 518. Avaro-Slavic invasions resulted in the abandonment of the city in the later sixth century. The city itself is set on a sedimentary ridge above the rivers Vardar / Achios and Crna / Erigon. Wind-blown loess deposits from the Vardar, 20-40cm deep, quickly filled up the city’s buildings before their eventual collapse.

Drainage was a continuing problem at Stobi: a low-lying 100m wide strip of land on the left bank of the Erigon (containing a Roman bath building among other structures) was abandoned with the construction of a new city wall in the early fifth century. Wiseman has connected this abandonment with repeated floods that began after 383-392 CE, based on coins found in overbank depositions, though he suggests that river aggradation may have begun as early as the second century CE.

At least one well has been documented in Stobi, at the House of the Fuller. No cisterns have been published; the city’s aqueduct functioned and was basically sufficient for the city’s needs until its abandonment in the later sixth century, forced by invasion. An aqueduct entered the city from the southwest, with its source either at Rosoman (11km southwest on the left bank of the Crna), or at a presently smaller spring at the closer village of Gradska Çesma. Water was carried under the via principalis inferior to supply a central fountain at the intersection of the via principalis inferior and the via axia.

1479 Butler’s early excavations revealed pipes entering and exiting the area of the temple, in addition to a pink hydraulic plaster that was re-uncovered in the 2014 season. Rautman (personal comm., 2010), some time earlier, indicated that he did not think the temple substructures had been used as a cistern.

1480 Wiseman 1984, 290-1.

1481 Theodosius issued two edicts from Stobi, see CTh 16.4.2 and 16.5.15.

1482 Marcellinus Comes, 100.

1483 Wiseman 1984, 302.

1484 Wiseman 2007, here at 105; note also the original excavation reports of affected structures in this area in Wiseman / Mano-Zissi 1974, here at 121-128; and of the city wall in Wiseman / Mano-Zissi 1973, here at 393.

1485 Kitzinger 1946, here at 135 for the well in the House of the Fuller, unmentioned in other reports.

1486 See Petrov 1967, with French summary 303-306.

and drainage under the main streets appear to be third century in date; new branches were added to these for fountains, latrines, and baths near the houses (e.g. the latrine in the House of Palms, small bath and fountain in the House of Peristerias, or the fountains in the so-called Theodosian palace and House of Parthenius) and churches that appear in the city at the end of the fourth century.

Churches acted as consumers like houses on this maintained ramified system of water distribution in the Late Antique city: the North Basilica was built over a Roman peristyle house, its courtyard was remodeled but maintained an apparently older three niched fountain apparatus with a small basin on its west side.\(^{1488}\) The Synagogue / Central Church was built immediately next to the Small Baths, whose entrance faced the church’s east side from across the via principalis inferior/via sacra.\(^{1489}\) It appears that the initial Avar-Slavic attacks on Stobi in the fifth and sixth centuries, as well as the recorded earthquakes, did not affect the city’s water supply. The piscina of the Episcopal basilica’s baptistery, surrounded by ‘Fountain of Life’ pavement mosaics, was filled with externally-supplied water via a lead pipe, in use until the basilica’s abandonment in the later sixth century, when the pipe was robbed out.\(^{1490}\) The Episcopal basilica’s atrium was also equipped with a basin set onto the stone paving, against the west wall, fed by a lead pipe coming from the street.\(^{1491}\)

\*\textbf{Macedonia, Thessaloniki}\n
Thessaloniki, Greece’s second largest city, was a longtime Byzantine stronghold in Macedonia, that persevered through Avar and Slav raids only to be finally taken by Murad II and the Ottomans in 1430. After the fifth century CE, Thessaloniki was capital of the prefecature of Illyricum and an important episcopal center, with bishops going back to Paul’s time: it was a papal vicarius subject to Rome, until it was incorporated into the jurisdiction of the Constantinopolitan patriarchate in 733 CE.\(^{1492}\) Thessaloniki is a coastal city built on the northeast corner of the Thermaic Gulf at the foot of the Kissos mountains, a ways east of the mouth of the Vardar, at a major waypoint on the Via Egnatia. Water was supplied to Roman and medieval Thessaloniki with groundwater, rainwater, and an external supply from an aquifer emerging from Mt Chortiates. Wells dotted the Roman and medieval city, as revealed by recent salvage excavations.\(^{1493}\) Large cisterns began to appear in Thessaloniki in public areas after the fifth century

\(^{1488}\) For the North basilica see Hattersley-Smith 1980, 84 and Aleksova 1986, here at 20-24.
\(^{1489}\) Hattersley-Smith 1980, 80 and 85-6; with Kitzinger 1946, 133.
\(^{1490}\) Wiseman 1978, here at 410-411 and Wiseman 1984, 309 with fig. 15. Note that the later fifth century basilica – the so-called Basilica on the Terrace – was the replacement of a late fourth century basilica 4m below the new terrace, which was also equipped with a pipe-fed baptistery in the same location.
\(^{1491}\) Wiseman 1978, here at 413.
\(^{1492}\) \textit{ODB} 3: 2071-3, s.v. Thessalonike.
\(^{1493}\) \textit{ADB} 55 (2000) [2009]: 743-7 and 751-2 for Byzantine wells cutting through earlier graves in the west necropolis; note also the sixth century basket capitals reused as wellcurbs, on display in the Thessaloniki Byzantine Museum.
CE; it is widely presumed that these were fed by rainwater alone, though this may not be the case (discussed below). A Roman aqueduct / qanat also carried water into the city over a massive bridge and through tunnels, from a source in the mountains 25km east of the city, to supply the city’s east and south sides; another conduit supplied the city’s W. Altogether, Thessaloniki presents a remarkable picture of the continuity of older Roman systems, alongside their re-integration and adaptation into the changing city after Antiquity.

Thessaloniki was supplied by at least two aqueducts. The west conduit is the lesser known of the two: it carried water from the modern village of Lempet at the NW, to the city’s west side – this line is related to the cisterns visible along the fortifications just west and north of the Church of the Holy Apostles, and by the Litea gate (Fig. 3.25).\textsuperscript{1494}

The Chortiates aqueduct supplied the city’s north and east sides. Its source – at Mt Chortiates by the village of that name – is a phreatic knapp where groundwater emerges in large quantities from an aquifer in the mountain, on whose site the monastery of Agia Paraskevi was built, at the latest after the twelfth century.\textsuperscript{1495} This source is still used today by Thessaloniki’s modern water supply system. At the monastery, the source was directed into a qanat, whose canalizations are lined with a non-Roman, pre-Ottoman masonry-type: this qanat was recently dated to Late Antiquity or the Byzantine period.\textsuperscript{1496} The connection of this qanat or another proximal outlet of the same aquifer source was carried – since the Roman period – over a massive, obviously multi-phase aqueduct bridge just west of the town, on the south side of the road, which is currently being studied by archaeologists from Thessaloniki (Fig. 3.26). Water carried beyond the Chortiates bridge past water mills,\textsuperscript{1497} through tunnels and pipes, and on to Thessaloniki: the Chortiates line entered the city from the northeast at the acropolis, just east of the Heptapyrgion.\textsuperscript{1498} Another branch of the same line came into the city near the Anna Palaiologina gate, and carried south down the hill on or alongside the fortifications, with cisterns distributed along the branch’s path.\textsuperscript{1499} By such means control of water distribution at its point of origin intra-muros was entangled with matters of defense.

Absolute dates for the aqueduct’s functionality are lacking from the archaeology

\textsuperscript{1494} Spieser 1984, 13 and Papageorgiou 1901, here at 36–7, for a 16.4 x 3.6 x 1.8m, triple chambered cistern at Holy Apostles.

\textsuperscript{1495} On the monastery, where “a late twelfth century octagonal chapel outside the monastery precinct survived as a church of the [secular] settlement [nearby],” see Bakirtzis 2003, here at 38.

\textsuperscript{1496} Manoledakis / Androudis 2011, 285-292.

\textsuperscript{1497} Siaxambani 1997, 338-341.

\textsuperscript{1498} Eleutheriadou / Kanonides / Makroupolou / Nalpantes 1988, here at 274-6 for traces of the Chortiates qanat as it entered into the city. Large early – middle Byzantine cisterns were also excavated nearby at 90 Olymbiados street, 10 Eptapyrgiou Street, and 3 Arsinoes and Kastoros Streets.

\textsuperscript{1499} Spieser 1984, 13 and Tafrali 1918, 118-9.
at present, but may be inferred from the related use of consuming structures like baths and cisterns, from the seventh through the twelfth and fourteenth-fifteenth centuries, despite evidentiary gaps between the ninth-11th centuries. The *Miracula of Demetrius* attests to water shortage in Thessaloniki – during the Avaro-Slavic siege of 618 and the Periboundous affair of 675-6 – due to lack of rain, and the overpopulation of the hinterland by marauding siegers, respectively, rather than any technical failure of the water system at these times. Many centuries later, the Komnenian *typika* of the Pantokrator monastery in Constantinople records, among the monastery's properties in Thessaloniki, the rights to water delivered by conduit from Chortiates and watermills in the city itself. In 1185, the threat of Normans besieging the city were cause for a repair to the large cisterns in the Acropolis, to ensure an emergency backup supply in the event of prolonged siege or attempts to cut the outside supply line from Chortiates. Bakirtzis indicates that the Vlatadon monastery – founded in the fourteenth century near the Acropolis – was equipped with three large cisterns in its courtyard, which were critical components for water distribution to the rest of the city. During the 1430 siege of the city, monks of the Vlatadon monastery became traitorous, and wrote to sultan Murad II to inform him that the city could be taken by cutting its aqueduct.

Apart from textual anecdota concerned with the Chortiates aqueduct itself, which have clustered into the later Middle and Late Byzantine periods, functionality of the city's external water supply systems throughout Late Antiquity may also be inferred from an assessment of the structures supplied by the aqueduct, namely baths and cisterns.

Two of Thessaloniki's churches incorporated pre-existing Roman bath buildings. The Acheiropoietos basilica of the fifth century was built over a small part of a larger bath complex on the east side of Thessaloniki’s south agora square. Two levels of mosaic floor belonging to the bath are exposed in the north aisle of the church; these have been dated between the second and fourth centuries. Whether or not the bath continued operation after the construction of the church is unclear; however, a ninth century homily of Leo the Philosopher, archbishop of Thessaloniki, relates the story of an ancient miracle which demonstrates the perseverance of Middle Byzantine memories of the former bath complex on this site.

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1501 τὸ δίκαιον τοῦ ἀπὸ τοῦ Χορταίτοθ καταρρέοντος ὕδατος σὺν τῷ ἄγωγῳ καὶ τοῖς ἐν θεσσαλονίκη ἐνεργοῦσι μύλωσι, see Gauthier 1974, here at 120-1, lls.1534-5.
1502 Spieser 1984, 12 n. 30-1.
1503 Bakirtzis 2003, 60.
1504 Tafrali 1918, 114-9.
1506 Laurent 1964, here at 300, n. 124.
The continued operation of the baths at the St Demetrius complex is more straightforward, with clear textual attestation for the bath’s operation after the establishment of the church, in addition to archaeological evidence for the appropriation of the former bath’s water supply\textsuperscript{1507} and position as a point of distribution in the larger scheme of the city’s water supply. The \textit{Miracula Demetrii} record that, during the plague of 586, the sick took refuge in the saint’s church and made their way every morning to the neighboring baths;\textsuperscript{1508} while Theodore the Studite writes, in a letter dated 795, that a visit to Thessaloniki’s cathedral included an invitation to use baths, presumably belonging to the episcopal palace.\textsuperscript{1509} These baths were in any case probably not identical to the Roman bath on which the church was built, but rather represent a continued maintenance and appropriation of its water supply for ecclesial purposes. As Lemerle noted, the ground around St Demetrius slopes down sharply from east to W; the baths on the site must have had two storeys, of which the crypt for St Demetrius is built directly onto the ruins of the lower storey. Preserved from the Roman bath’s phase is the five niched nymphaeum which, with new chancel plaques and architectural sculpture, functioned as the font of the church’s hagiasma, not entirely miraculous but rather supplied by piped-in water from the city’s aqueduct.\textsuperscript{1510}

Just south and west of the church of St Demetrius is the Roman agora: here, sometime in Late Antiquity, a massive cistern was installed in the double cryptoporticus and the south stoa, whose interiors were lined with waterproof mortar (Figs. 3.28-29). These were not rainwater cisterns, but rather were supplied via a pipeline introduced from the north – Bakirtzis explicitly identifies these as issuing from the area of St Demetrius.\textsuperscript{1511} On the east edge of the quadrangle was a small room, decorated with a mural of the Anargyroi saints Cosmas and Damian and equipped with a small nymphaeum, which drew its waters from the agora cisterns via another pipe. Bakirtzis identifies this installation and explains its frescoes as components of an hagiasma with healing water.\textsuperscript{1512} Another interpretation might be that the saints were simply guarantors of the water’s safety and potability. Either way, the late sixth century date Bakirtzis offers for the installation is entirely circumstantial, and relies on the passage of the Demetrius \textit{miracula} that reported water shortage around the city due to the unwelcome presence of Slavs and Avars in the city during the 586

\begin{footnotesize}
\begin{enumerate}
\item[1507] Banded brick and masonry structures at the northwest corner of the church’s exterior, with visible hypocausts, should probably be related to another late antique bath or episcopium on the site.
\item[1508] \textit{Miracula Demetrii}, I. 3, 39 trans. Lemerle, I: 73 and see also on this Hattersley-Smith 1980, here at 229-30.
\item[1509] Theodore the Studite, \textit{Epistles} I. 3 = \textit{PG} 99, col. 917D.
\item[1510] Lemerle 1978-80, II: 205-6 for Lemerle’s comments on the church’s relationship to the Roman baths, and the nymphaeum/hagiasma in the crypt.
\item[1511] Bakirtzis 1984, II: 5-19, here at 13.
\item[1512] ibid., 17.
\end{enumerate}
\end{footnotesize}
Hattersley-Smith is more circumspect but still agrees on the proffered date, suggesting that the agora cisterns “were built in response to external pressures and changing demographics of late sixth and early seventh century.” Lacking firmer evidence, however, we might better point to the widespread installation of cisterns in public areas, across the Eastern Mediterranean, anytime after the later fourth or fifth century, when Late Romans became increasingly concerned with water storage rather than drainage. Such an earlier date could situate the agora cisterns in the context of the construction of the Demetrius church and its reconfiguration of the agora and bath quarter’s water supply, rather than depending on a direct relationship to the 586 siege.

A massive cistern installed in the vestibule of the Octagon, in the Palace of Galerius, has been dated to the seventh century on better (namely, ceramic) evidence; it was in use until the twelfth century. While this cistern has been described as rainwater fed, though simple calculations that consider the annual average rainfall of the modern city (450mm) in tandem with the cistern’s enormous capacity—roughly 2 million liters—leads to an unavoidable but problematic conclusion. If the cistern were to be filled from one year’s rainfall, this would require a rainfall catchment area of roughly 4.4 million square meters (larger than the intra-muros area of the city itself) or, if the palace complex’s insulae alone were its catchment (16,000 m²), 277 years worth of collected rainfall. It is far easier to conclude that the cistern was in fact filled by an external supply delivered by pipe: due to its low-lying position, the cistern at the palace complex could have been filled by the surplus of either the west or the north conduits.

One other aspect of the Demetrius church’s relationship to water infrastructure for industrial purposes should be mentioned. Namely, an edict of the emperor Justin II gave the church of St. Demetrius an unprecedented privilege in the year 688: responsibility for the operation of a salt-pan or magazine [ἀλική] in Thessaloniki, in addition to an exemption from any obligation to the supply of the military. This gift was declared as satisfaction for the emperor’s wish to guarantee the martyr’s church security in the years to come. Vasiliev followed Papageorgiou to identify a probable location for the salt-pan, at Kitros: this area was already the location for considerable episcopally-directed industrial activity in the sixth century, as attested by the 1980s excavation of a fortified episcopal complex here, with installations for wine/oil processing, collection tanks, presses, mills, and storage areas with pithoi in situ, that may have “served the needs of local farmers who did not have the necessary processing equipment

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1513 Idem.
1515 For the cistern at the Octagon, see F. Athanassiou, V. Malama, M. Miza, and M. Sarantidou in ΑΕΜΘ 18 (2004) [2006], 238-268 and see http://www.chronique.efa.gr/index.php/fiches/impression/385/.
1516 Dolger 2009, 129 #258 and see Vasiliev 1943 with Gregoire 1944-1945.
Water was also a common theme in the dedicatory inscriptions and art of Thessaloniki’s churches. The famous fifth century mosaics at Latomos / Hosios David, near the Acropolis and the entrance of the Chortiates aqueduct into the city, depict Christ enthroned above the waters – two of its three dedicatory inscriptions refer to the living water of Christ that nourishes faithful souls, a play on the words of the prophet Ezekiel 47:1 and the language of Roman law alike, which categorized waters as living or still.\footnote{\textit{Gerousi} 2013, here at 35 n. 16-18 with fig. 23.}

\*MESOPOTAMIA, AMIDA / DIYARBAKIR

Amida was metropolis of province Mesopotamia. Situated on a bluff above the Tigris, at the limit of its navigability, Amida was on the border of the Byzantine-Persian wars in the fourth-sixth century: it was sacked by Shapur II in 359 CE,\footnote{\textit{Amm. Marc.} 19.1-8.} rebuilt between 367-375 CE,\footnote{\textit{CIL} III.6730.} and restored again by Justinian, according to the \textit{Buildings}.\footnote{\textit{Buildings} 2.3.27.} Little is known of its water system in antiquity, though a medieval aqueduct (photographed by G. Bell) approaches the citadel from the north and may be the replacement of an earlier Roman/Byzantine system. The location of its episcopal complex is unknown.

