

## Going against the flow

Wells, cisterns and water in ancient Greece

Edited by Patrik Klingborg



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Edited by Patrik Klingborg

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## ABSTRACT

Despite the prevalent picture of the water supply in the ancient world as being dominated by fountains and aqueducts, the large number of excavated wells and cisterns show that these were the primary water sources for most individuals. Yet, little research has been done on their construction, function and use. This prompted the organization of the workshop *Going against the flow. Wells, cisterns and water in ancient Greece*, held at the Swedish Institute at Athens on 28–29 September 2017, and subsequent publication of the contributions in this volume. The ten papers presented here offer new evidence as well as a wide range of new perspectives on the use and function of wells and cisterns in ancient Greece. Considering the ubiquity of these installations in every type of setting during antiquity, from pan-Hellenic sanctuaries and civic centres to domestic workshops and remote farmhouses, it is hoped that the breadth of interest among the authors will allow other scholars to advance their own work further, illuminating new and exciting aspects of life in ancient Greece.

*Keywords:* wells, cisterns, water supply, ancient Greece, archaeology, climate, sanctuaries

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Cover illustration: section of typical ancient Greek cistern, by Patrik Klingborg

Dust jacket: Photograph by Pavlos Karvonis. The rights of the depicted monuments belong to the Hellenic Ministry of Culture and Sports (Law 3028/2002). Delos falls under the responsibility of the Ephorate of Antiquities of Cyclades, Hellenic Ministry of Culture and Sports

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PATRIK KLINGBORG  
Athens, December 2021



# I. Introduction

## Wells, cisterns and the water supply in ancient Greece

### Abstract

Despite the prevalent picture of the water supply in the ancient world as being dominated by fountains and aqueducts, the large number of excavated cisterns and wells show that these were the primary water sources for most individuals. Yet, little research has been done on their construction, function and use. This prompted the organization of the workshop *Going against the flow. Wells, cisterns and water in ancient Greece*, held at the Swedish Institute at Athens on 28–29 September 2017, and subsequent publication of the contributions in this volume. This chapter begins by providing a background to why cisterns and wells should be studied, followed by the aims of the volume, i.e. to collect studies on Greek cisterns and wells that bring the empirical evidence into focus. Following this the chapter provides a background to the contributions by discussing the definitions of the terms “cistern” and “well”, previous research, and suggestions for future work. Finally, the chapter presents the individual contributions in the volume.\*

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### Wells, cisterns and water supply in ancient Greece

Water is necessary for human survival. While oft repeated, this remains valid both for modern and ancient societies.<sup>1</sup> Especially during the Mediterranean summer a well-functioning water supply was necessary for societies to emerge, survive and grow. Originally, early settlements relied on natural sources such as springs, watercourses and lakes. But to progress beyond a rudimentary scale, societies needed to transform, re-organize and expand the water supply by augmenting it and creating artificial sources—man-made water supply installations in the form of wells are found at least from Neolithic times in Greece.<sup>2</sup> By the Archaic period fountains (tapping local springs or using long conduits) and wells were widely used, along with small numbers of cisterns.<sup>3</sup> From 400 BC

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<sup>1</sup> Stroszeck 2021, 110; Klingborg & Finné 2018, 2; Mariolakos 2018, 4; Rogers 2015, 1; Albrecht 2014, 9; Koufopoulos & Myriantheos 2014, 109; Angelakis *et al.* 2012, xxi; Paliouras 2006, 95; Brinker 1990, 5; Tölle-Kastenbein 1990, 8; Biernacka-Lubańska 1977, 26; Camp 1977, 15.

<sup>2</sup> See e.g. the water supply in Athens which has its roots in the Neolithic period (Camp 1977).

<sup>3</sup> For overviews of the development of the water supply in ancient Greece see Rogers 2018 (Roman period); De Feo *et al.* 2012; Mithen 2012, chapter 4; Wikander 2000; Crouch 1993; Tölle-Kastenbein 1990; Fahlbusch 1987; 1982; Schmidt-Ries 1956; Ninck 1921. Cisterns were, however, unusual during the Archaic pe-

cisterns became increasingly popular at the expense of wells, while monumental aqueducts occur from the 2nd century BC, and in particular during Roman times.<sup>4</sup>

Despite the many available water sources, scholarship has focused on specific parts of the water supply. The use of natural sources has largely been overlooked. While often mentioned as important, especially in earlier periods, they are rarely discussed, perhaps because of the ephemeral evidence for their use.<sup>5</sup> In contrast to this, monumental structures, in particular aqueducts and fountains, have received substantial attention.<sup>6</sup> Less impressive installations, such as most wells and cisterns, have rarely been discussed. For example, in Örjan Wikander's impressive *Handbook of ancient water technology* from 2000 only a brief overview of wells and a few paragraphs on cisterns were included, both by Trevor Hodge who was an expert on aqueducts.<sup>7</sup>

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riod (Klingborg 2017, 52–66; Lang 1996, 121). For a securely dated exception, see Klingborg 2017, no. 157; Tanoulas 1992; 2017.