\*MOESIA, MARCIANOPOLIS / DEVNYA

Marcianopolis was metropolis of Moesia Inferior. An early Christian basilica and aqueduct are known here, if poorly studied and published only in Bulgarian.\footnote{See briefly on Marcianopolis, with references to the Bulgarian literature, \textit{Ivanov / von Bülow} 2008, passim.}

\*MOESIA, SIRMIO / SREMSKA MITROVICA

On the left bank of the Sava river, Sirmium is primarily known as the residence of numerous emperors after the third century, and as the excavated site of the palace of Maximian. A second century CE aqueduct here carried water for 14km from the northeast at Fruška Gora to the city, originally a Flavian colony, along the Roman road to the castellum of Malata-Bononia.\footnote{See \textit{Wilkes} 2005, here at 164 with n. 43 on 185.} There is no evidence for water distribution inside the city, apart from the palace and its small bath (for its plan cf. Byllis or Corinth), which was covered in the late fifth or sixth century with domestic installations, before a near total disruption and dispersal of settlement here in the seventh century.\footnote{\textit{Ochsenschlager and Popovíc} 1973, here at 87.} There are no known churches in Sirmium, despite its status as an archbishop’s metropolis in the sixth century.

\begin{footnotes}
\footnote{1517} Gerousi 2013, here at 35 n. 16-18 with fig. 23.
\footnote{1518} Text from Feissel 1983, here at 97-9 no. 103: 1 + Πηγὴ ζ(ω)τική, δεκτική, θρεπτική ψυχῶν πιστῶν 6 πανέντιμος οίκος ουτος. Εὐξαμένη επέτυχα καὶ ἐπίτυχος επλήρωσα. + 2 + Ὑπὲρ εὐχῆς ἓς οἶδεν ὁ Θεός τὸ ὄνομα.
\footnote{1519} Amm. Marc. 19.1-8.
\footnote{1520} \textit{CIL} III.6730.
\footnote{1521} \textit{Buildings} 2.3.27.
\footnote{1522} See briefly on Marcianopolis, with references to the Bulgarian literature, \textit{Ivanov / von Bülow} 2008, passim.
\footnote{1523} See \textit{Wilkes} 2005, here at 164 with n. 43 on 185.
\footnote{1524} \textit{Ochsenschlager and Popovíc} 1973, here at 87.
\end{footnotes}
**MOESIA, VIMINACIUM**

Viminacium was metropolitan capital of Dacia Ripensis before its abandonment by Aurelian in 271, though it later became metropolitan capital of Moesia Superior under Diocletian. The city was sacked by Attila in 441, before rebuilding under Justinian. The site is now protected, but the environment immediately to its east and south has been devastated by large-scale strip mining. Recent work has uncovered a late Roman bath and sections of an aqueduct, but these remain difficult to contextualize, with reports published primarily in Serbian. No churches are known in the city.

**OSRHOENE, EDESSA / ŞANLIURFA**

Edessa was the capital of Osrhoene province on the east bank of the Euphrates, home of important cults for Atargatis, Nabu, and Bel, until its conversion to Christianity under King Abgar IX (179-214 CE). Edessa was annexed as a Roman colony in 216 CE, before its proximity to the Sasanian / Arab border with Byzantium led to its frequent exchange between these empires, culminating in its final conquest by the Arabs in 638/9. The story of water in Late Antique Edessa, so far as it is known, is primarily the story of its recurring problems with drainage, from the torrential rains carried into the seasonal River Daysan / Skirtos – efforts to control major floods in 201, 303, 413, and 525 were studied by Palmer. The river was drained by a man-made channel north of the city (presumably Diocletianic, as it was not built by Abgar VIII after 201 but was seen by Egeria in 384 CE), which was cleared and built up by Justinian, who also extended the citadel’s walls to the south to include springs emerging from the the face of the cliff, and built a large domed basilica. Little else is known owing to the lack of urban archaeology there. However, so far as water is concerned, mention should be made of the pool of sacred fish (Balıklıgöl), where Abraham was thrown into the fire by Nimrod, and God turned the coals into fish. This pool is today in the courtyard attached to the Ayyubid mosque of Hallil-ur-Rahman; whether it had a Christian predecessor is unclear, but as such it may compare with the Zoodochos Pege in Constantinople or the fish pools of Phrygian Germia.

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1525 See Popovic 1987/8.
1526 On Edessa generally see Bowersock / Brown / Grabar 1999, 421, s.v. Edessa.
1528 Buildings 2.7.1-14.
1529 For Edessa see principally Segal 1970 and Millar 1993, 553-562 ("Materials for the History of Roman Edessa and Osrhoene").
**PALESTINA PRIMA, AKKO/PTOLEMAIS**

Frankel dubiously asserts the primacy of this aqueduct as “the earliest dated aqueduct in Israel,” saying that it is “typically Hellenistic/Greek” because it uses rock-cut tunnels with terra cotta pipes following contours rather than high level bridges.\(^{1530}\)

**PALESTINA PRIMA, CAESAREA MARITIMA**

The three aqueducts of Caesarea Maritima – the metropolis of Palestina Prima excavated by the Italians and Israelis since the 1950s – were thoroughly investigated by Diane Everman in her 1997 PhD dissertation. To her conclusions we can add the results of more recent excavations and a few additional observations. The larger picture is as follows: Hellenistic Caesarea was presumably supplied by bottle-shaped cisterns and wells (though none have been found). Early Roman buildings in the city’s southwest were originally outfitted by wells and cisterns, though these were filled in the later first century CE, about the time that the city was outfitted with the first of three aqueducts Channel A.\(^{1531}\) The system was expanded with with new aqueducts added in the second (Channel B) and fourth centuries (Channel C). The system encountered difficulties during Late Antiquity: after a repair by proconsular governor Flavius Florentius in 385 to two aqueducts,\(^{1532}\) repairs are indicated again c. 534/6 by the governor Stephanus, in an oration for the governor by Choricius. Choricius specifically cites blockages in the channels that prevented water from reaching the city’s fountains, leading to violence and unrest.\(^{1533}\) Additionally, there is a well-studied inter-urban diversion to the suburban agro-industrial settlement at Tel Tanninim (fl. 4th-8th cent.), from Channel A to Channel E, which supplied a water-wheel and fish ponds.\(^{1534}\) The latest consumer inside the city walls is the Byzantine Bath in Field E, which was maintained between the fifth and seventh centuries: it is one of three baths in the Near East which was discovered with a complement of Late Antique sculpture, in addition to pierced marble screens.\(^{1535}\) During the sixth century, the bath north of decumanus S3 was “disconnected from the municipal water system, and the water required for bathing was supplied from a well with a mechanical lifting device.\(^{1536}\) Additional Late Antique baths include one certain example (in area K/119),\(^{1537}\) one probable example,\(^{1538}\) and a converted example (the bath-praetorium, converted during the fourth century). Nearly all of the drains, wells and cisterns known in the city – for example from Areas B, D-E/8 and E/2 north of the harbor, in Area I, and on the Temple Platform – are fourth or fifth century in date, with continued use into the

\(^{1530}\) Frankel 2002.
\(^{1531}\) Porath 2002, 124
\(^{1532}\) identified as A and B by Everman, 170; CII 1259 and Hamburger 1959.
\(^{1533}\) Mayerson 1986.
\(^{1534}\) Stieglitz et alii 2012.
\(^{1535}\) Gersht 2007.
\(^{1536}\) Porath 2002, 125.
\(^{1537}\) CII 1348.
\(^{1538}\) In area Z/2 near Temple platform, see CII 1419-20 for χάρις and πθόνος inscriptions.
Abbasid period. Particularly notable are the two cisterns built into the Temple Platform substructures west and east of the octagonal martyrion, with which they are contemporary, all dating to the later fifth century – these collected rainwater from the roof of the church and side rooms “through well constructed downspouts attached to the interiors of the side room walls,” and were also maintained after the collapse of the octagon in the 749 earthquake, when a residential district was constructed on the platform. Porath points to Muqaddasi to conclude that later, “almost every home of the medieval town, both Early Muslim and Crusader, owned a well dug to the water table.”

The city’s supply can be quickly summarized as follows:
Channel A: Caesarea’s first aqueduct was built sometime between the reigns of Herod and Hadrian. This open-channel line carried water on a west-to-south path from springs around Shuni near Mt. Carmel and entered the city on the beach-side arcades to its N. Along this path, the channel was carried on ashlar-foundation substructiones and through a 420m tunnel, before transitioning to arcades for the city approach. The arcades (depth 1.65m, spans 3-4m wide and ~2.5m high) are built of kurkar blocks with stone-faced mortared-rubble for the upper specus channel portions. Everman notes eight subtle variations in construction – from putlog holes, imposts, and projecting pier stone dimensions – which she connects to the presence of multiple groups of workmen laboring simultaneously. The channel of the specus was relined two-four times, and covered with gabled-capstones for protection. Buttresses abut the piers of the aqueduct in numerous places along the arcade and represent later efforts to stabilize the channel, possibly after the addition of the High Level Channel C. The height relationship of Channel A (7.45m) to the Herodian/Roman city wall (10m) means that the conduit either pierced the city wall, or the wall was rebuilt around the conduit – the Italian excavators suggested that the introduction of the conduit rendered the east round tower dysfunctional, while Everman prefers to think that they functioned simultaneously. Channel A’s original destination is unclear – no first century baths or fountains are known at Caesarea, though Everman prefers a Herodian rather than Vespasianic date.

Channel B: A group of inscriptions indicates that Caesarea’s second aqueduct was built by the Tenth Legion Fretensis during the reign of Hadrian, between 130 and c. 135, after the Bar Kokhba revolt. Very much like Channel A, Channel

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1539 Note the stratigraphic tables in Lenzen 1983, 22-30 and Everman 170 with references.
1540 Holum 2004, 193-5.
1541 Porath 2002, 174 = LeStrange 1890, 474.
1543 Everman 1997, 70-1.
1544 Ibid., 74-8.
1545 Everman 1997, 78-9 and 166-7.
1546 Ibid., 83.
1547 Ibid., 86-90.
1548 CII 1200-1209.
B also took its waters from the area around Mt. Carmel, its channel following a path immediately alongside Channel A, including a newly-built arcade that abuts the Channel A arcuationes as they enter the city from the N. The initial collection point is uncertain, but was identified by Everman with a reservoir at 'En Sabarim / Ein al-Balad, used and repaired in modern times but equipped with antique intake and outtake channels cut into the rock.\textsuperscript{1549} The outtake channel could only be partially followed towards Caesarea, with primary indicators from horizontal putei/access shafts along its course south and then west from the source. One shaft – so-called puteus 4\textsuperscript{1550} – had a trapezoidal section and led down twenty-four steep rock-cut steps to Channel B’s primary tunnel. Sections of the channel in substructione and arcuatio appear very similar to Channel A’s construction, with some greater irregularities in imposts, specus, and arch details. The specus was relined at least twice: the last re-lining is dated by Porath’s chronology to the third or fourth century AD, and its nearly pristine condition was interpreted as a sign of short use-life, before it was filled with rubble and used as a substruction for Channel C.\textsuperscript{1551} Near the marsh between Mt Carmel and the kurkar ridge, the specus was filled with a triple-pipeline.\textsuperscript{1552} It should be noted that the placement of inscriptions indicating Hadrianic-period construction by the military – in uncentered and odd positions of the pier’s facing – probably indicate that they were re-placed there in the course of a late repair to Channel A.

Channel C was a narrow construction built on top of Channel B, which raised its height by 1.22m. Porath’s plaster chronology has tentatively dated its construction to the fourth-fifth century.\textsuperscript{1553} Its small dimensions (41 cm wide) were further reduced by sinter build-up (25 cm wide), which could indicate a 75% reduction of capacity from 10,000 m\textsuperscript{3} /d to only 2,500 m\textsuperscript{3} / d.\textsuperscript{1554} Channel C’s source was at ‘En Sur / Ein Umm el-'Alaq, 1.75 km northeast of the Shuni source for Channel A and B. Its course from the reservoir is poorly known, though it is probably associated with a set of triple-pipe conduits and vertical surge tanks near Bet Hananya.\textsuperscript{1555}

Low Level Channel: Also in Late Antiquity, the Nahal Tanninim river was dammed up at two points, which served to impound both the river and springs in the Kabara swamp, raising their level in the new reservoir (1.2 ha) to an elevation from which it could be carried into Caesarea by the rock-cut (1.5 km) and kurkar-block vaulted construction of the Low Level Channel. Stieglitz et al. suggest that this water was not potable for human consumption.\textsuperscript{1556}

\textsuperscript{1549} Everman 1997, 117-120.
\textsuperscript{1550} Olami and Peleg 1977, 129.
\textsuperscript{1551} Everman 1997, 130 and 160-1.
\textsuperscript{1552} Olami and Peleg 1977, 132.
\textsuperscript{1553} Porath 2002, n. 78.
\textsuperscript{1554} Everman 1997, 161.
\textsuperscript{1555} Evermann 1997, 164-5.
\textsuperscript{1556} Stieglitz et alii 2006, 60-1.
The diversion to Nahal Tanninim (Channel E): Contrary to Everman’s earlier assertion,¹⁵⁵⁷ Porath¹⁵⁵⁸ and Stieglitz¹⁵⁵⁹ have demonstrated that the Nahil Tanninim agro-industrial settlement with fishponds, reservoir, a water-wheel, and possibly a bath, was fed by a diversion from Channel A. This complex is most closely dated by Constantinian coins (indicating TPQ) and sixth-century ceramics found in the reservoir and in its latest plaster-coating, respectively. The reservoir’s fill was tentatively dated by Porath to the eighth century, though he acknowledged the difficulty of a lack of repairs for the two centuries previous.¹⁵⁶⁰ Finds from within Channel E itself indicate disfunctionality before the 9th or 10th century, but certainly into the Late Byzantine and Early Islamic period.¹⁵⁶¹

**Palestina Prima, Jerusalem**

Jerusalem was capital of Solomon’s Israelite kingdom and later the Herodian tetrarchy. The Herodian kingdom dissolved and the Temple was destroyed in 70 CE. Jerusalem was named a colony by Hadrian following the Bar Kochba revolt: Jews were excluded from the city, which reorganized around the city’s west spur, where the temple of Capitoline Jupiter was constructed, with the Temple Mount in ruins to the E. In the Christianized geography of the empire after the fourth century, Jerusalem sat at the head of an episcopal see as one of the pentarch cities (along with Alexandria, Antioch, Constantinople, and Rome) that led the Church. As such, Jerusalem acquired honorary metropolitan status in the province, though the administrative capital of Palestina Prima was still located in Caesarea Maritima. In the city itself, Jerusalem’s western focus was maintained after the construction of the Holy Sepulcher by Constantine and Helena, on the site of the Capitoline Jupiter temple; the focus shifted back east to the Temple Mount only after the Umayyad construction of al-Aqsa and the Dome of the Rock.¹⁵⁶² These shifts have important consequences for the hierarchical distribution of water within the city.

Jerusalem is a notoriously parched and water-scarce city: besides wells and cisterns ranging from small and domestic to monumentally huge and institutionalized, the city was supplied by “the longest and most complicated aqueduct system in Israel,” which has fascinated seminal scholars like Edward Robinson, Charles Wilson, Conrad Schick, and Amihai Mazar for more than a century.¹⁵⁶³ The latter, along with Ya’akov Billig and David Amit, has the last word on the topic, after new fieldwork and a series of important articles published in *The Aqueducts of Israel* (2002).

¹⁵⁵⁷ Everman 1997, 183.
¹⁵⁵⁹ Stieglitz et alii 2006, 60-1.
¹⁵⁶¹ Stieglitz 2006, 62-67
¹⁵⁶² On late antique Jerusalem see most recently the work of Avni 2011.
¹⁵⁶³ Quote from Mazar 2002, here at 211.
Briefly summarized, their most-recent assessment of Jerusalem’s fully-developed external water system is this: two lines carried spring-water from stone-built catchments in the ‘Arrub valley\(^\text{1564}\) (39km) and Wadi el Biyar\(^\text{1565}\) (4km), through tunnels and cliff-side channels, to Solomon’s pools. These pools were at the heart of the Jerusalem system – besides the conduits importing spring water from elsewhere, water was also collected into Solomon’s pools from the springs quite close by in the Wadi El Hoch, and from rainwater collection on the el Khader plateau.\(^\text{1566}\) The total capacity of the three pools is estimated between 180,000,000 and 280,000,000 liters.\(^\text{1567}\) From Solomon’s pools, water was directed to Jerusalem via Low-level (21.5km) and High-level (13km) aqueducts. The Low-level aqueduct “was in use for a long time, including most of the Ottoman period,” when the channel was almost entirely reconstructed, and laid with sections of clay and iron pipes.\(^\text{1568}\) After passing by Bethlehem, the Low-level aqueduct entered Jerusalem by crossing the Hinnom valley on an arched bridge last described in 1926,\(^\text{1569}\) then coursing around the southwest and south slopes of Mt Zion, past the site of Justinian’s Nea Ekklesia, and finally terminating at the Temple Mount, after crossing the Tyropean valley via the bridge to which Robinson’s arch belongs.\(^\text{1570}\)

Without entering into the thornier problem of the Low-level aqueduct’s original build date sometime during the Second Temple period (from the Hasmoneans to Herod\(^\text{1571}\) or Pilate),\(^\text{1572}\) Billig refers to evidence from the Midrash that the Low-level aqueduct was sabotaged and ceased to function during the Bar Kokhba Revolt (132-136 CE), and consequently that Hadrian neglected to repair it. Rather, the High-level line was privileged because it supplied the upper west city, which became the center for new development under Hadrian, apart from the old Temple Mount in the east. The Low-level line was repaired in the Early Byzantine period, when an inscription forbidding encroachment or planting was placed along the Low-level line – variously dated between Anastasius and Maurice – was placed near the Low-level line in Bethlehem, an indication of its continuing relevance at that time.\(^\text{1573}\) Repairs and a new diversion from the Low-

\(^{1566}\) Mazar 2002, 212.  
\(^{1568}\) Mazar 2002, 217-219, with quote from 217.  
\(^{1569}\) Hanauer 1926, 364.  
\(^{1571}\) Herod famously spent the treasury of the Temple, the Corban, on the construction of an aqueduct: see Eusebius, \textit{HE} 2.6.  
\(^{1572}\) Mazar 2002, 238.  
\(^{1573}\) The date of this inscription has (with some problems of titulature) traditionally accorded a Justinianic date, though C.P. Jones advocates for a date during the reign of Anastasius (491-518), and L. Stirling promotes a date during the reign of Maurice (587-602). This is a repetition of an order forbidding seeding or planting within 10 ft of an aqueduct (\textit{CTh}. 15.2 = \textit{C/C} 11.43.6.1; see Appendix 1.98).
level aqueduct enabled it to supply the cisterns at the Nea Ekklesia,\textsuperscript{1574} before it was later re-diverted back to the Umayyad Temple Mount and the palaces below it, at south and west. The Temple Mount was covered in cisterns and depressions, some for rain-water collection, but with others directly connected to the Low-level aqueduct – the largest, the so-called “Great Sea,” held over 9 million liters of water.\textsuperscript{1575} Sediment and ceramics in a settling tank at the entrance to the Armon Hanatziv tunnel, where the Low-level line crosses over from the arched bridge (to which Wilson’s arch belongs, last noted by Arculf in the 670s) to the Temple Mount platform, seem to indicate that this line was last cleaned out or maintained in the ninth century.\textsuperscript{1576} The line was repaired again in the Mamluk period, when sebils were erected by Mamluk dynasts on the west side of the Temple platform.

The High Level aqueduct takes a shorter path, also via Bethlehem, but utilizes an inverted siphon made of linked stone blocks to cross a 2-3km wide valley near Rachel’s Tomb. Some of these blocks carry the inscriptions of a Hadrianic corps of army builders from the Tenth Legion Fretensis; the inverted siphon pipeline was a replacement and technical upgrade of an earlier Herodian arched bridge on the same path.\textsuperscript{1577} Approaching Jerusalem from Bethlehem, the High-level aqueduct follows the terrain’s contour to the foot of Khirbet Saleh / Ramat Rahel, where Aharoni found a bath-house of the Tenth Legion, and thence presumably to the upper city around the Jaffa gate, from which point it supplied Hezekiah pool’s and the area of Herod’s palace that was later occupied by Hadrian’s legionary camp, as well as the Temple of Capitoline Jupiter / Holy Sepulcher, but not the Mamilla pool.\textsuperscript{1578} This line was also maintained in the Byzantine period: Maeir’s excavations at Mamilla revealed an originally Herodian aqueduct carrying from west to east toward the Jaffa Gate, over and next to which was its Byzantine replacement, dating to the fourth or fifth century.\textsuperscript{1579} The Holy Sepulcher, if it ever had a supply line from an aqueduct, must have been supplied by the High Level aqueduct which entered the fortified city at the Jaffa Gate, in association with the Pool of Hezekiah. Under the church of the Holy Sepulcher is a sizeable rock-cut cistern (surface area = \( \sim 30 \times 10 \text{m} \)), accessed by stairs from the present Coptic chapel, which is little-studied but traditionally accorded a fourth-century date in association with Helena and the construction of the church. Today, the cistern appears to be rainfed by seepage, though its location meant that it could easily have been fed, originally, from the Upper Level aqueduct by way of Hezekiah’s Pool.

\textsuperscript{1574} For the Justinianic inscription, see SEG 27.1015 and IEJ 27 (1977): 145-151.
\textsuperscript{1575} Gibson / Jacobson 1996, the connection is confirmed with cisterns #6 and #36 according to Wilson’s older enumeration.
\textsuperscript{1576} Billig 2002, here at 249-252.
\textsuperscript{1577} See Appendix 1.53-4.
\textsuperscript{1578} Mazar 2002, 228-230.
\textsuperscript{1579} Amit 2002, here at 256.
Religious institutions were integrated into the city’s water systems from an early date: besides the Temple Mount and the Church of the Holy Sepulcher, the famous Theodotus inscription from 70 CE, found at Mt Ophel, records the establishment of a synagogue with guest rooms and water installations \(\tau\omega\nu\ \upomicr\upsilon\sigma\tau\omicr\upsilon\nu\) for visitors, probably either a bath or a mikva.²⁵⁸⁰ Synagogues were important predecessors for monastic institutions with baths, in Jerusalem and abroad, like the unnamed bath and guesthouse that was added to a monastery on Mt Scopus in the late seventh or eighth century.²⁵⁸¹

Jerusalem had a wealth of smaller pools and birkets with very long occupational histories. John 5:1-9 contains the account of Christ’s encounter with an infirm man at the pool of Probatka, which John describes as having five porticoes. The pool and its porticoes may date back to the First Temple period, when it was used for cleaning sacrificial animals. Actually a double pool, one side was filled with rainwater by an originally Bronze-Iron Age dam, the other with thermal waters originating underground in a cave. John’s account of Probatka’s reputation for healing was reinforced by excavations directed by the French school, which revealed the Hellenistic porticoed pools, and Roman - Late Antique ex votos. John Rufus describes a church here, built between the two pools, around 450 CE; the pilgrim Theodosius mentions a church of Mary here around 530, aligning Mary with her description in the Song of Solomon 4:15 as \(\textit{puteus aquarum viventium}\). The church and healing powers of Probatka continue to be mentioned into the seventh century and later, by Sophronius in the early seventh century, Willibald (725), John of Damascus (730-750), and around 800. Baert describes how later medieval authors sacrificed Marian connotations at the site in favor of its evangelical importance as the place of one of Christ’s miracles.²⁵⁸²

Besides evidence for continuity of Jerusalem’s aqueducts to the seventh century and beyond, we should also emphasize how Jerusalem was a city where the Roman drive for top-down infrastructural solutions to water shortage collided with the bottom-up approach of the saintly and miraculous. Procopius of Gaza, in his panegyric for the emperor Anastasius, tells us that the emperor was so aggrieved to hear that his citizens in Hierapolis (identified by C.P. Jones with Jerusalem) were drinking dirty water from cisterns and wells that he built (or really, repaired) the city’s Low-level aqueduct.²⁵⁸³ Other solutions to the frequent water shortage in Jerusalem in the sixth and seventh centuries were divinely inspired: not many years after Anastasius’s efforts, the city was again afflicted by water shortage. The archbishop “fearing a revolt of the people, went round the more humid spots, using a large work-force to dig ditches in the hope of finding

²⁵⁸⁰ \textit{CIJ} 2.1404 and see Hachlili 2013, 523-5.
²⁵⁸¹ \textit{SEG} 53.1854 = \textit{\'Eπι \'Οξεωδόρου | πρεαβιτζερου κ(αι) ήγουμένουρ κ(αι) Κυριακ(ο)υ μο|γοχου έγε|νετ(ο) τ(ο) τη δεν | ἐργόν.}
²⁵⁸² For the Bethesda pool, see Baert 2005, 1-22.
²⁵⁸³ See Jones 2007.
water, but did not find any. Descending into the gorge of Siloam … He employed an engineer and a mass of workmen to dig down two hundred feet; on not finding water he was distressed." The archbishop was compelled by an advisor to seek the help of Sabas, who promised to return to his cell and pray: sure enough, the rain came, and “the cisterns of the holy city were filled to the brim.” In the early-seventh century, another drought in the city was averted with the efforts of Theodore of Sykeon, who led a procession and prayers that brought a rain cloud, so that “the rains spread over the country like a river, and all the pits and cisterns were filled.”

**Palestina Secunda, Abila**

Urban aqueducts. Two aqueducts supplied ancient Abila, designated as the upper and the lower. Both aqueducts show signs of repair in Late Antiquity, while the upper aqueduct was upgraded with the addition of a second spring input (from ‘Ain Khureibah, at 4.5km distance). Both aqueducts enter the city from the south, crossing the Wadi Quailibah via a Roman bridge, turning west down the east cardo next to the church basilica in Area E, before descending into the area of the civic center with its theater, bath/nymphaeum complex, and five aisled church basilica (Areas B and C). Wineland describes a two phase street system here, with a limestone street cut and covered by later basalt paving: water channels in this area were lined with heavy sinter accretions which suggests a long duration of use for water flowing in this area, presumably sourced from the Lower Aqueduct system.

The Lower Aqueduct dates from the Iron Age or the Hellenistic period. It carried water some 1400m from a major spring, ‘Ain Quailibah, which produced 7.7 liters/second. The Lower Aqueduct line, as it coursed towards the city, cut through several pre-Roman tomb complexes. Roman repairs are indicated by modifications that nearly doubled the depth of the channel running through the tunnel, as well as the addition of a gray mortar lining. Late Roman repairs are indicated by a peaked stone-slab roof in one section (whose mortar lining contained late Roman/early Byzantine ceramics), and a tunnel bypass that circumvented a collapsed section of tunnel, though no inscriptions or monograms from the early Byzantine period were found here, as in the Upper Aqueduct.

The Upper Aqueduct, so-called because it runs only 1-3m higher than the Lower in some sections, was a later Roman or Byzantine addition to the city’s water supply presumably necessitated by mechanical or natural causes. In any case, it

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1586 Wineland 2001: 35
1587 Mare 1997b, 728.
1588 Mare 1997b, 729-31.
added to the total flowthrough of the city’s supply. Fed primarily by the ‘Ain Quailibah spring, a second source at ‘Ain Khureibah was added into the system with a sinuous 2.5km long tunnel that emptied directly into the Upper Aqueduct line near its original source. It has been speculated that this system may connect with the much longer system, over 100km long, known at Wadi Shallalah and Gadara.\textsuperscript{1589} In the tunnel of the Upper Aqueduct line, just south of the city, a painted inscription was found indicating that this tunnel was cleaned on the orders of a bishop in the year 568 CE; 14 crosses and three chi-rho monograms were also found along the length of the conduit’s interior.\textsuperscript{1590}

In addition to the city’s aqueduct system, whose Upper Line was cleaned out on orders of the bishop in the year 568, a series of large cisterns were associated with the city’s church complexes. The Area D basilica, dated to the early 7\textsuperscript{th} century, had two cisterns in its interior that were well-positioned to draw water off the aqueducts as they entered Abila.\textsuperscript{1591} The Area A basilica, near the tell, was equipped with a surface water channel that drained rainwater from the buildings on the acropolis, depositing it in a cistern next to the church. Rainfall in the city averages between 350-450mm per year.\textsuperscript{1592}

Fuller and Shoup recount a modern story in which a copper clad book and a zir, or large jar containing holy water, was hidden in the Abila aqueduct system.\textsuperscript{1593}

**PALESTINA SECUNDA, BANIAS**

Urban aqueduct, consisting of 3km of rock-cut channels occasionally reinforced by conglomerate, and covered with slabs. This aqueduct served the community around Pan’s sanctuary site with a sophisticated distribution system that supplied branches feeding into 17 pools. Berlin argues that Banias – like the surrounding eastern Upper and Lower Galilee but unlike the flourishing settlements in nearby western Galilee – was gradually abandoned during the early to mid-fifth century CE: the aqueduct became filled with shards of locally produced ceramic, and several villas just outside the city proper were abandoned.\textsuperscript{1594} The system had been repaired after 211 CE, however: a coin was found embedded in the plaster of a tank at the channel’s end. Additional repairs included walls raised, the disconnection or addition of distribution basins, and the installation of pipes to circumvent blocked sections of channel.\textsuperscript{1595}

\textsuperscript{1589} Mare 1997b, 732.
\textsuperscript{1590} Van Elderen 1989 and Wineland 2001, 76-78.
\textsuperscript{1591} Mare 1997a, 308.
\textsuperscript{1592} Shoup 1988, 39.
\textsuperscript{1593} Fuller 1987, 35 and Shoup 1988.
\textsuperscript{1594} Berlin 1999, 42-3.
\textsuperscript{1595} Hartal 2002.
Scythopolis had at least four urban aqueducts with rock cut and masonry built channels, and arguably an inverted siphon that carried water up to the acropolis. Seven springs are described by Fahlbusch [2002]. Ein Migdal and Ein Shokek west of the Nahal Amal were brought into the city from the W: a related channel was discovered on the west slope near the west baths. Portions of the Ein Migdal canal were found during construction at the Kibbutz Messilot. Conduits carrying water from a basalt spring capture at Ein Muda and Ein Revayah entered at the city’s southwest/west gate to supply the city around the amphitheater; this is also the location of the city’s modern water distribution apparatus. A castellum was found near the hippodrome but, as recently as reports in *Hadashot* 2013, had not been excavated. Fahlbusch also refers to heavy sinter deposits in pipes and channels in the city that were subjected to scientific testing, though the nature of these tests and their results have not yet been published.\textsuperscript{1596}

Notably, there are no churches in the monumental core of Beth Shean. Rather, changes and improvements to the core’s water system were entirely secular in character, to the benefit of fountains and the east and west baths. Renovations of the city’s aqueducts – particularly the west line where it entered through the city gates – probably coincided with the burst of construction in the city during the early sixth century, when city walls were built by a *gloriosissimus* Flavius Arsenius mentioned in three, sixth century inscriptions.\textsuperscript{1597} The Comes and archon Orestes is credited with new streets and water supplies for the city’s south area around the Hippodrome between 515-522, which likely drew on the city’s west aqueduct.\textsuperscript{1598} A mosaic inscription found on the Silvinus Street, whose portico fronted the east Baths on their north side, records the “pavement with a new water conduit,” ἔργον | τῆς πλακώ- | σεως μετὰ κ(α)ὶ τοῦ νέου | ὑδρίου, under clarissimus count between 521-2 CE (Appendix E.99). Around this time, the colonnaded square and odeion were dismantled with spolia reemployed in a renovation of the west bath, prior to the construction of the Sigma by the governor Theosevios and Silvinus in 507.\textsuperscript{1599} Part of the Sigma’s construction entailed the destruction of a curving line of shops and taverns and pavement in the south portico of the piazza, in favor of a water channel that supplied the west baths and latrine.\textsuperscript{1600} This area, including the baths, began to fill with building

\textsuperscript{1596} Fahlbusch 2002, 62.
\textsuperscript{1597} See Tsafrir and Foerster 1997, 102.
\textsuperscript{1599} On all these inscriptions, see Di Segni 1999, 149-178; for the Sigma inscription see specifically Di Segni 1999b, 637–638.
\textsuperscript{1600} Mazor / Najjar 2007, 87 “this well planned drainage system … indicates that … in the early sixth century the planning of drainage systems in the city was still quite efficient, and its execution obviously preceded the construction of the new sigma complex. Its outlets integrate into the civic
refuse around the time a hoard was deposited here, containing TPQ mid sixth-seven century coins.\textsuperscript{1601} Water-powered flour mills were later installed in the west baths – whether these should be related to the earlier sixth-century dismantling of the baths and the refurbishment of the Sigma, or should be placed rather later at the end of the sixth century or even in the Umayyad period, remains unclear (see below).

A bath for lepers (read: plague victims) was built at Beth Shean in 558/9 by local bishop Theodoras, with another bath for the sick built by Bishop Ioannes sometime in the mid-sixth century.\textsuperscript{1602}

Nevertheless – and like Jarash and Beit Ras\textsuperscript{1603} – gravelly washes and other evidence of the gradual abandonment of drainage systems became commonplace during the later Byzantine period. At Beth Shean, "neglect of [the] water supply system to the city and the drainage out of it caused a flood in the area toward the end of the Byzantine period and prior to the Muslim conquest, when the wall formed a kind of dam in the southwest of the city. In the wake of the floods, travertine deposits became stratified at the base of the wall. The deposits and layers of alluvium that accumulated near the western side of the wall’s foundation (L3) contained a large quantity of potsherds from the Byzantine period and a few fragments from the Umayyad period ... A hoard of seven coins of the Emperor Justin II from the years 565–578 CE (below) was found on the stones near the northwestern corner of the square."\textsuperscript{1604}

However, Umayyad rule also saw the continuation of aqueduct functionality at Bet Shean, related to the use of the Sigma portico area as a market,\textsuperscript{1605} and the increasingly industrial character of the downtown area. Water mills – whether Byzantine or Umayyad – were installed for grinding flour, in the shops on Palladius Street and in the obsolescent west baths.\textsuperscript{1606} An Umayyad period aqueduct channel was exposed north of the theater, where a reservoir was linked with baths, latrines, pottery kilns with vats filled from externally-supplied water, and a fountain house\textsuperscript{1607} – the aqueduct then crossed from southwest to northeast to supply installations in the east baths on basalt-built arches 2.7-2.9m in height.\textsuperscript{1608} The east baths were remodeled in the Umayyad period, subdivided center’s main drainage system that runs under its major colonnaded streets and via Valley Street into Nahal Harod." See the review in \textit{JRA} 22 (2009): 745-51.

\textsuperscript{1601} Bijovsky 2002, 161-227.
\textsuperscript{1602} IEJ 13 (1963): 325-6; the bishop Ioannes inscription is unpublished but see the brief mention in Di Segni 1999, here at 156 and 168.
\textsuperscript{1603} Walmsley 2007, 133.
\textsuperscript{1605} Khamis 2001.
\textsuperscript{1606} ESI 17 (1994).
\textsuperscript{1607} See ESI 7-8 (1988/9).
\textsuperscript{1608} ESI 17 (1994).
into four rooms around a central court.\textsuperscript{1609} After a spate of dedicatory inscriptions from the sixth century, the west baths appear to have become industrialized – the date of flour mills there is contentious – these were supplied by a broad water channel that crossed through the area of the colonnaded temenos and odeion, which appears to be sixth century in date (see above). The mills are variously referred to as Umayyad or even Mamluk in date, though depending on their relationship to the aforementioned supply channel coming through the temenos/odeion, the mills may well be Byzantine in date. If so, they could constitute important evidence for elite Byzantine investment in the industrialization of the downtown area (rather than mere encroachment), which did not begin but merely continued under the Umayyad administration, with new pottery kilns installed at the theater which were also fed by aqueduct-carried water. All of this activity seems to have come to a close after the 749 CE earthquake, after which time settlement at Bet Shean relocated to the area around the so-called Saraya and the southeast walls, and took on a decidedly less dense, more agrarian appearance.\textsuperscript{1610}

Wells are also known at Beth Shean. Gil and Khamis point to the circulation of \textit{Hadith} which “called Beth Shean \textit{lisdn al-ard}, ‘the tongue of the Earth’, and said that its well (‘Ayn al-Fulis) brought water from Paradise and is mentioned in the Quran, and also that two or four just men live there, out of forty ever-renewed just men in the entire world.”\textsuperscript{1611} Muqadassi reported that “at Baisan the water is heavy and bad, while of a truth we take refuge in Allah from that of Sughar.” Presumably Sughar is the name of another well.\textsuperscript{1612} Interestingly, a bishop Ioannes is recorded by two inscription to have patronized wells nearby at Sirīn in Wādī Feğgās, between the Mediterranean and Lake Tiberias – this may be the same bishop Ioannes of Scythopolis mentioned by Leontius, or in a mid-sixth century inscription for a bath, cited above.\textsuperscript{1613} One of the inscriptions invokes the holy spirit – [\textit{Ἁγίου Π(νεύματος} – but whether or not this represents a holy well any more than a communal appurtenance, is unclear.