<sup>4</sup> Klingborg 2017; *AvP* 1:4; contributions in Aristodemou & Tassios 2018.

<sup>5</sup> For research on rivers and springs see Dan & Lebreton 2018; Skoulikidis *et al.* 2018; Chiai 2017; Schönach 2016; Günther 2009; Larsen 2001; Brewster 1997; Weiss 1984; Smith 1922. Crouch 1993 discusses the water supply system in Greek cities at large, but focuses largely on the importance of springs. See also Crouch 1996.

<sup>6</sup> For a selection of important contributions on fountains see Aristodemou & Tassios 2018; Rogers 2015; Richard 2012; Longfellow 2011; Robinson 2011; Reinholdt 2009; Hellner 2004; Dorl-Klingenschmid 2001; Marchetti & Kolokotsas 1995; Frigerio 1992; Glaser 1983; Walker 1979; Gagniers *et al.* 1969; Parson 1943; Dunkley 1935–1936; Hülsen 1919. On the terminology of fountains and springs, see Rogers 2015; Tölle-Kastenbein 1985; Wycherley 1937. For aqueducts and similar structures, see Wiplinger 2019; Aristodemou & Tassios 2018; Angelakis *et al.* 2016; Parise 2012; Lolos 2011, 571–584; Mavromati & Chryssaidis 2007; Kelly 2004; *AvP* 1:4; Hodge 2000c; Lolos 1997; *Samos* 19; Hodge 1992; Coulton 1987; Kienast 1979.

<sup>7</sup> Wells, see Hodge 2000b. Cisterns, see Hodge 2000a, 21–22.

The lack of studies on cisterns and wells is problematic because they were extremely common and consequently used by a large number of people in a wide range of settings. For example, about 230 wells and 160 cisterns are known from the Athenian Agora and its immediate environment.<sup>8</sup> In Piraeus, Klaus-Valtin von Eickstedt recorded 240 cisterns and 200 shafts.<sup>9</sup> At Olympia 240 wells have been excavated.<sup>10</sup> In the *Burgberg* area in Pergamon 150 cisterns have been found.<sup>11</sup> Dozens of wells and cisterns are also known from Delos.<sup>12</sup> At Corinth Mark Landon catalogued 600 installations connected to the water supply, many of them wells and cisterns.<sup>13</sup> In contrast to this, Franz Glaser knew of just 95 fountains from the 7th century BC to the 2nd century AD in modern Greece.<sup>14</sup> Yannis Lolos records 48 Roman aqueducts in the same area.<sup>15</sup>

As a consequence of the almost exclusive focus on aqueducts and fountains, our view of the water supply and how it was used is severely skewed. It was against this background that the workshop *Going against the flow. Wells, cisterns and water in ancient Greece* was organized at the Swedish Institute at Athens, taking place on 28–29 September 2017. The intention was to highlight the importance of cisterns and wells while spreading knowledge about these and encouraging scholars to incorporate them in their studies. Many of the papers presented at the

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<sup>8</sup> Klingborg 2017, nos. 1–156; Camp 1977, 183.

<sup>9</sup> von Eickstedt 1991, 194–237. von Eickstedt's terminology makes any definitive number difficult to reach as no functional distinction is made between *Schächte*, regardless of whether they are cisterns, part of water conduits or well-like installations.

<sup>10</sup> Kyrieleis 2011, 114.

<sup>11</sup> *AvP* 1:4, 17–23.

<sup>12</sup> Karvonis 2000; for the cisterns in the Theatre Quarter see Klingborg 2017, nos. 312–337. See also Karvonis in this volume, *Chapter 4*.

<sup>13</sup> Landon 1994, 3; for a selection of cisterns from Corinth, see Klingborg 2017, nos. 211–253.

<sup>14</sup> Glaser 1983, 7–123.

<sup>15</sup> Lolos 1997, 303–312.

workshop are published here, alongside a few additions widening the scope of the volume.