The dams of the Bet Shean valley were opened as part of the terms of surrender to the Umayyad conquests, after which time Bet Shean became known as ‘the marshy one’ (dhat al-radgha).\textsuperscript{1614}

\textsuperscript{1609} Walmsley 2007, 118.
\textsuperscript{1612} LeStrange 1890, 81.
\textsuperscript{1613} SEG 8.7 and 8.8 for the inscriptions; and for the identification of Ioannes with a bishop of Scythopolis, see Loofs 1887, I: 269.
\textsuperscript{1614} See Gil 1992, 44 and Tabari I.2158.
**PALESTINA SECUNDA, RAMLA**
Under the White mosque complex are a group of late Umayyad / Abbasid reservoirs, the largest of which features an early appearance of the pointed arch. Securely Abbasid public reservoirs, still named for St Helena, are across the street.\(^{1615}\)

**PALESTINA TERTIA, PETRA**
Archaeological study of the water system at Petra is on-going; the site was endowed with a highly sophisticated system of check dams and flood protection in the Siq, in addition to drainage and other supply provisions for the rest of the city. The interrelationships of separate systems, which are identifiable in the surrounding wadis with their tributaries, remain problematic despite the misleadingly totalizing conception from hydraulic principles, provided by Ortloff.\(^{1616}\) A conception of Petra’s water systems – even in major public buildings – or their integration and historical trajectories, remains very unclear. Wadi al Jilf, Wadi al Qantara, and Wadi al Madrass were all “built as elevated flumes with rectangular outlets,” with settling tanks set into the lines of the conduits.\(^{1617}\)

Petra was the capital of Palaestina Salutaris/Tertia, after it emerged from the Tetrarchic division of provincia Palaestina. Bishops from Petra attended church councils after Serdica in 343 CE, subjects of the metropolitan see at Bosra. Archaeological and literary evidence indicates that the city was severely affected by the Palestinian earthquake of 363 CE,\(^{1618}\) with dire effects for the complex Nabatean water schemes that protected and supplied the city. Epiphanius indicates that a cult for Dusares, the Nabatean water god, was active here in Late Antiquity;\(^{1619}\) the name Dusares also recurs in sixth century documents from the *Petra Papyri*.\(^{1620}\) The vita of Barsauma describes an early fifth century (419-423) conversion of the city after rain was miraculously produced by the saint, saving the city after a severe drought.\(^{1621}\) By the early sixth century, Anastasius and Justin I banished individuals to exile here; few bishops from the period are known – a bishop Jason made an inscription for his conversion of the Um Tomb into a church in 446/7 – and the last is mentioned as a contemporary by John Moschus.\(^{1622}\)

Petra’s Siq featured an interdependent system of spring-water supply with a double aqueduct [one pressurized line and a gravity flow channel, both crossing

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\(^{1615}\) Rosen-Ayalon 2006 and Vogué 1912.
\(^{1616}\) Ortloff 2009, 244-277.
\(^{1617}\) Bellwald 2004, 78.
\(^{1618}\) Fiema 2002, 192.
\(^{1619}\) *Panarion Haer.* II 51.22.11.
\(^{1620}\) Kaimio and Koenen 1997: 460-1.
\(^{1621}\) Ibid. with references.
\(^{1622}\) *Prat. Spir.* 127.
an arched bridge]; street surfaces for caravan transit; and rainwater protection for the streets, consisting of retention dams with sluices and tunnels to carry stormwater away at the tributary wadi entrances to the Siq. This system was published by Bellwald, after work by Brown University archaeologists between 1996 and 1999. The Siq street surfaces were laid in the third quarter of the first century BCE. Repairs to this system are attested by coins and pottery found under street-paving slabs in repairs, datable to the early second century (related to annexation in 106 CE and construction of Via Nova Traiana). Additionally, a “TLC” graffito on some of the pavers may indicate construction work carried out by the Tertia Legia Cyrenaica. Probably sometime in the third century CE, the top halves of some water pipes in the Siq line were apparently crushed intentionally to “preserve the pressurized pipe from destruction through over-pressure inside,” thus transforming the inverted siphon pipeline into a small gravity-flow channel: similar interventions are known from Priene and Pergamon. Heaps of construction debris found along the street were identified, thanks to coins and pottery, with partially-successful clean-up efforts following the CE 363 earthquake. The pipe-conduit in the double aqueduct was abandoned, while the channel was thickly replastered – a coin in the plaster gave a terminus post quem for CE 378. But this was a shoddy repair, and other signs of damage in the area may be attributed not only to the 363 earthquake, but to the flooding that would have followed destruction of dams at the heads and junctures of the wadi system. Fiema suggests that “the slow and continuous process of washing away the pavement and depositing alluvium probably began already by the later fourth century, as suggested by the alluvial deposits inside Shops XXIX-XXX.” Small finds attest to continued use of the street into the mid-sixth century, when flood protection was not centrally organized, but left to remaining shop-owners who built installations inside the colonnades on small earthen platforms to resist the damage of rushing flood water. An Arabic inscription in the bedrock “Allah” indicates that the level of the Siq was unchanged after the Arab conquest in 630. Final destruction of the Siq’s hydraulic system remnants is dated to the 749 CE earthquake.

The hydraulics of the Great Temple were investigated by Brown University archaeologists between 1993 and 1997, and published in Joukowsky 2004. The 35 x 42.5m Great Temple was built by Nabataeans in the last quarter of the first century BCE, with a theatron standing in place of the cella, all situated above a large colonnaded Lower Temenos that was extensively decorated with figural...
reliefs and elephant-head column capitals. It was enlarged in the first century CE, and remained in use until sometime in the fifth century.\textsuperscript{1631} The Great Temple set beside a large \textit{paradeisos} or open-air pool with an island pavilion: this complex was a marvel of Nabatean hydraulic engineering in the service of a temple. The temple and the \textit{paradeisos} were severely damaged in the 363 CE earthquake. Water channels feeding this complex – carrying water south down the slopes of ez-Zantur – “might have been re-used in later periods,” as indicated by thick lime deposits in the east exedra on a Late Byzantine crosswall across the temple and \textit{paradeisos} complex.\textsuperscript{1632} The plot of the \textit{paradeisos} was apparently reused in late antiquity for agriculture. Extensive subterranean canalizations were installed here for drainage and un-/pressurized supply conduits, and integrated into the city’s larger system, though the precise functionality and interconnection of the features excavated at the Great Temple remains unclear.

The west end’s south sidewalk on the colonnaded street was cleared by a British-Jordanian team in the 1950s: they found multiple phases of extensive damage to both the original Roman shops, and the secondary installations built into their front porches, along the colonnade. The dates of silt layers and masonry tumbles – suggestive of flooding and/or earthquake – could not be determined, however.\textsuperscript{1633} Later excavation by Bikai similarly revealed alluvial and colluvial deposits in the Roman and Byzantine shops, which were abandoned from east to west between the fifth and later sixth/seventh century.\textsuperscript{1634} Drainage channels in this south part of the city went out of use, but were carefully utilized for the storage of architectural elements, dated by a follis of Justinian I.\textsuperscript{1635}

The Great Church, constructed on the site of a residential quarter that had been erected after the CE 363 earthquake, had a large, newly-built cistern at the center of its peristyle atrium for rainwater collection. The church was destroyed by fire after the beginnings of a large-scale renovation or re-occupation project – architectural members, storage jars, and water pipes were found stacked inside – at the end of the sixth or early seventh century.\textsuperscript{1636}

The Ridge Church, near the summit of Jabal Qabr Jumay’an, was built in the fifth or sixth century, a three-aisled construction with apse and pastophoria that reused an earlier cistern found under its west end.\textsuperscript{1637}

Despite the somewhat dire evidence for the state of the city’s water protection

\textsuperscript{1631} Joukowsky 2004, 122.
\textsuperscript{1632} Fiema 2002, 196.
\textsuperscript{1633} Fiema 2002, 198.
\textsuperscript{1634} Egan and Bikai 1999, 507-10.
\textsuperscript{1635} Khairy 1990, 3-8.
\textsuperscript{1636} Fiema 2001.
\textsuperscript{1637} Bikai 1996 and 1997.
and supply installations after the fifth and sixth century, it is nevertheless clear that the city retained its political and ecclesiastical status as capital of Palæstina Tertia, even with dilapidated urban water infrastructure. Rural systems in the surrounding area continued to be operational, however, as known from archaeology at Jabal Harun, or in Petra Papyri inv. 83’s description of the Ghassanid phylarch Abu Karib’s/Kherebos’s mediation of a rural water dispute between residents at nearby Kastron Zadacathonin sometime around 529 CE.\textsuperscript{1638}

**PALESTINA TERTIA, SHIVTA / SOBATA**

Urban aqueduct, fed by seasonal precipitation. The line is 2.5km long with several branches, formed by a retaining wall built along slope, forming a channel 2m wide and 0.40m deep. The aqueduct collected rainwater draining off a slope roughly 100m wide, with total catchment area of 250 dunams. The channel carries across the plateau before entering a wadi with diversion dams, before approaching Shivta. Outside of Shivta, a triple-gated sluice directed water through two openings to the settlement’s cisterns (57 total, mostly in north, west, and east), while the third sluice directed water to the north church, which was the site of Shivta’s largest cistern (162.5 m\(^3\)). 5 other cisterns were located in the city’s churches: in the south Church’s south aisle and atrium; in the mosque square near the south church; in the central hall and near entrance of the main church; and in the north church yard. Tsuk notes that their location vis à vis the churches is odd; they may have pre-existed the churches, even if cross-patterns made of Glycimeris shells indicate their continued use in the Byzantine period after church construction.\textsuperscript{1639} At the south church, a distribution basin was installed – a round pit 0.5m in diameter and depth with three openings – through which water could be directed into the church’s cisterns individually, as needed.

A group of ostraka found by the Colt expedition attest to the community provision of labor for cleaning the town’s pools/cisterns in October, when cisterns were nearly empty before winter rains began.\textsuperscript{1640}

Tsuk dates the city’s aqueduct and cisterns, for houses and the churches, to the period between the fourth to seventh centuries, while the two pools in the south part of the city (vol. = \textasciitilde 2025 m\(^3\)) are thought to be Nabatean or Roman in date, and were filled by rainwater collection from the surrounding area.

Given the provision of the Umayyad mosque with a cistern connected into this system, it necessarily was maintained at least into the 7\(^{th}\) or 8\(^{th}\) century.

**PAMPHYLIA, ATTALIA / ANTALYA**

The Antalya water system is poorly studied and known only in small fragments,
having been mostly destroyed by development since the beginning of the twentieth century.

**Pamphylia, Lyrboton Kome / Varsak**
The water-management arrangements of this temple-estate turned early Byzantine village deserve mention. There is no aqueduct at Lyrboton Kome; rather, this settlement was entirely supplied by cisterns. A series of well known inscriptions record the establishment of a trust and the construction of an agricultural established, paid for by (a priest or priestess of) the goddess Arete, and dedicated to Perge’s Artemis and Domitian. Six hundred olive trees were entrusted to yearly-elected town elders proceeds from whose oil was advanced towards the purchase of animals for sacrifice. Mismanagement portended a large fine payable to the Temple of Artemis. A large Hellenistic tower at the center of the complex became the focus for additional construction, including a row-type bath building (2nd–4th century?) and several churches. At the bath’s northwest is a large cistern (19.9 x 5.4 x >1.2m). Large numbers of oil processing facilities are in its vicinity, in addition to at least 65 cisterns. Çevik observed six cisterns that preserved their rock-cut intakes for rainwater collection, and many exhibited multiple phases of plastering that indicates long-term use. Additionally, the two largest cisterns are carved just in front of a Roman period rock-cut tomb, which they likely post-date. Another large cistern north of Varsak is masonry built, and was thought by Çevik to be Byzantine. The three-aisled north church (21 x 13m) is surrounded by olive oil workshops and water installations.

*Pamphylia, Perge*
Perge was metropolis of Pamphylia II until Side took that honor after the seventh century; Perge continued to be noted with Side in various ecclesiastical documents of the following centuries, however. The city continued to be occupied after the failure of its aqueducts, as indicated by construction of a small church in the euripus/canal that runs north-south through the center of town. (The euripus itself was perhaps repaired as late as the fourth century, to judge from several third century inscriptions reused for the repair of its basin closures.) A thorough study of Perge’s water systems during and after antiquity remains a desideratum worthy of new fieldwork, but for the present moment several distinct phenomena should be noted at Perge: the construction of a fish-farm in the macellum of the agora, with hundreds of amphorae installed in the base of the Rundbau (this is otherwise described by Mansel as an hagiasma); the continuity of bathing in the south baths until it began to be

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1641 Şahin 1993.
1642 Keil 1926b, Broughton 1934, 226; Çevik 1997; Güçlü 1998, and Çevik, unpublished
1643 TIB 8.1.360-372, here at 362.
1644 For the engineering and trace of the aqueducts at Perge, see Albek 1972.
1645 IK 61.285
1646 Mansel 1975, 81.
robbed out probably the seventh century;\textsuperscript{1647} and the unpublished latrine installation in the southwest corner of the gymnasium of Cornutus/by the tetraconch.\textsuperscript{1648} Ongoing excavations in the west quarter and the north baths that remain unpublished: set in proximity to three major churches, these baths were very likely used well into late antiquity. Perge had significant problems with sintering, as evidenced by the massive 3m thick deposits on the west side of the cardo. Akarca describes a large three-aisled cistern of the early Byzantine period, measuring 13.5 x 13.25m internally. Akarca indicates that the roof was vaulted and carried on various spolia, including statue bases.\textsuperscript{1649} On the acropolis, another large vaulted cistern (12.95 x 13.05 x \sim 3.15m) collected rain from the basilica lying to its east; Abbasoğlu and Martini suggest that this basilica may have been reused as a church owing to the arrangement of later entrances cut into its east and south walls.\textsuperscript{1650} Numerous wells are scattered throughout the town; most appear to be late antique with spolia reused for curbstones. Wells are especially visible around the agora and in the shops/houses east of the Cardo.

**Pamphylia, Selge**

A Roman period inverted-siphon may have supplied the acropolis temple here, which was converted into a church after the fifth century.\textsuperscript{1651}

**Pamphylia, Side**

Side was metropolitan of Pamphylia, with a presence on the conciliar lists extending from the fourth to the fourteenth century. Side was originally suffragan to Perge, before it appeared as a metropolitan after councils in 536 and 553. The city disappears from secular sources after the tenth century, though its bishopric was maintained as a titular see in the conciliar lists.\textsuperscript{1652}

After initial investigations by Lanckoronski,\textsuperscript{1653} Side\textsuperscript{1654} has been excavated almost continuously since A. M. Mansel began his work at the site after 1947, continuing until 1976,\textsuperscript{1655} with renewed Turkish investigation of the site under the direction of Alanyali since 2000. Despite decades of archaeology here, and the clearance and restoration of impressive monuments, the town is overrun by tourism and illegal construction at the expense of its important archaeological record. The history of drastic clearance archaeology here, with little attention to ceramics or stratigraphy, means that precise occupational chronologies are

\textsuperscript{1647} For ceramics from the South bath, see Atik 1995, esp. 202-3 and 209-210.
\textsuperscript{1648} For the tetraconch see Kleinbauer 1987.
\textsuperscript{1649} Mansel and Akarca 1949, 66.
\textsuperscript{1650} Abbasoğlu and Martini 2003, 50-1
\textsuperscript{1651} Machatschek and Schwarz 1981, note also \textit{IK} 37 and Büyükyıldırım 1994, 165.
\textsuperscript{1652} For the documentary sources see TIB 8.1.376-7.
\textsuperscript{1653} Lanckoronski 1890-1893.
\textsuperscript{1654} TIB 8.1.373-394
\textsuperscript{1655} The principal(ly frustrating) publications by Mansel include: Mansel / Bosch / Inan 1958; Mansel 1963; Mansel 1965; Mansel 1975; Mansel 1978; and with Bean 1965.
generally lacking. Nevertheless, we can make some clarifying points about the
development and operation of its water system in Late Antiquity.

Wells dotted the city; they are found along the main colonnaded street between
the outer and inner walls, both inside the shop/houses and in the porticos.\footnote{5}{5} A
number of wellcurbs are left in-situ, while some carved from reused capitals can
be found in the museum’s sculpture garden.

The gravity-flow aqueduct supplying Side is well studied by engineers:\footnote{6}{6} taking
its source from springs behind the modern dam at Oymapinar (30km), the
aqueduct hugged the west side of the Melas river gorge, crossing six large
bridges whose repairs include patches of brickwork, reused Hellenistic and
imperial Roman architectural sculpture or inscriptions,\footnote{7}{7} as well as a new Late
Antique acclamation.\footnote{8}{8} A group of German PhD students in engineering
completed a prescient, energetics-style assessment of labor invested towards
the construction of the Side aqueduct: this is probably the most detailed, meter-
for-meter study of an aqueduct anywhere in the Roman world.\footnote{9}{9} They estimate
that roughly 500 persons working full-time, 365 days a year for three years would
have been required for its construction.\footnote{10}{10} An inscription dating sometime in
the third century records the construction or restoration of the aqueduct, in poetic
language, attributing the works to the generosity of a δουκηνάριος, Bryonianus
Lollianus.\footnote{11}{11}

Water carried by the aqueduct entered the city from the northeast, where one
branch crossed through the walls at the second tower from the north (rebuilt in
the Early Byzantine period)\footnote{12}{12} and thence bee-lined towards a distribution
complex and reservoir outside of the Museum bath (T), on which more below.
Another branch diverted from the main channel towards the large, pedimented
façade Nymphaeum (N) outside the city gates, which may be dated by a

\footnote{5}{5} See briefly on this point Yildizturan in ANMED 1 (2003), who notes that “Water wells of
various sizes were found, both in the pedestrian way and the shops. Some of the wells are
situated in the portico, others are either in front or inside the shops.”
\footnote{7}{7} The present superstructure and specus channel atop the arches of the Kirkgöz bridge is a
replacement, whose fabric contained a Roman inscription see I K 44.2, #60; note the brick
patchwork repairs on the Yüksekkemer bridge; and the Hellenistic triglyphs embedded in the east
side of the Akçay bridge’s second storey.
\footnote{8}{8} αὔξει Σίδη is inscribed on the 18th arch of the Kirkgöz / Kirkkemer bridge, see I K 44.2, #165.
\footnote{9}{9} Engels / Hupperich / Müller / Olberding 1983; this is unpublished, but may be consulted at the
DAI Istanbul Bibliothek.
\footnote{10}{10} ibid, 245 where the authors summarize their calculations to conclude that 485,000 total
person days were required in aqueduct construction, here divided by (365 * 500) = 2.65 years for
500 persons a day on site, or 5.3 years for 250 persons a day on site, etc.
\footnote{11}{11} “…With noble spirit you built at your cost, the unmeasurable river from its source to here” For
the question of its date, see references infra Appendix 3.1.#62; on Bryonianus Lollianus see Foss
1977b.
\footnote{12}{12} See TIB 8.1.381-2.
Caracalla statue base between 211 and 217 CE, with later repairs under the aforementioned Bryonianus Lollianus. Immediately to the nymphaeum’s north is a group of poorly-documented houses and workshops, which abut or are contiguous with the very late wall (filled with brick fragments and spolia) that adjoined to the fountain’s back as a sort of ante-muros to the gated outer city wall. This is suggestive of late encroachment around the fountain, comparable with similar activity at Messene or Beth Shean or Amathonte for instance, though a lack of documentation makes conclusions about the operational history of the fountain vis-à-vis the houses impossible.

Somewhat better understood is the complex just west of the Museum bath, where the aqueduct intersects and is carried along under the Attius wall: the channel fills two large reservoirs (H1 and H2), and is pierced in numerous places for secondary distribution into stone and ceramic pipes, which ran down from here into the city under several meters of pressure (Figs. 3.23-24). The Philippus Attius wall was traditionally thought to be a c. 330 CE construction on the basis of an inscription found high in a tower north of the gate by the theater. If so, then a rather later TAQ for the water system’s functionality should be sought in the small nymphaeum (hh), placed at the very southwest end of the colonnaded street, near Temple P and Basilica aa. The deep relief and drillwork of the chancel plaques / closure slabs and the little Ionic Kämpferkapitelln could suggest a later fifth century or Justinianic date. However, Foss convincingly argues that the Attius Philippus inscription – which does not mention a wall, but merely τὸ ἔργον – is a spolium (embedded high up on a tower’s exterior near the inner city gate), and that the inner wall’s construction is better associated with the threat of Persian or Arab incursions during the seventh or eighth century. If so, this is an important and rather late TPQ for the water system’s functionality, since the aqueduct channel and Byzantine reservoir are built atop and abut the inner city wall.

The episcopal church and palace – situated between the Hellenistic and the so-called Attius Philippus walls, in the area of the Fabrica – is today extremely overgrown and difficult to assess. The complex certainly had a fountain and a baptistery. Gliwitsky’s recent work here clarified the relationship of the small, domed four-column church that was implanted into the original episcopal

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1664 Dorf-Klingenschmid 2001, here at 244, and for the restorations of Bryonianus Lollianus see the above-cited inscription.
1665 H2 measures 16.7 x 10.4 x 5m = ~868 m$^3$ or 868,000 liters; see Mansel 1963, 171.
1666 Many of the stone pipes in Side appear to be recarved sections of Doric columns, as in the Museum sculpture garden.
1668 Note also the inscriptions referring to construction work in the main colonnaded street during the fifth or sixth century, see Önur 2006, 193-200.
1669 On a later seventh or eighth century date for the walls, see Foss 1977c and see Gliwitsky 2005, here at 376 says that the later date is “seit Foss alle Bearbeiter annehmen.”
complex’s bath, after the ninth century (Raum VI). Immediately north of Raum VI is a large, masonry-built, buttressed and vaulted two-chamber cistern (approx. 18x10x2m = 720,000 liters). Its size suggests that it was not fed by rainwater alone, but was probably integrated into the city’s aqueduct. Its date, and the water supply disposition of the basilica’s baptistery, remain to be clarified.

Brief mention of results from the recent excavations should be made, so far as they concern Late Antique activity in and around the city’s water infrastructure. The 2009-2011 campaigns indicated that glass workshops were installed in the theater’s galleries after the theater’s obsolescence in the fifth or sixth century. At about the same time, the paving from around the Tyche temple in the Agora was removed. Large quantities of glass production waste – including ingots, threads, and wasters – were recovered here. Soundings made in 2002 at the Harbor baths revealed that it was converted, at an undefined date during Late Antiquity, for olive oil processing; lime kilns were installed even later to aid in the bath’s demolition. The archaeological evidence for the industrialization of the city is counterindicated by contemporary epigraphic evidence for continuing patronage of the city’s streets and other facilities after the fifth century, alongside the construction of churches.

*Paphlagonia, Claudiopolis / Bolu
There is evidence for neither an aqueduct nor the location of the episcopal complex at Claudiopolis, the metropolitan capital of province Paphlagonia.

*Phoenice, Damascus
Damascus, metropolitan capital of Phoenice Libanensis, was principally supplied by the river Chrysorrhoas / mod. Barada which flows through town from sources on the plateau some 40km to the E. Masterman noted a number of springs which fed into, or diversions which carried water away from, the river Barada as it made its approach to Damascus, where it was divided into a complex system of interlinked canals feeding mills, fountains, baths, and manufactories. The city is also dotted by wells which tapped the high-water table, filtered from the river through the substrate. The temple platform which became the episcopal church of St John, and the later Umayyad mosque, was equipped with ablution

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1670 Gliwitsky 2005, esp. the summary chronology at 373-4.
1671 See Mansel 1975, here at 52-4.
1672 Alanyali in ANMED 2010, here at 99.
1673 Alanyali in ANMED 2011, 104-5.
1674 Yildizturan in ANMED 2003.
1675 See e.g. the late antique dedications in Önur 2006.
1676 These baths are important for the study of medieval Islamic architecture, though none date before the c. 11th century; see LeCoeur 1942-3.
1677 Masterman 1903, 98-107.
fountains and an *automate*/waterclock. The relation of the mosque’s water supply to a predecessor Roman system is unknown but may be judged likely.

*Phoenice, Tyr*

Tyre was the metropolitan of province Phoenice; it has had a bishop since at least the third century, when the city’s archbishop and Origen were martyred under Decius. The diocese of Tyre became metropolis of province Phoenice before 198 under Septimius Severus, and retained its title when Phoenice was split into Maritima and Libanensis in the late fourth or early fifth century (Tyre being metropolitan of the former, Emesa of the latter). This organization was maintained until the Arabic conquests in 635, when Tyre was taken by treachery and subsumed into the administration of Damascus. The city and its harbor was deeply ancient, and a center of commerce and industry (including glass, silk, and purple murex dye) well into Late Antiquity and thereafter, with renewed importance during the Crusades.

The island of Tyr was separated from the mainland until the fourth century CE, when alluvium built up over the dam of Alexander finally linked the two together. The lone spring source on the island was protected by the ‘Tower of Hiram,’ of unclear date. Ground- and rain-water sources were also collected on the island. Ibn Jubayr, later in the 11th century, wrote that no house lacked a well or a cistern, and large cisterns can be seen in the ancient/medieval houses and shops along David Street, in addition to the reservoirs located in front of the Rectangular Building (likely a Roman temple) and north of the Cathedral, though their history and integration with the aqueduct remains to be explored. An aqueduct connected the island to the mainland by the fifth century BCE; this was reconstructed on arcades by the second century CE at the latest, when many of the city’s Roman buildings went up. This aqueduct, only 7 km long, was supplied by sourcers from the northeast at al-Ma’shook and in the south at Ras el-Ain and al-Rashidiyeh; the south source is interesting for its ancient catchments in large rectangular pools. The system is still used for the town’s water today. Much of the original aqueduct was still intact and functional until the latter part of the nineteenth century.

1678 See Flood 2001, 114-138 on arguments for an Umayya d water clock / automata at the gates of the Damascus mosque, a judgment derived from the accounts of later Abbasid authors.
1679 *ODB III.*2134 s.v. Tyre.
1680 Aldsworth et alii 2002 for the find of a four furnaces with the capacity to make over 140 tons of raw glass. Water was required for this enterprise.
1682 Eusebius *HE* 7.32.3.
1683 On sources for late antiquity, primarily drawn from the city’s rich epigraphy, see Rey-Coquais 2005 = SEG 55.1686; and Hall 2007, 73-87.
1684 For written sources concerned with Tyre between the Hellenistic period and the Crusades, see the recent book by Gatier / Aliquot / Nordiguian 2011.
1685 See Boas 2010, here at 174 for Ibn Jubayr and medieval water at Tyre.
1686 See Bakalowicz 2002 for the aqueduct at Tyr.
A primary consumer of water from the aqueduct was the city’s hippodrome, on either side of which, built into the seating, were Late Antique baths built for the blue and green factions, as identified by mosaic inscriptions.\textsuperscript{1687}

The early Christian cathedral was mostly obliterated by the Crusader construction, which Eusebius describes in the \textit{Historia Ecclesiastica} as a basilica fronted by an atrium with phiale: “And here he hath placed symbols of sacred purifications, by erecting fountains right opposite the temple, whose copious streams of flowing water supply cleaning to those who are advancing within the sacred precincts. And this is the first stopping place for those that enter...”\textsuperscript{1688} No trace of the atrium remains, but to the north of the church are a complex of vaulted “vast cisterns adjoining this building,”\textsuperscript{1689} built partly above ground but set under the paving of a court. Their history is unclear, and I was unable to locate good photographs of these installations. Pringle prefers to interpret these cisterns as relics of a medieval cloister, while earlier authors like Pococke associated them with an episcopium on the site.\textsuperscript{1690} Their location and scale (even in plan) suggests that they were not merely for rainwater collection, but were probably integrated at some point into the city’s aqueduct. A baptistery was set into the first bay of the south aisle west of the crossing (its broken white marble font observed by Rey); it was adjacent to a rock-cut cistern in the third bay from east that “appears to have remained in use during the life of the church.”\textsuperscript{1691}

\textbf{PHRYGIA, ACROCUS / EĞRİGÖZ}

Acrocus is a fortified place 30 km west-north-west of Kütahya, standing on a steep rock above the Emet Çayı.\textsuperscript{1692} The site was surveyed by Foss, who found remains of three large, partially built, partially rock-cut cisterns, which could be associated with the stone pressure-conduit elements found in town.\textsuperscript{1693} Little known of this system, though Foss relates that “according to villagers, there was a spring here until a recent earthquake” which apparently served to fill the cisterns, rather than a pressurized siphon line.\textsuperscript{1694} Foss also communicates something of the scholarly quest to relate Eğrigoz with the ancient Tiberiopolis,\textsuperscript{1695} but cautions that its secure medieval name (Acrocus), “associated with Tiberiopolis, but differentiated from it,” appears only twice in

\begin{thebibliography}{99}
\item[1687] For the Byzantine baths at Tyr see Chéhab 1973, 20; cited from Cameron 1976, 317 and more recently with plans, see Kahwagi-Janho 2014; and for the hippodrome generally see Kahwagi-Janho 2012 [non vidi].
\item[1688] Eusebius \textit{HE} 10.4.40; and see generally Smith 1989.
\item[1689] Guérin 1880, II 192.
\item[1690] Pringle 2001, with references to Pococke see 183.
\item[1691] Ibid. 184.
\item[1692] \textit{TIB} 7.245.
\item[1693] Foss 1985.
\item[1694] Ibid. 116.
\item[1695] Ibid. 108.
\end{thebibliography}

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history during the ninth and twelfth centuries, rather than during Late Antiquity.\textsuperscript{1696}

**PHRYGIA, AMORIUM**

Amorium was the seat of the Anatolikon theme in the seventh and eighth centuries, and a city of greater Phrygia during the Roman and Early Byzantine period. Amorium was attached to Galatia II in 396-9 with Orkistos and Troknada; the city was ‘founded’ by Zeno and probably walled at that time. Amorium was located on a major cross-road and had considerable strategic value: it was the frequent site of battles with Arab armies between 644 and the eventual 838 sack of the city.\textsuperscript{1697} No clear signs of an aqueduct (or cisterns) have been found by the Ivison and Lightfoot excavations at Amorium, even if there are rumors among the locals that one might have existed. Amorium’s coinage includes representations of the river god Knepeleos, a well acknowledged sign of the city’s projected control of natural resources that frequently included aqueducts or irrigation systems. Wells are in any case numerous throughout the lower city. Ivison’s work on the bath house concluded that a piped supply was “highly probable,” but “by no means essential” since room V of the Early Byzantine bath contained a 2.5m deep well that may be an “original feature of the bath house, rather than a later addition.”\textsuperscript{1698} No water features have been published from the city’s churches, outside of the Lower Enclosure.\textsuperscript{1699}

PHRYGIA, APAMEIA / DINAR

Urban aqueduct. Apameia was a Hellenistic foundation and a Roman city, with bishops known from the second to the twelfth century; besides the usual Late Antique councils, two tenth century lead seals for bishops are also known.\textsuperscript{1700} Stone-pipe elements from a high-pressure line were found in the city; Weber suggested that the terminus of this line was the north part of acropolis, on top of which was a temple, whose site was later demolished for the construction of a church.\textsuperscript{1701}

*PHRYGIA, HIERAPOLIS / PAMMUKALE*

Hierapolis produced bishops signing as metropolitans after the Council of Ephesos in 431, with persistence on the conciliar lists after the seventh century.\textsuperscript{1702}

The Italian excavations at Hierapolis/Pammukale, on-going since Paolo Verzone began work there in the 1950s, have made it one of the best explored ancient

\textsuperscript{1696} Ibid. 111.  
\textsuperscript{1697} \textit{TIB} 4.122-125  
\textsuperscript{1698} Lightfoot and Ivison 2012, 23  
\textsuperscript{1699} On Amorium’s water see also Lightfoot 2007; and Katsari et alii 2012, 52  
\textsuperscript{1700} \textit{TIB} 7.188-9  
\textsuperscript{1701} Weber 1891, 1892, 1904  
\textsuperscript{1702} \textit{TIB} 7.269.
cities in the Roman world. Work led by D’Andria since the 1990s and Scardozzi in the 2000s has made significant contributions to our understanding of the city’s water system, from its origins through its evolution in the course of Late Antiquity.\textsuperscript{1703}

Of interest for our purposes, especially, is the evidence for late maintenance of the northeast aqueduct system, and the conversion of two large public baths into churches contemporary with the creation of a new, smaller Late Antique bathing facility in the center of the city.

Archaeological evidence from Hierapolis indicates that, after the late C4 earthquakes, the city was gradually ruralized and converted to lower-density industrial and agricultural after the fifth century CE, coincident with its post-EQ restoration. Church direction of these processes is manifest in changes made to water infrastructure, with churches at the edges and center of the city acting as distribution points and primary consumers; as such the hydraulic trajectory of Hierapolis is cognate with the example provided, for instance, by Jarash, where churches were grafted onto existing infrastructure to dominate localities where water was supplied and consumed in the ancient city. Particularly, the north and Central Baths were converted into churches; while the late [cf tremissus of Leo III and other eighth century coins] function of a pilgrimage church and bridge to the St Philip complex is related to the maintenance of an aqueduct and small inverted siphon feeding the complex from the south and E.

The aqueduct system’s eventual breakdown after large, debilitating, and well-evidenced earthquakes in the later seventh century was coincident with denucleation of the old settlement, away from the ancient city core and toward smaller spring sites, much like Troia: survey indicates Middle Byzantine village/agricultural occupation around a number of the spring sites that had originally fed into the Hierapolis aqueduct system.

**PHRYGIA, KIDYESSOS / ÇAYHISAR**
Urban aqueduct. Roman city with bishop after the fifth century, on a fortified hill, in which a stone pressure-conduit pipe section was found, possibly in association with a high-pressure line. Little is known of this system.\textsuperscript{1704}

**PHRYGIA, LAODIKEIA / LADİK**
There is precious little physical remaining of the former Byzantine metropolis of Laodicea in Phrygia Pacatiana, and nothing of the episcopal complex besides an exceptionally important inscription.\textsuperscript{1705} Dated c. 340 CE, this inscription is very early evidence for the concern of bishops with the provision of water in episcopal

\textsuperscript{1703} See especially Scardozzi 2012a, 2012b, and Campagna and Scardozzi 2013 for the aqueducts.
\textsuperscript{1704} *TIB* 7.301.
\textsuperscript{1705} See the inscription infra in Appendix 3.1.#80.
complexes. Bishop Severos and his successor Eugenius are credited, in a funerary inscription on a sarcophagus, with the construction of a church with a hydreion (often reservoir or fountain) in its atrium surrounded by tetrastoa, along with mosaics and sculptures. This system may either be a late dependency on an earlier aqueduct constructed for Laodicea by the agoranomos Bassos Plutinos in the second century or – as Dresken-Weiland, Trombley, and Calder suggest – a survival of a cult to an unknown deity, focused on a large temple complex several miles south of the city, within which Calder observed “a rectangular tank cut in the ground, nine feet by six, which was fed by a fresh water spring.”

PHRYGIA, LAODIKEIA (2)
The high-pressure line aqueduct at Laodikeia, just south of Hierapolis, is well studied as a technological artifact but remains to be better integrated into its local and historical contexts, where excavation has largely been directed towards restoration.

PHRYGIA, NAKOLEIA / SEYYITGAZI
Urban aqueduct. Near the city, east of the Cevizli – Bardakçı road are the remains of a Roman? pressurized line with both pipe and tunnel sections, the old sources for which reportedly still serve fountains in modern Seyyitgazi. This system has not been studied. Note also that the nearby town of Orkistos was in the territorium of Nakoleia until it successfully petitioned Constantine to upgrade its status to polis, on account of its baths and numerous watermills, which do not survive.

PHRYGIA, PEPOUZA (USAK PROV.)
Rural aqueduct, likely connected to irrigation works; this line may also be related to urban supply for Pepouza. Nearby are a Roman imperial estate (3rd century), marble quarries (Late Roman-Early Byzantine), and a rock-cut “monastery” (9th-11th centuries).

A seventh-eighth century graffito was found at Cîlandıras in the Ulubey Canyon was found near the rock-cut channel for an aqueduct that was probably carried over a nearby Roman-Byzantine bridge. Ceramic pipe sections were also found nearby, in the area of marble quarries and an imperial estate attested in the third century CE, which apparently survived into the 7th-8th centuries, if it is

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1706 Quote from Trombley 2001, I: 152; see also Dresken-Weiland 2005/6, 67-76 who identifies the hydreion as a fountain rather than a reservoir, and originally Klio 1910, 233 and MAMA I, nr. 170.
1708 TIB 7.344-6
1709 Chastagnol 1981
1711 Ibid., 165 and 230.
in fact referred to in the inscription (see infra Appendix E.104). A nearby rock-cut installation, somewhat questionably interpreted as a monastery rather than a secular villa rustica, contained tree-rings that were dated between 862-1019 CE.¹⁷¹²

**Phrygia, Synnada / Şühüt**
Nothing is known of the Roman or Byzantine system of water supply and distribution at ancient Synnada, which was the regional metropolis for Phrygia Salutaris after the end of the fourth century, an important center for the region focused on the famous marble quarries at Dokimeion.¹⁷¹³ The only excavations at Synnada to date have focused on Hittite period material, while various and rich fragments of architectural sculpture from Late Antique churches there are preserved in the museum at Afyonkarahisar. The city stands at the confluence of six wadi-like channels that drain seasonal torrents towards Lake Eğirdir; these would have been as useful for irrigation in the past as they are today. One such channel is presently dammed up into a sizeable reservoir just west of the village of Ortapinar.