Acknowledging the wide proliferation, and importance, of cisterns and wells we can begin to ask new questions. For example, the material presented in this volume from the Heraion at Samos and the Sanctuary of Zeus at Nemea allows us to think about how wells affected life at these sites: what were they used for, who controlled them and which individuals could access the water? This, in turn, enables us to further develop what we know about life and practices at these sites. In a different vein, the chapters dealing with cisterns and wells in urban contexts allow us to reconsider old perspectives. Were fountains the primary source of water even when a large part of the population had access to wells and cisterns in their homes? If not, which the contributions to this volume seem to suggest, how does this affect our views, for example, on women fetching water from fountains? This is of particular interest as drawing water is often perceived as a gendered activity. Is this perspective sustainable if we assume that most individuals, men and women, had access to water in their own courtyard? Overall, cisterns and wells were important installations in the lives of the vast majority of the population and something with which they interacted on a daily basis in many cases. As such, their presence, form and function would have affected just about every aspect of daily life in ancient Greece.

While highly relevant, these and other questions cannot be answered in this volume, largely because evidence in terms of published material is lacking. Instead this volume aims to collect studies on Greek cisterns and wells that bring such evidence into focus. By doing this, it contributes to making it possible to ask such questions, and hopefully answer them, in the future by providing a better empirical basis for scholars. This, in turn, will allow greater incorporation of cisterns and wells into our understanding of both the ancient water supply system and the society that used it.

This chapter contributes towards these aims by first discussing issues with the modern terminology and proposing definitions for the words “cistern” and “well”. Secondly, an overview of previous research provides a backdrop to the following chapters. Thirdly, it looks forward to possible future directions in the study of these installations.

## What are cisterns and wells?

To date, the inconsistent use in modern scholarship of the terms “cistern” and “well” has hampered the study of these installations. This means that structures have been designated as wells and cisterns, or even fountains and aqueducts, or any other of a number of terms, without reflection on the difference between them. Sometimes this tendency becomes somewhat confusing, for example, in the description of an installation in Corinth (my italics): “In the southwest corner of the area is a *well* [...]. The *shaft*, which has a depth of only 6 m., probably never had water of its own but seems to have been filled from the conduit at the top and was thus in the nature of a *reservoir*. Possibly it was intended as a *manhole* to a *cistern*.”<sup>16</sup> What type of installation is intended in this passage? A well, cistern or reservoir? Some other water source? A means of access to a water source? The use of so many terms also suggests that the difference meant little to the excavator, even though cisterns, wells and reservoirs (depending on what is intended by the terms) create very different circumstances under which water can be used. Difficulties like these have been a serious impediment to the study of cisterns and wells, perhaps resulting in less research being produced.

<sup>16</sup> *Corinth* 1:4, 7. For “shaft” as a term for a type of water source, see von Eickstedt 1991.

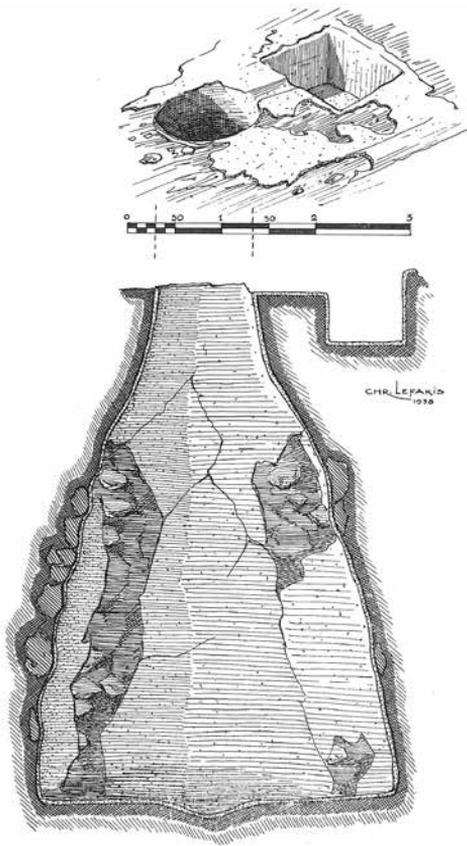


Fig. 1. Cistern in house Av5 at Olynthos, late 5th to first half of the 4th century BC. Drawing from Olynthus 12, pl. 101.

For cisterns, the terminological issues have forced scholars studying these to closely define what they mean by the word.<sup>17</sup> While the authors of this volume have approached this aspect individually, in this chapter cistern refers to a statically situated waterproof container constructed above or below ground to store water (Fig. 1). Cisterns held water that had been received from an external source—usually rainwater—and were not intended to receive a constant inflow or facilitate a constant outflow.

<sup>17</sup> Fuchs in this volume, *Chapter 7*; Klingborg 2017, 4; van Tillburg 2013, 17; Hellmann 1994, 273; Brinker 1990, 3–4; Biernacka-Lubańska 1977, 27.