**Phrygia, Sülüklü Kale**
Roman-Byzantine fortified place south of Egridir, with ceramic pipe elements and cisterns. Little is known of this site or system.¹⁷¹⁴

**Phrygia, Trapezopolis (Bolo / Beylerbeyi)**
Urban aqueduct. Roman city of Caria and Byzantine city of Phrygia 20km west of Hierapolis, whose bishops attended councils after the fifth century until 787.¹⁷¹⁵ A high water line descends the Babadağ/Salbakos mountain into town, where Weber recorded the remains of a large vaulted cistern or fountain in the east of the city that could be Byzantine.¹⁷¹⁶

**Pisidia, Antioch / Yalvaç**
A Seleucid foundation, Antioch became metropolis of Roman province Pisidia after it was separated from Galatia in the early fourth century CE. The city may have been sacked by Goths and Isaurians in the fourth century, with Arabs raiding parties advancing into Antioch’s territory between 647 and 720/1, though it remained an important component of the Byzantine provincial system into the Crusader period.¹⁷¹⁷

The aqueduct at Pisidian Antioch was composed of two conduits, with terminations at a nymphaeum and a bath complex whose palestra was the site

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¹⁷¹² Ibid. 251.
¹⁷¹³ For the written sources on Synnada see *TIB* 7.393-5.
¹⁷¹⁴ *TIB* 7.391.
¹⁷¹⁵ *TIB* 7.408.
¹⁷¹⁶ Weber 1904, 92-6.
¹⁷¹⁷ *TIB* 7.185-187.
of Late Antique church construction. Two other churches in town (the Church of St Paul and the Central Church) were associated with water reservoirs. The Eastern conduit was 10-11km in length, and included roughly-cut stone and mortar built tunnel sections and three bridges carrying an inverted siphon 800m long. Weber studied the system, and dated it to the Hellenistic period with Roman repairs, though Burdy and Taşlıalan, after exhaustive study of its design and construction,\(^{1718}\) compared its opus quadratum arched bridges to nearly identical works at Side, Aspendos, Phaselis, and Alabanda – all from the first century CE. Water from the north aqueduct terminated in the city at two locations: a reservoir tank for a nymphaeum, and a large imperial-style bath and palestra complex which is currently being excavated (as of 2014). The springs feeding this aqueduct, at Suçikan Dere 13km from the ancient city, are still relied upon for Yalvaç's modern system, built in 1952. Repairs to this line include "rebuilding of some of the piers, and the replacement of some of the arcade with stretches of continuous walling...perhaps [from] the fourth century, when the city was revived as the capital of the province of Pisidia."\(^{1719}\)

The north aqueduct terminated at a bath-gymnasium complex on the northern side of the plateau. Its opus quadratum construction compares with the Temple of Augustus with which it is probably roughly contemporary. Later, the bath’s palestra was used for the site of a three aisled basilican church. Özhanlı, Harmankaya, and Gümüş have published preliminary reports of its excavation in \textit{ANMED} for seasons in 2005, 2008, 2009, and 2010. They dated the first phase of the church’s construction by its capitals to the latter sixth century;\(^{1720}\) water pipes associated with the later phase were also found in the bath. If this is the case, it could indicate the simultaneous function of the church and the bath, or in any event the reappropriation of its water supply for other functions. The 2010 report indicates that the Yalvaç Museum-directed excavations were "terminated prematurely," though it also noted the long-term use of this area for burials whose date extends into the Late Byzantine period.\(^{1721}\)

The nymphaeum was supplied by a reservoir drawn by Weber as 32x13m with only a single course above ground remaining; if its height were extrapolated at 3m, this would portend a volume of 1250m\(^3\). The nymphaeum’s pi-shaped design compares with other early-mid first century constructions, like the Side Theater fountain, the Pollio nymphaeum at Ephesus, or the nymphaeum of Trajan’s father at Miletus.\(^{1722}\) Mitchell and Waelkens note that from this elevation at 1178m ASL, water could not reach the imperial sanctuary or the eastern part of the city; an additional 8m of height was required.\(^{1723}\) The inability of the east

\(^{1718}\) Burdy and Taşlıalan 1997.
\(^{1719}\) Mitchell and Waelkens 1998, 195.
\(^{1720}\) \textit{ANMED} 4 (2006), 149.
\(^{1721}\) \textit{ANMED} 8 (2010), 83.
\(^{1723}\) ibid., 195-7.
conduit to supply important areas of the city is cause for Mitchell and Waelkens to conjecture that a second conduit existed, which was proved by later investigation.

Owens suggested that the west conduit “swept around the northern edge of the city to supply the water installations known in upper parts of the city.” Remains of this system include a collecting tank at the source 15km northwest of the city, and parts of an inverted siphon – a header tank on a ridge outside town, and another tank just inside the city wall near the west gate of the Decumanus. This supply is probably related to the cascade channel that divides the carriageways of the Decumanus, a feature which compares with the well-known system from Perge. It may also be related to bronze and terra-cotta pipe-elements which were discovered flanking the entrance to the Temple of Augustus on the Platea Tiberia.

In town also is the Church of St Paul of the later fourth or fifth century, with dates based on the mosaics studied by Kitzinger, which include mosaic inscriptions recording donations from Bishop Optimus, known as Antioch’s representative to the Council of 381. The church was a rectangular, basilican plan with nave and two aisles, narthex, and a large forecourt set. This complex received water directly from the aqueducts: Taşlıalan describes a reservoir near stairs on the south side of the church, measuring 1.4 x 7.6 x at least 1.5m internally, which was connected by terracotta pipe to the main aqueduct. The room to the reservoir’s south had marble paving and revetment, and was interpreted as a space for bathing. The complex also had a baptistery, whose stone font was cut down from a Roman altar, and is now in the museum at Yalvaç, where can be seen its inscriptions naming St George, St Paul, and “the voice of the Lord upon the waters.” Like most fonts, this was not connected to the aqueduct, but rather would have been filled manually with a bucket. Its drainage has not described in publication, though a pipe here would not be surprising.

Opposite the Platea Tiberia and the Temple of Augustus to the west is the smaller Central Church, to whose immediate northwest is a rectangular Roman building that was later converted into a pool for retention or distribution of water: this structure has been dated broadly to ‘Late Antiquity’ because of its spolia construction, though it remains poorly understood.

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1727 Kitzinger 1974.
Three Late Antique inscriptions relate to the city’s water supply.\textsuperscript{1730} Two are epigrams which concern the restoration of aqueducts by Gorgasos and Kolobrasos. Another fragmentary inscription demands the reader to witness the ‘helikon’, ὁρᾶις τῶδ᾽ ἔργον ἡλίκον, likely a water-raising device, which was patronized by an unnamed strategos.\textsuperscript{1731} No inscriptions relating to water supply are known from the Roman period.

Portions of this system have been revived and are in use today for agricultural irrigation, where the old supply line terminates and collects north of the ancient city at the artificial lake, Yalvaç Göl / Hisarardi Baraji,\textsuperscript{1732} for distribution to the rich fields and orchards around Pazar Yukarı and Hisarardi.

**PISIDIA, KREMNA**

Urban aqueduct, 2km distant from spring as the crow flies, but aqueduct follows a sinuous course. Two other fragmentary aqueducts have also been identified. The city sits on a limestone/variable karstic plateau rising above a large, well-watered valley; seep through the porous rock has created two low-output springs in the lower parts of the city.

Notable in Kremna, which has been surveyed but remains unexcavated, is the massive 16-cell vaulted reservoir in the center of the town (1052m\textsuperscript{3} capacity below vault springs). Owens indicates that, because of a difference in elevation between the reservoir (1190m ASL) and the spring (1160m ASL) feeding into the aqueduct, water must have been raised mechanically if the reservoir was not supplied by rainwater.\textsuperscript{1733} Between the spring and the town, a single pipe on a stone foundation was led across two small gulleys by means of arched structures which have left little in the way of remains; another, deeper valley was also crossed by means of a siphon on a low level arched bridge/venter. Complete sections of ceramic pipes were found nearby: Owens provides their dimensions, noting internal diameter of 8cm with wall thickness approaching 16cm.\textsuperscript{1734} Owens located two installations (one with foundations 14.4 x 12.5m) that could have supported water-lifting mechanisms to feed water from the spring-line aqueducts into a separate set of channels to supply the town.\textsuperscript{1735} The aqueduct approached Kremna from the west, though its receiving tank and other components are not preserved – Owens postulates that their destruction was due to the siege of Kremna by the emperor Probus in 278 CE, after the town had been occupied by Isaurian rebels. Two other aqueducts were discovered in fragments near the city, presumably for distribution of water raised from the spring-line aqueduct at the W; an upper channel may have supplied the baths,

\textsuperscript{1730} Appendix 1.#88-90.  
\textsuperscript{1731} Appendix 1.#90.  
\textsuperscript{1732} 38°19’8.67”N, 31°11’49.95”E.  
\textsuperscript{1733} Owens 1991, 48.  
\textsuperscript{1734} Ibid. 50.  
\textsuperscript{1735} Ibid. 55
and a lower one whose elevation allowed it to supply water only to the southwest corner of the city.\textsuperscript{1736}

The bath in Kremna was the site of a series of interrelated family dedications for the gens \textit{Ulpia} in the second or third century; a date not before 220 CE is probably indicated by some of the abbreviations used.\textsuperscript{1737}

Despite a victory inscription dedicated to Probus, the extent to which the city was repopulated remains unclear. Late Antique activity includes inscriptions and a notice by Hierokles that the city belonged to Pamphylia; later medieval settlement apparently shifted to the regional center of Girme/Bucak.\textsuperscript{1738} Mostly scant remains from seven churches are known \textit{intra muros}: church A was installed in the imperial basilica on the Forum, perhaps at the end of the fourth century. The church’s proximity to the reservoir (in addition to the absence of channels directing runoff from the church into the reservoir), and the preservation if not functionality of the adjacent bath complex, all point to the functionality of an aqueduct in the city during the Early Byzantine period.

\textbf{Pisidia, Sagalassos}

Water at Sagalassos has been superbly studied by the Belgians working there under Waelkens’ direction for the last twenty years, so I will limit my remarks to Late Antiquity. Jacobs noted “the appearance of water storage facilities from A. D. 500 onwards,” after a major earthquake caused extensive damage in the town, alongside the utilization of “increasingly diversified” water resources that captured runoff water from snow and rain, in addition to spring sources carried by an aqueduct (comprising a monumental basin in the Upper Agora’s west portico, and storage on the west side of the northwest Heroon). This was coincident with two different diversions of water from the lower agora to structures in the city’s south, alongside a reduction in output from at least one of the five aqueducts in the city.\textsuperscript{1739} The basin and fountains began to fill up with bone and ceramic sherds by the later sixth century however.\textsuperscript{1740}

\textbf{Pontus, Neocaesarea / Niksar}

Neocaesarea was a Hellenistic foundation and a favorite of Mithridates Eupator who made it one of his residences, before its incorporation into the Roman empire by Pompey in 64 BCE as Diospolis. The city became metropolitan of province Armenia I and later Pontus Polemoniacus, and the home of Gregory Thaumaturgus, who was the city's first bishop after c. 240 CE. Neocaesarea was the site of a major synod in 315, whose acta survives. The city suffered major

\textsuperscript{1736} Ibid. 53.
\textsuperscript{1737} \textit{TAD} 19 (1970/2): 51-97 and Horsley 1987
\textsuperscript{1738} \textit{TIB} 7.662-3
\textsuperscript{1739} Jacobs 2013, 244 and 251
earthquakes in 340 and 499 CE. Neocaesarea remained in Roman / Byzantine hands until 1068, when it was taken by Melikgazi for the Seljuks, before a series of territorial exchanges in following years, until its ultimate capture by the Ottomans in 1397.

So far as the city’s water system is concerned, it appears that the fortified acropolis was the destination of an external aqueduct: Hamilton recorded that a part of the city’s aqueduct leading to the acropolis was still in use when he visited the city in 1841, with ruined stretches of an older masonry conduit replaced by wooden pipes. A visit to the site in 2010 by the author identified stone inverted-siphon blocks used as decorative spolia on the façade of an Ottoman building on top of the acropolis that are without note in previous scholarship on inverted siphons in Anatolia (Fig. 3.22). Unconfirmed reports of a rock-cut tunnel with stairs leading down from the acropolis could be related to a secure well or spring catchment under the acropolis, akin to Hittite and Iron-Age systems.

Bryer and Winfield refer to the tradition of Makarios (1658) that a hot spring, in his time emerging several miles away from the city, had formerly been a feature of the town center, adjacent to the town’s cathedral: “The belief is spread among the people, that a hot spring here, called Eboas, now at a distance of several miles from the town, was formerly in the very center of the city. This place contains a stupendously large church, of the most magnificent architecture, called Thaumatourgos, with many monuments still remaining.” It is unclear, however, whether the Roman / Late Antique city referred to by Makarios was on the present site, or was some distance to the south in the foothills – Bryer and Winfield seem to think (with some confusion on their part) that the cathedral was not in the modern city.

**Rhodope, Trajanopolis / Traianoupoli**

The metropolitan seat of Rhodope province, Trajanopolis was a hot-spring town elevated to provincial capital after the Diocletianic reorganization, though little is known of its archaeology – there are the remains of Late Byzantine and Ottoman baths here, poorly published, besides a fourteenth century church. Trajanopolis is mentioned as one of the cities in Rhodope restored by Justinian in the Buildings IV.11 by Procopius, though without further detail.

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1741 Jerome, *Chronicle* A.M. 2363 for 358 CE and Theodore Lector *PG* 86.1 col. 210, respectively.
1742 On the acropolis, whose fortifications are attributed with a Late Roman – Byzantine or medieval / Danishmendid date by Bryer and Winfield, see their 1985, 1: 109-110.
1743 Hamilton 1842, 1: 345-6.
SCYTHIA, TOMI / CONSTANTA
Tomi is the fifth-largest and oldest-continually occupied city in Romania; the metropolitan of Scythia Minor after Diocletian’s territorial reorganization, there is little known of its archaeology or water supply in antiquity apart from a 10km long aqueduct (poorly published), and a group of isolated structures with mosaics (the so-called Edificul Roman cu Mozaic) in the city center.

SYRIA, ANTIOCH ON ORONTES
A thorough study of the water system at Antioch is under preparation by Matthias Döring. See the present author’s comments on Antioch above in sec. 2.7, n. 222 and 230.

SYRIA, APAMEA ON ORONTES
Apamea was the capital and metropolis of Syria Secunda. A 150km long open-channel Roman aqueduct supplied Apamea from a source in the east at ‘Ain Zarqa, just west of Salamiya. The conduit was punctuated by at least twelve bridges and viaducts, in addition to sinuous detours that avoided crossing the deeper wadis directly.1747 The aqueduct swept from its source in the east around to the north, from which direction it entered the city’s gates, where an inscription and a fountain announced the introduction of water into the city by the Emperor Claudius.1748 Excavations indicated that the pavement around the fountain and the Ummidius Quadratus exedra-monument – at the head of the Grand Colonnade that bisected the city – was maintained until perhaps the twelfth century.1749 From the north gate, water flowed down a masonry channel in the Grand Colonnade, from which it was distributed into a pressurized, ramified system of pipes that supplied the baths, churches and elite houses that dotted the insulae of the city. The system was expanded during the reign of Hadrian by a descendant of the Hellenistic tetrarchs, coincident with the construction of a bath.1750 Excavation of the north bath revealed four main phases with use of the bath as such between the second and seventh centuries, the latter including the city’s latest water system, which included an elevated inner aqueduct preserved in the north part of the city, dated to the later fifth or sixth century.1751

A few important points: Balty drew attention to the abandonment of Hellenistic cisterns coincident with the construction of the aqueduct and the reorganization of the streets in the first and second centuries AD, before their reintroduction after the second quarter of the sixth century.1752 In the agora, three giant basins

1747 Balty 1987, here at 18.
1748 Balty 2000 for the north gate and this inscription at 474-5.
1749 Balty 2000, 481.
1750 Appendix 1.30-31.
1751 The bath excavations are still unpublished, but see short descriptions of phasing in Vannesse / Haut / Debaste / Viviers 2014, 245-254; see then Paridaens / Vannesse, in press.
(22.9 x 5.86 x >1.5m each) were built for at least 200,000 liters of water – these are contemporary with renovations made in the latrines (dated by coins) and with the construction of other private cisterns in town, some of which supplied domestic fountains. At the House of Capitals with Consoles, cisterns were “plus monumental encore,” 14.5m square on each side in the peristyle, and 8.5 x 5m in the northeast corner of the house. Balty attributes this change to the earthquakes of 526 and 528 known to have affected nearby Antioch; he also claims that the city’s sack in 573 saw the abandonment and infilling of these reservoirs, just a few decades later. Cylindrical and upto 30m deep, wells were introduced in the increasingly ruralized city after the later sixth century, and persisted until the twelfth.

While Balty thought that the aqueduct was cut by the sixth century, and that new Byzantine cisterns and reservoirs were supplied by rainwater, recent work by French hydraulic engineers and archaeologists proved that these were in fact part of larger systems for private nymphaea and baths that were still supplied by the aqueduct, which was still functional during the seventh century. An important group of late antique hydraulic installations revealed in the northeast corner of the city in the walls demonstrates how – rather than flowing directly down the cardo maximus through the city gates – the inner aqueduct’s distribution was embedded into the walls and towers of the city’s late antique circuit of fortifications (Fig. 3.21). By beginning its distribution from defensive architecture, governors at Apamea secured the source of the city’s ramified supply lines. The Apamea aqueduct may also have shared its supply with nearby Hama, where Balty draws attention to the much later claim, by Aboulfida, that he cleaned an aqueduct’s channel here in 1325 AD / 726 H.

Churches in Apamea functioned merely as consumers of water in the urban network, akin to houses, without any significant role for water storage or provision as we’ve seen in cities like Jarash: the “église à atrium de la grande colonnade” is a good example. Here, the fifth-century construction of a three aisled basilica entailed encroachment of a north-south sidewalk surface (by the apse), which cut off access to a string of four pipes running under the sidewalk. The church was modified in the sixth century, when the church gained water features, built within the constraints of the older, unmodified network of the city: the church was truncated at the west, and replaced by a peristyle atrium

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1753 Balty 1987b, 21-2.
1754 Balty 1987, 21.
1755 Balty 1987, 23.
1758 Idem.
1759 For the houses in Apamea, see Balty 1969.
1761 Balty and Lemaire 1969, 17.
with a phiale set at its center, its pipes running in from the north. Despite the church’s integration with the municipal network, a basin identified as a baptistery (on the atrium’s south) had a drain-pipe that connected it to the older Roman street-drains, though it lacked an external supply, and was thus probably supplied with a vessel from another source (like the phiale).

**SYRIA, BOSRA**

Bosra’s was a complex, multi-layer urban system, with an urban aqueduct [Roman-EI] and a channelized wadi catchment system [Nabatean] feeding birkehs [Nabatean-Ayyubid]. The ancient city of Bosra, first mentioned in early second millennium BC Egyptian documents, was a part of the Nabatean kingdoms annexed to Roman territory following the death of Herod the Great’s son Philip between 34 and 41 AD. An abundant perennial source, al-Jahîr, was captured in a vast enclosure from an early date, with later Roman and medieval improvements – it is situated at the southwest corner of the Roman encampment, and partially explains the longevity of Bosra’s permanent settlement. So far as external sources are concerned, water was directed into the city via two Nabatean canals and a Roman-medieval aqueduct. The Nabatean canals diverted rainwater from the descending wadi of the Djabal al-Druz; a reservoir related to this system is visible 5km north of Bosra at Djmarrin. The north canal fed installations to the north of the Roman legionary encampment; the south canal (called #31) brought water into the city from the east, and supplied two birkets or reservoirs, the birket an-Nabatiyah at the east and the birket al-Hâjj at the SE. These have been variously dated as Roman and medieval, though Nabatean letters (mason’s marks) indicate a much earlier date. The system itself probably functioned well over the longue durée – with urban distribution changes in the Late Umayyad period, to the benefit of the birkets and mosque, and to the detriment of the church and bath complex that had earlier dominated the late antique city core and received much of its supply. The reservoirs were maintained over the longue durée; besides Roman and Byzantine improvements, the southeast Birket al-Hâjj was restored by the Ayyubid governor of Damsacus between 1217 and 1229, contemporary with the construction of a madrasa adjacent to the birket.

Late antique activity related to this water system may be summarized as follows: An inscription [see infra Appendix E.101-2] records that this system was repaired in the mid-sixth century, with financing by Justinian managed by the

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1762 Balty and Lemaire 1969, 70.
1763 Balty and Lemaire 1969, 72 and fig. 17.
1766 ibid. 96.
1767 **PPUAES** II.A, 229-230.
1768 Dentzer-Feydy / Valierin / Fournet / Mukdad / Mukdad 2007, 164.
1769 For the city’s development during late antiquity, see Dentzer / Blanc / Fournet 2002, 75-154.
archbishop, who acted as an intermediary. Local financing was provided by a silversmith. Downstream from the Djmarrin reservoir, Blanc and Genequand describe a complex of Umayyad horizontal water wheels, driving millstones, which were powered by water flowing through the aqueduct’s conduits.\textsuperscript{1770} This research confirmed the Byzantine date for the aqueduct channel itself, on the basis of ceramics in the mortar of the channel walls, while five Umayyad coins were found in the millworks themselves. This complex was modified in a second phase, and demonstrates a transition from the use of “oblique water chutes, before later medieval introduction of the droptower.” This second phase is dated tentatively to the later eighth or ninth century.

Besides the aforementioned inscriptions, urban archaeology from Bosra also indicates the high degree to which the church was integrated into the city’s water system, as a primary consumer of water drawn off the aqueducts, to locations of public consumption in addition to specifically ecclesial installations: namely, late sixth century modifications to the central-planned church / cathedral included the installation of a east-west conduit that bisected the church’s interior, and supplied water from the east birket through the church to fountains on the west façade.\textsuperscript{1771} A basin in the south annex, identified as a baptistery, was fed externally and also integrated into the city’s preexisting drainage networks. These connections to the east birket were suppressed, probably, in the late Umayyad period / early eighth century, when workshops were installed in the church to aid in its despoliation, and underground conduits were replaced with terracotta pipes laid in the old drains so as to be more accessible.\textsuperscript{1772}

Bosra was also home to a bath-church complex. The south bath was a small row-type bath that expanded into a symmetrical, imperial-style complex by the beginning of the third century. Expansion continued into late antiquity, when palestrae were built at its east and west end between the fourth and fifth centuries. In the later sixth century, a church was built over the north end of the east palestra at a slightly higher level: crucially, a vaulted entrance-way from the Propylaeum Street gave access to the bath, through the church and truncated palestra. As Fournet remarks, “Cette adaptation illustre la vitalité et l’importance que conservait l’édifice thermal face aux imperatives d’une fondation religieuse nouvelle.”\textsuperscript{1773}

Richard notes the contraction of the basin at Trajan’s fountain in Bosra by the raising of its floor level, at a late date, which “might reflect the unstable character of water supply to the fountain.”\textsuperscript{1774}

\textsuperscript{1770} Blanc / Genequand 2007, 295-306.
\textsuperscript{1771} Dentzer / Blanc / Fournet 2002, 91.
\textsuperscript{1772} ibid, 92.
\textsuperscript{1773} For the south baths at Bosra see Fournet 2012, 185-246, here at 192-6 and Dentzer / Blanc / Fournet 2002, here at 93-98.
\textsuperscript{1774} Richard 2012, 144 and Mougdad / Makowski 1983, 35-46.
SYRIA, DEAD CITIES
A description of these systems is omitted here, because none of the Dead Cities had status as a polis or relied on an aqueduct, but rather each featured complex systems for rainwater collection and in some cases communal arrangements for storage and use, comparable to the cities of the south Hauran like Umm El Jimal, or the Negev cities. 1775

SYRIA, DEIR EL KAHF
Deir el Kahf is a very well preserved 60m square fort with square towers. 1776 A cistern in courtyard appears in WW I aerial photographs as a deep square pit; another cistern was built into a room that projected outside the southwest postern. 1777 An inscription found here records Roman construction of an aqueduct and cistern at the main fort during the third or fourth century: ἐπὶ Ἀγρίπποθ ἐπάρχου ἐγένε(το) / ο λάκκος κ(αὶ) ο αγωγός. 1778 The earliest certain inscription dates to CE 307, the latest CE 367, while pottery in Parker’s survey ranged from 1st-8th, with high numbers drawn from the 7th/8th centuries. 1779 Kennedy also reports that, besides two cisterns inside the fort, there are substantial traces of a sophisticated system extra muros with several reservoirs and cisterns in the village, more cisterns on the hill-slopes nearby, and a substantial dam downstream. 1780 A small tower 100m northeast of the main fort is set next to reservoir, 2.28 x 1.8 and 6m deep, that is “said to hold water throughout the year,” according to Stein. 1781 Kennedy speculates that this reservoir may be related to the inscription of Vincentius, found at Khirbet Umm el Menara. 1782

SYRIA, PALMYRA
Urban aqueducts (2). Carle surveyed the local geology’s affect on water supply in the 1920s, 1783 at which time he identified two spring sources of importance for the ancient city; additional investigations were carried out by Crouch, 1784 Baranski, 1785 and most recently by Zuchowski. 1786 The earliest aqueduct installation in Palmyra may be related to a group of pipelines found in the Hellenistic Quarter in the southwest of town, which were dated to the end of the

1775 PPUAES, Charpentier 2000; Dumond-Maridat 2008; Mango 2009; Tate 1992; Tchalenko 1953-8; Charpentier 1994.
1776 Gregory 1995-7, 276-81.
1779 Parker 1986, 21-4.
1781 Stein 1985, 259.
1782 Kennedy 2004, 76.
1783 Carle 1923.
1784 Crouch 1979.
1785 Baranski 1997.
1786 Zuchowski 2007 and 2012.
second or first century BC. Terra cotta pipes along the Great Colonnade were repaired as late as the 4th century AD, after which time stone pipes on the street surface were introduced, sometime before the 8th century, with later Abbasid lines suggesting a continuity of spring sources employed for the city’s supply, despite potential breaks in service caused by e.g. the 749 AD earthquake.

The Palmyrene Tariff provides “for use of two sources of water in the city – 800 denarii,” indicating subscription payments for intra-muros, presumably piped supplies of water to private domiciles. Teixidor and Matthews concluded that this was an annual fee. The sources supplying Palmyra are problematic – these include the sulfuric source Efqa in the southeast, which issues from a grotto in use since the Neolithic period and filled in later periods with dedicatory altars and offerings, used until recently as a bath; an unknown source near the Bel temple identified by Carle in the 1920s but since dried up; a spring at Gebel Rueisat nine kilometers west of Palmyra, the spring at Biyar al-Ameyt to the north now inaccessible due to its location in a military zone; and a source between Palmyra and Sedat at the southwest, where greek letters and tunnel access were noted in the 18th century though little remains today.

The Gebel Rueisat source supplied the so-called west aqueduct, which is the best known of the Palmyrene supply-mains: spring water collected at the foot of a hill in five rock-cut channels and conveyed them to an underground pool, from which water was then carried in a carved underground conduit to Palmyra by gravity. The collection basin zone featured architectural decoration and a statue dated by Baranski to the 2nd century AD, providing a terminus post quem for the aqueduct’s construction. As this line approached the city, it began to run on the surface in a stone channel north of the wadi al Qubur near the Valley of Tombs – this section of the aqueduct was dated between the 3rd and 8th century. A ceramic pipeline was also found in this area, though its relation to the other hydraulic structures here is unclear. The Camp of Diocletian, at the city’s west, marks the entrance of the aqueduct intra muros. Pipes in the camp were dated by Baranski to the 3rd – 5th century, and exited at the east through the so-called Water Gate to supply the rest of the city. Water was carried west-east along the main road, the Great Colonnade, and distributed from pressure towers which survive as stone/brick piers 1.2 x 1.1m with vertical pipes, near the Baths of Diocletian. Terra cotta pipes in this street were frequently repaired and replaced, with the last repair destroying the street surface and taking place

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1787 Zuchowski 2012, 63.
1788 CIS II.3913.
1789 Teixidor 1984, 74 and Matthews 1984, 177.
1790 Zuchowski 2012, 63 and 64, referring to Tourtechot 1735, 341.
1792 Zuchowski 2012, 64.
1793 Baranski 1997, 14.
sometime in the first half of the 4th century. After the 4th century repairs, water was conducted along the same general path, but in newly-laid stone pipe sections – occasionally but groundlessly attributed to Justinian. These reappear as spolia in the Umayyad Suq, providing a terminus ante quem in the 8th century for these stone pipes. However, another line (stone or terra cotta?) was laid along the same path as previous conduits in the Umayyad period, during which time the water towers in the south portico of the Great Colonnade remained in use. Additionally, Abbasid period pipes were reported by Baranski in the Camp of Diocletian and along the Umayyad Suq. Zuchowski suggests that a rectangular basin (3.7 x 4.7 x 1.5m) in the south portico of the Great Colonnade, near northeast corner of Theater and close to the main mosque, may have functioned as a sabil – its chronology is uncertain.

The north source is known from several pieces of evidence. Palmyrene inscriptions reported but not published from inside the channel suggest an earlier, probably pre-3rd century date for the line’s construction. Adjacent to the city walls, at tower Tt13, is a structure identified as a castellum for the north aqueduct. This structure was barrel vaulted and five-chambered, either for purification/settling or distribution. Zuchowski rejects Aurelianic and Tetrarchic dates on the basis of building techniques, in favor of a Justinianic date without specific evidence. Zuchowski records the presence of two pipelines on a north-south orientation on Diogenes Street from a fifth/sixth century context. The north line was probably still in use during the Umayyad period; Zuchowski reports a water line between Basilica IV and the Tower Tomb M discovered during survey in 2010 that was conceivably supplied from the N.

Zuchowski also draws attention to three lines of foggaras near Palmyra that are reportedly not connected with the aqueduct lines; they remain unstudied.

Reservoirs at Palmyra are known from Basilica II and Basilica III, totaling ~100m³: basins with reused column drums were lined in ashy waterproof marble, and connected with conduits running under the adjacent street. Gawlikowski dates their abandonment to the 9th century.

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1795 Buildings 2.11.10-12.
1796 Zuchowski 2012, 67.
1797 Baranski 1997, 9-10.
1799 Zuchowski 2012, 70.
1801 Zuchowski 2000, 189.
1802 Zuchowski 2012.
1803 Zuchowski 2012, 72.
1804 Gawlikowski 1999, 257.
Wells are known from throughout Palmyra: they are found in the porticos of the Great Colonnade, in houses, the Camp of Diocletian, and in the temenos of the temple of Baalshamin and Allat, however very few have been excavated. One well (2m wide and 15m deep) was found in the Hellenistic quarter, dating to the second century BC.\textsuperscript{1805} This is indicative of the city’s elevation of the water table – other wells were found throughout the city, though they must have been excavated only at some risk and expense.\textsuperscript{1806} In the south portico of the Great Colonnade, another well was identified as a second century BC construction, with abandonment already by the Byzantine period.

**SYRIA, QASR BURQU**

Qasr Burqu is a 12x8 tower of coursed basalt within a c. 30x30m irregular quadrilateral enclosure.\textsuperscript{1807} An Arabic inscription on lintel bears a date of CE 700, with a Greek epitaph and safaitic graffiti, a cross in enclosure north of fortlet is lake formed by dam c. 100m long built across wadi 500m north of fort. Masonry of the dam matches tower: Interpretations of date range from Nabatean to Islamic. Its isolation suggests Qasr Burqu wasn’t an official Roman military structure, but was perhaps developed as a monastery, and was later adapted for use as a meeting place. Questions remain as to whether the tower and dam are 3\textsuperscript{rd}/4\textsuperscript{th} century or perhaps later signs of early Islamic development.\textsuperscript{1808}

**SYRIA, QASR AL HAYR AL SHARQI**

Two Umayyad water powered mills were located outside the qasr enclosure.\textsuperscript{1809}

**SYRIA, QASR AL HAYR AL GHRABI**

An Umayyad water-powered mill is associated with this qasr.\textsuperscript{1810}

**THESSALY, LARISA**

Larisa was metropolitan of province Thessaly with an archbishop since the reign of Constantine.\textsuperscript{1811} The city’s archaeology is quite patchy, known primarily through salvage excavations.\textsuperscript{1812} Built on the right bank Peneios river, a twelve-arched Byzantine bridge crossing the river near town no longer survives. The city was walled by Justinian, according to Procopius – elements of fortifications for the acropolis at the northwest close to the river were discovered by salvage excavations after 1991.\textsuperscript{1813}

Elements of the city’s water distribution system are known only fragmentarily

\textsuperscript{1805} Zuchowski 2012, 62.
\textsuperscript{1806} Zuchowski 2012, fig. 15 for map of ~30 wells in the city.
\textsuperscript{1807} Kennedy and Riley 1990, 71-3 and 218-220; Gregory 1995-7, 239-43.
\textsuperscript{1808} Helms 1991.
\textsuperscript{1809} Genequand et alii 2006 and 2007.
\textsuperscript{1810} Schlumberger 1986.
\textsuperscript{1811} TIB 1.198-9.
\textsuperscript{1812} See the assessment of salvage excavation results summarized by Karagiorgou 2001, 33-51
\textsuperscript{1813} Buildings 4.3.7-10 and Karagiorgou 2001, 36-7.
through salvage excavations, which have yielded some results: at the archbishop’s church of St Achilleos, built over the tomb of the martyr, a sixth- or seventh-century inscription was found in the church’s cistern.\textsuperscript{1814} Just south of the Achilleos church, salvage excavations (sector Γ) uncovered a small but multi-phase Early Byzantine – Byzantine bath, on the level of the church and thus contemporary with it, that drained into a soakaway pit filled with coarse wares, bones, iron slag, and coins.\textsuperscript{1815}

Salvage excavations at the Agamemnon Blanas / New Market parking garage revealed a small triple-apsed bath that was dated to the fifth century by stratigraphic excavation, and is thought to be the neighborhood bath, perhaps in conjunction with a basilica or episcopal quarter thought to also be located here.\textsuperscript{1816}

*THRACE, PHILIPPOPOLIS / PLODIV
Philippopolis was a Hellenistic city that became ecclesiastical metropolis of Northern Thrace, which was long on the borders with the Goths in the third century, and the Bulgars after the eighth.\textsuperscript{1817}

Its archaeology is well published but primarily in Bulgarian.\textsuperscript{1818} We should note here a three aisled church basilica that was built on top of two insulae in the first half of fifth century; one of these insulae was home to a small, unnamed bath complex. The basilica was abandoned sometime in the sixth century, even if the baths continued to function until late 500s.\textsuperscript{1819}

\begin{footnotes}
\textsuperscript{1814} SEG 35.603 = [ - - - καὶ τοῦτο τὸ ἔργον - - - | - - - Ἀχιλλείου ἀρχιεπισκόπου ].
\textsuperscript{1816} For the excavations of this bath near the Larisa parking garage, see Sdrolia 2009 and S. Sdrolia in AD 56-59 (2001-2004) [2012] B’2, 600-601.
\textsuperscript{1817} ODB 3.1654-1655.
\end{footnotes}
1.1. The Soreq Cave Speleothem converted into annual precipitation, from 0 – 2.5 kya (from Orland / Bar Mathews et al. 2009).
1.2: City Map of Jarash (from J. Braun et al for the IFAPO City Mapping Project 2001).
1.3: Map of known springs and their relation to pipe cuts or sections found north, northwest, and south of the city from a long distance supply line (from Jarash Hinterland Project 2010 report).
1.4: Map of fountain locations in Jarash, with numbering referred to infra in text (from Seigne 2008).

1.5: Fountain 5b from the west (author photo).
1.6: Plan of Fountain 5b (author plan).

1.7: Fountain 7 from northwest (author photo).
1.8: Fountain 7 basin from southeast – note the lower water intake channel at left, under the second sidewalk step, to the right of the column base (author photo).
1.9: Fountain 7 profile plan (author).
1.10: Fountain 7 basin southwest corner at back of basin. Note building tiles at right, covered in packed earth and rough mortared masonry. Note also curvature of the mortar lining towards the foreground at center left (author photo).

1.11: Fountain 7 northwest corner at back of basin. Note the curvature of the mortar lining; as well as the pavers covered by packed earth, mortar and a box tile below the mortared, roughly-cut ashlar (author photo).
1.12: Fountain 7 top-down plan (author photo).
1.13: Fountain 8, from SE. Note reused architrave blocks used as top edge of basin above original closure slabs, and of a different type in the steps leading to upper sidewalk surface used at right. Note also the channel for drainage at lower left, built in lower than a presumably earlier drain hole at center, with pipe intact (author photo).
1.14: Note the depressions on the splash plate, and especially the lower secondary supply channel cut, under the half meter stick at lower left, cut between the column base and the left side of the fountain apparatus (author photo).
1.15: Fountain 8 plan (author).

1.16: View of Fountain 10D facing southwest, at the remains of the basin (author photo).

1.17: View of Fountain 10D facing west from across the street, behind the sidewalk colonnade from which fell a column onto the basin, necessitating its repair (author photo).
1.18: stitched together ground plans from the American/British, Swiss, and Italian excavations showing related water installations in the Artemis Temple-Cathedral complex. Storage areas (cisterns/settling tanks) in green; conduits (whether open/closed) in blue. NB that water on the Artemis platform naturally flows south and east (author).
1.19: Plan of the western temenos of the Artemis Temple (from G. Guillini 1983-4)
1.20: 1) At left, facing north, the north-south supply line at the temple steps. At right, facing southwest, 2) the settling basin should be noted in the foreground, emptying south into 3) the long basin and southwest towards 4) the rock-cut reservoirs (author photos).
1.21: At left, 3) the long basin south of the Artemis temple, facing west. At right, 4) the rock cut reservoir, facing east. Note the vaulting of the chamber at left, and the hewn steps leading down to the basin floor which are visible in the center background to the right of the vaults (author photos).

1.22: Masonry built conduit at the Artemis temple platform’s southeast corner, facing west (from Yale University Gallery Gerasa Archives).
1.23: Plan of the vaulted substructures under the temple platform (from R. Parapetti 1989).

1.24: Vaulted substructures under the temple of Artemis podium, looking east down a channel connecting two of the chambers (from Yale University Gallery Gerasa Archives).
1.25: On left, a drawhole giving access to the temple substructures is surrounded by large blocks at center. At right, a photo from 1930 shows the blocking of the main cella door (photo by author and from Yale University Gallery Gerasa Archives).
1.26: At left, open air reservoir? on the hill rising to the west of the Artemis temple. At right, curving foundations of a possible pipe casing snaking towards the west-north-west (author photos).

1.27: At left, facing north from the temple’s colonnade, an uncovered section of the masonry built and covered drain that runs under the temple portal’s sill along
the St Theodore Street. At right, an interior view of a covered section of the same sewer drain (from Yale University Gallery Gerasa Archives).

1.28: At left, facing west from the temple court’s southeast side, a masonry conduit running towards the sawmill cistern; and at right, a plan for the sawmill housing (from (Yale University Gallery Archives and Seigne 2002).
1.29: The evacuation channel of the water line coming down the hill from the north, away from the saw mill complex, at the point where it enters the Fountain court (author photo).

1.30: Set in the background between the first two columns on the left, the evacuation channel from the Cathedral complex is built into a late encroachment against the south side of the Nymphaeum, while an associated pipe cut is visible in the portico sidewalk surface next to the second column from left (author photo).
1.31: Plan of the Placcus Baths (from Kraeling 1938).

1.32: At left, the cistern B43/47 from the Placcus Baths northwest corner, and at right the cistern’s latest mortar lining set on rough cobbles, with the overflow channel at upper right (author photos).
1.33: In B44, facing NWW at the lower supply and upper overflow channels of the Placcus Baths cistern. The overflow channel is set into the wall about 30cm above the covered masonry channel running left to right across the mid-ground (author photo).
1.34: Plan of the neighborhood at the west side of St Theodore. Note the stone-covered water channels running south and downhill from across the foundations of the Artemis platform (from Kraeling 1938).

1.35: At left, facing north and at right, facing south, showing the many Byzantine/Umayyad water conduits running down the hill away from the Artemis temple platform under the St Theodore street (from Fisher 1930 and the Yale University Gallery Gerasa Archives).
1.36: At left, and facing south, open and closed channels descending St Theodore Street. At right, supplied by the closed channel, the vaulted cistern 1, whose arches rested on a row of reused columns dividing the cistern into two long chambers. Compare with cistern construction at Umm el Jimal, for instance (from the Yale University Gallery Gerasa Archives).
1.37: The St Theodore Atrium Cistern: view from the interior of the cistern to the southwest, towards the Roman hypogeeum entrance. Note columnar support at left, and mortar lining on the wall visible at right foreground (author photo).

1.38: View of the Genesios church, from the northwest, with well head #1 visible in the center foreground, and wellhead #2 covered by an architrave block in the left mid-ground (author photo).
1.39: Close up view of the Genesios church wellhead #1 and 2 from the south-southwest, with well head #1 visible in the center foreground, and wellhead #2 covered by an architrave block in the right mid-ground (author photo).

![Image of Genesios church wellheads](image1.jpg)

1.40: Both photos taken inside Cistern A under Genesios; at left, looking east towards wellhead #2; and at right, looking west towards wellhead #1. Notice the mortar lining at right, and the visibly moist walls below ceiling level (author photo).

![Image of inside Cistern A under Genesios](image2.jpg)

1.41: The Apsed Fountain Niche southeast of the Genesios Church (author photo).

![Image of Apsed Fountain Niche](image3.jpg)
3.1: The Pulgo Water Temple near San Francisco, CA (b. 1934), inscribed "I give waters in the wilderness and rivers in the desert, to give drink to my people" (Isaiah 43:20)

3.2: City gates in Modesto, California (photo credit: Brianna Bricker)

3.3: Perspective restoration of the Jerwan aqueduct, note its bridge and
breakwaters carrying water inside the canal and over the Khenis river at center (from Jacobson and Lloyd 1935).

3.4: Schematic diagram of inverted siphon

3.5: L. Marcius Philippus's denarius with aqua Marcia on the reverse (after Crawford 1975, 425 / #1)
3.6: View from the acropolis at Aspendos onto the south pressure tower and arcade of the Aspendos aqueduct; the north tower is visible in the R-side background (author photo)

3.7: The header-tank at Aspendos (author photo)
3.8: Note the deep wear marks in the balustrade of the Hydrekdocheion of Laecanius Bassus in the Upper Agora at Ephesos, built in the reign of Domitian and maintained into the seventh century AD if not later (author photo)

3.9: This map, based on an evolving list, indicates the locations of archaeological remains of aqueducts (in blue, based on the Romaq.info dataset), and of inscriptions for aqueducts (in green, based on my own evolving list, for which see the Appendix E)
3.10: Graph of Epigraphic Attestations of Aqueduct Construction / Repair in the Eastern Mediterranean between the Hellenistic Period and the 7th century

(author)
Fig 3.11: Water distribution apparatus near the Stadium. From the ÖAI archives: EPH-3734
Fig 3.12: Water distribution apparatus near the Stadium. From the ÖAI archives: EPH-3727

3.13: One set of pierced blocks for pipe distribution, here set above the reservoir on the Philippus fortifications (several more groups of pipes being led off from the channel were visible here, including one set up as a 2\textsuperscript{nd}/3\textsuperscript{rd} -degree inverted siphon; author photo)

3.14: Multiple strings of replacement pipes laid along same path, in the southeast corner of the Upper Agora, Ephesos (author photo)
3.15: Sintered up pipes at ‘Der Fontane’ on the south side of the Upper Agora, Ephesos (author photo)
3.16: Sinter deposits completely block the arches under the Anazarbus aqueduct
(photo: Emily Neumeier)
3.17: A 3m thick and high column of sinter (just out of photo to left) seeped over the edge of a Roman statue base on the Cardo at Perge (author photo)
3.18: Massive sinter deposits leeching over the masonry piers of the Tyr aqueduct in al-Bass Archaeological Area 3 near the monumental arch (photo: user MM212 at virtualtourist.com)
3.19: The mill complex at the nymphaeum in Messene: the mill is in the foreground, with the long nymphaeum visible behind it, cut into the hillside (author photo)
3.20: Pipes led off from the nymphaeum at Amathous (author photo)
3.21: The northeast distribution complex in the fortifications at Apamea (from Haut/Viviers 2007)
3.22: Note the stone inverted siphon blocks in the façade, flanking the stairs and piers on either side of this Ottoman structure on the kale at Neocaesarea / Niksar (author, 2010)

3.23: Side. Closure slabs and monolithic basins for Byzantine fountain hh, which was found at the terminus of the colonnaded street
3.24: Side. Byzantine cistern H2 built against the so-called Attius Philippus wall; the triumphal arch and cavea of the theater are at center and right background (author photo)

3.25: Triple-chambered cistern just northwest of the Holy Apostles, supplied by the west conduit
3.26: The aqueduct bridge just west of the village of Chortiates
3.27: Thessaloniki. The hagiasma / niched Roman fountain under the Church of St Demetrius, a relic of the Roman bath previously on the site (author photo).

3.28: Plan of the agora at Thessaloniki (author photo of plan on site)
3.29: The cryptoporticus under the agora at Thessaloniki; converted in Late Antiquity for use as a cistern (author photo).

3.30: Stone pipe from the spring catchment outside Tyana (author photo).
3.31: The spring catchment reservoir outside Tyana; the modern road follows along the path of the outtake channel from pool to camera and on to the southwest (author photo).
3.31: Elevation profile for the Tyana aqueduct from source to city, indicating that no stone pipes for an inverted-siphon were required, though they were nevertheless employed both inside and outside the town proper. Were stone-pipes easier to acquire than ceramic pipes at Tyana in the early third century, assuming these are original, or was their durability especially valued to compensate for the greater labor required in their manufacture? (author)
3.32: Water Supplies of the Military Capitals after the seventh century (author)
4.1: Interior view of the Old Penn Station (public domain)
4.2: Reconstruction of the Bath of Caracalla’s interior (public domain)

4.3: The Projecta casket from the Esquiline Treasure (British Museum)
4.4: Plan of statue bases at Hadrian’s baths, in their Late Antique display positions (from Smith 2007).
4.5: The oecobasilica at the Kremna baths, with a third century group of interrelated statue bases (author photo).
4.6: Plan of Scholastikia’s bath, Ephesus (from ÖAI archives)
4.7: Photo of the Cryptoporticus on Akademiegasse, at the Scholastikia bath's west (author photo)
## LIST OF ABBREVIATIONS

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<th>Abbreviation</th>
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<tbody>
<tr>
<td>AA</td>
<td>Archäologische Anzeiger</td>
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<td>ABSA</td>
<td>Annual of the British School at Athens</td>
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<td>AΔ</td>
<td>Ἀρχαιολογικὸν Δελτίον</td>
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<td>AE</td>
<td>Année Épigraphique</td>
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<td>AEMΘ</td>
<td>Τὸ Ἀρχαιολόγικο Ἑργο Στή Μακέδονια καὶ θράκη</td>
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<td>AJA</td>
<td>American Journal of Archaeology</td>
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<td>AnatAnt</td>
<td>Anatolia Antiqua</td>
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<td>ANMED</td>
<td>Anadolu Akdenizi Arkeoloji Haberleri, accessed online at <a href="http://www.akmedanmed.com">http://www.akmedanmed.com</a></td>
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<td>AnzWien</td>
<td>Anzeiger: Akademie der Wissenschaft in Wien</td>
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<td>AST</td>
<td>Araştırma Sonuçları Toplantısı</td>
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<td>BASOR</td>
<td>Bulletin of the American Schools of Overseas Research</td>
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<td>BCH</td>
<td>Bulletin de correspondence hellénique</td>
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<td>CIC</td>
<td>Corpus iuris civilis, ed. P. Krüger et al. (Berlin, 1928–29; repr. 1993)</td>
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<td>Acronym</td>
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<td>CIC Dig</td>
<td><em>Corpus iuris civilis</em>, vol. 1, pt. 2, <em>Digesta</em>, ed. Th. Mommsen and P. Krüger (Berlin, 1928; repr. 1993)</td>
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<td>CIG</td>
<td><em>Corpus inscriptionum graecarum</em>, ed. A. Boeckh et al. (Berlin, 1828–77)</td>
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<td>CII</td>
<td><em>Corpus Inscriptionum Iudaearum/Palaestinae</em></td>
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<td>CIJ</td>
<td><em>Corpus Inscriptionum Judaicarum</em></td>
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<td>CIL</td>
<td><em>Corpus inscriptionum latinarum</em> (Berlin, 1862–)</td>
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<td>CRAI</td>
<td><em>Comptes Rendus des séances de l'Académie des Inscriptions et Belles-Lettres</em></td>
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<td>CTh</td>
<td><em>Theodosiani libri XVI cum constitutionibus Sirmondianis et leges novellae ad Theodosianum pertinentes</em>, ed. Th. Mommsen and P. M. Meyer (Berlin, 1905)</td>
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<td>DeltChAE</td>
<td>Δελτίον τῆς χριστιανικές Ἀρχαιολογικές ἑταιρείας</td>
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<td>DOP</td>
<td><em>Dumbarton Oaks Papers</em></td>
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<td>EA</td>
<td><em>Epigraphica Anatolica</em></td>
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<td>EI²</td>
<td><em>Encyclopaedia of Islam</em>, 2nd ed. (Leiden–London, 1960–)</td>
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<td>EO</td>
<td><em>Echos d’Orient</em></td>
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<td>ESI</td>
<td><em>Excavations and Surveys in Israel</em></td>
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<td>FiE</td>
<td><em>Forschungen in Ephesus</em></td>
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<td>Hadashot Arkheologiyot</td>
<td>Reports from the Israeli Antiquities Authority. See the electronic reports available online at: <a href="http://www.hadashot-esi.org.il/">http://www.hadashot-esi.org.il/</a></td>
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<td>IEJ</td>
<td><em>Israel Exploration Journal</em></td>
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<td>IG</td>
<td><em>Inscriptiones Graecae</em> (Berlin, 1873–)</td>
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<td>IGLSyr</td>
<td><em>Inscriptions grecques et latines de la Syrie</em></td>
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<tr>
<td>IK</td>
<td><em>Inschriften griechischer Städte aus Kleinasien</em></td>
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<td>IRT</td>
<td><em>Inscriptions of Roman Tripolitania</em></td>
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<td>H. Wankel ed., <em>Die Inschriften von Ephesus</em> = <em>IK</em> 11-17 (Bonn, 1979-1987)</td>
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<td>IstMitt</td>
<td><em>Istanbuler Mitteilungen</em></td>
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<td>JDAI</td>
<td><em>Jahrbuch des Deutsches Archäologisches Institut</em></td>
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<td>JRA</td>
<td><em>Journal of Roman Archaeology</em></td>
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<td>JRS</td>
<td><em>Journal of Roman Studies</em></td>
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<td>KST</td>
<td><em>Kazı Sonuçları Toplantısı</em></td>
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<td>LP</td>
<td><em>Liber Pontificalis</em></td>
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<td>MAMA</td>
<td><em>Monumenta Antiqua Asiae Minoris</em> (Manchester, 1928-)</td>
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<td>NEAHL</td>
<td><em>New Encyclopedia of Archaeology in the Holy Land</em></td>
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<td>ODB</td>
<td><em>Oxford Dictionary of Byzantium</em></td>
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<td>ÖJh</td>
<td><em>Jahresheft des Österreichisches Archäologisches Institut</em></td>
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<td>PPUAES</td>
<td><em>Publications of the Princeton University Archaeological Expeditions to Syria in 1904–5 and 1909</em></td>
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<td>PLRE</td>
<td><em>Prosopography of the Later Roman Empire</em> (Cambridge 1971-1992)</td>
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<tr>
<td>RE</td>
<td>Pauly's <em>Realencyclopädie der classischen Altertumswissenschaft</em></td>
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<tr>
<td>RECAM II</td>
<td><em>Regional Epigraphic Catalogues of Asia Minor, volume II: The</em></td>
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SEG Supplementum Epigraphicum Graecarum

TAD Türk Arkeoloji Dergisi

TAM Tituli Asiae Minoris

TIB Tabula Imperii Byzantini

ZPE Zeitschrift für Papyrologie und Epigrafik
al-Masudi

Al-Tabari

Anonymous Miracles of the Pege

Antiochixos

Athenaeus, Deipnosophistae

Book of Ceremonies
trans. A. Moffatt and M. Tall, Byzantina Australiensia n.s. 18 (Canberra, 2012) (follows pagination of Reiske edition)

Buildings

Caesarius of Arles

Celsius, De Medicina

Chronicle of Pseudo-Joshua the Stylite

Chronicle of Tel Mahre
Pseudo–Dionysius, *Chronicle of by Tel Mahre*, 629
trans. W. Witakowski, Translated Texts for Historians 22 (Liverpool, 1996)

**Chronicon Paschale**


**Corippus**


**CTh**

*Theodosian Code and Novels and the Sirmondian Constitutions, a Translation with a Commentary, Glossary and Bibliography*, trans. C. Pharr with T. S. Davidson, M. B. Pharr (Princeton, 1952)

**Cyril of Scythopolis**


**Démétrius**


**Evagrius Scholasticus**


**Excerpta de insidiis**

*Excerpta de insidiis*, ed. C. De Boor (Berlin, 1905)

**Fragmentary Classicising Historians**


**Frontinus**

Frontinus, *De Aquis Urbis Romae = The Aqueducts of Rome*, trans. C. F. Bennett, Loeb
<table>
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<td>Geography</td>
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<td>Hippocrates, De liquidorum usu</td>
<td>Hippocrates, De liquidorum usu, ed. J. L. Heiberg</td>
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<td>Life of Theodore of Sykeon</td>
<td>Three Byzantine Saints, Contemporary Biographies of St Daniel the Stylite, St Theodore of Sykeon and St John the Almsgiver, trans. by E. Dawes and N. H. Banes</td>
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<td>The Chronicle of John Malalas, trans. E. Jeffreys, M. Jeffreys, and R. Scott, Byzantina</td>
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Menander Rhetor

Miracula Demetrii

Miracles of Thekla

Oxyrhynchus Epitome of Livy

Panegyrici Latini

Patria

Pausanias

Philostratus, *Lives of the Sophists*

Pliny the Elder, *Natural History*

Plutarch, *Moralia*
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<td>J. C. Rolfe</td>
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<td><em>Historia Ecclesiastica</em></td>
<td>J. P. Migne</td>
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<td>C. Mango and R. Scott</td>
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Downey, Loeb 48, 81, 107, 173, and 217 (London and Cambridge MA, 1914–1928)

**Vegetius**

**Vita Basilii**
*Chronographiae quae Theophanis Continuati nomine fertur Liber quo Vita Basilii Imperatoris Amplectitur*, ed. and trans. I. Ševčenko, CFHB 42 (Berlin, 2011)

**Zachariah of Mytilene**

**Zosimus**
*Zosimus, the New History*, trans. R. T. Ridley (Sydney, 1982)
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