Installations with a constant inflow and outflow are instead referred to as reservoirs. The effect of this is that many installations commonly referred to as cisterns are not included here, e.g. the massive water storage units connected to aqueducts (e.g. the Basilica Cistern in Istanbul and the *Piscina Mirabilis* in Naples).<sup>18</sup>

<sup>18</sup> For the Basilica Cistern, see Crow *et al.* 2008; for *Piscina Mirabilis* see e.g. Döring 2007. For less well-known examples, see e.g. the monumental urban cistern in Ostia (Locicero 2017, 365), the “cistern” at New Pleuron (Diamanti & Kalavrouziotis 2013, 590, 593–595; Lippman 2004, 498, figs. 4–5; Lang 1996, 296; Bommeljé 1987, 104; Biernacka-Lubańska 1977, 30; Tomlinson 1969, n. 10; Woodhouse 1897, 120–121, figs. 4–5, and photograph, p. 121) and the “cistern”



the South Stoa are frequently called wells.<sup>23</sup> Here a well is defined as an artificially created water source—usually, but not necessarily, in the shape of a shaft—dug into the ground until it reaches the water table, from which it is fed (*Fig. 2*). Importantly, this means that water is constantly “produced” by the well, while the water level may rise or recede over the short or long term. The water tends to be drawn from one, or in rare cases several, clearly delimited horizontal openings. Wells may be interconnected with other wells or cisterns in various ways. For example, some cisterns overflow into wells.<sup>24</sup> However, a continuous row of wells (or shafts) interconnected at the bottom by a tunnel which also accesses groundwater and leading to a primary outflow, functions quite differently and should be distinguished as such. Some scholars would consider such structures qanats, others shaft-and-gallery aqueducts.<sup>25</sup> The distinction from a regular well is, however, important, regardless of the term used, as the types of structures differ radically in terms of the water quantity, as well as how the water was distributed and used.

## Cisterns and wells in modern scholarship

While cisterns and wells have been treated differently in terms of the need for definitions, research on the two types of installation has largely followed the same trajectory: early studies focused on the material deposited in the installations while it is only more recently that cisterns and wells have been viewed within the framework of the water supply system. But

despite these similar trends the two are treated separately below for greater clarity. Moreover, this overview is focused on studies with an expressed focus on cisterns and wells, not general studies on the ancient water supply where such features are intermittently mentioned.

## CISTERNS

The earliest travellers and scholars in Greece noted the presence of cisterns at archaeological sites.<sup>26</sup> As excavations commenced these cisterns were often cleared, usually in order to recover the material deposited in them.<sup>27</sup> Thus, early exploration of cisterns may be compared to the excavation of tombs, first and foremost seeking prestigious finds. The rich deposits in cisterns also led to large numbers being excavated. Beginning in the 1930s the approach changed somewhat from a focus on impressive finds to one where ceramics in closed contexts became increasingly sought after as they could be used to develop typologies and chronological frameworks.<sup>28</sup> As a result many publications of cisterns, in particular from the mid-20th century onwards, focus almost exclusively on the material found in them. This trend is particularly notable at the American Agora Excavations in Athens.<sup>29</sup> Some prominent exam-

<sup>26</sup> E.g. Gell (1810, 130) writing about the cisterns on the Bisti peninsula at Hermione in the Peloponnese.

<sup>27</sup> The following passage in Humann *et al.* (1888, 55–56) is representative of this tendency: “Südlich des höchsten Felsens [...] fanden wir wohlerhalten eine statliche Cisterne von 4½ m Durchmesser im Quaderbau; wir waren nicht wenig enttäuscht, beim Entleeren auch nicht das Geringste in dem Schutte, der sie 6 m tief bis oben füllte, zu finden.”

<sup>28</sup> Klingborg 2017, 12. See studies dedicated to the fill of one or more cisterns: e.g. James 2010; Lomtadze & Zhuravlev 2004; Pfrommer 1985; Miller 1974; Thompson 1963; Homann-Wedeking 1950; Thompson 1934.

<sup>29</sup> A large number of *Agora* volumes are dedicated to material largely found in cisterns, and practically all contain deposit lists relating the finds from various contexts. Further articles also treat material found in cisterns. See also *Olynthus* 8, 122, n. 80: “practically no

<sup>23</sup> *Corinth* 1:4, 59–65; Robinson 2011, 16–17. See also Lolos in this volume, *Chapter 3*.

<sup>24</sup> E.g. Klingborg 2017, nos. 91, 97, 148.

<sup>25</sup> On qanats, see Wilson 2008, 209–293; Hodge 2000c. For a discussion of the definition of a qanat, and the growing use of the term, see Chiotis 2018.

ples are Homer A. Thompson's article (1934) 'Two centuries of Hellenistic pottery', Dorothy Burr Thompson's (1962) 'Three centuries of Hellenistic terracottas, II C the Satyr cistern' and Stella G. Miller's (1974) study 'Menon's cistern'.<sup>30</sup> While these publications have been instrumental in increasing our understanding of ceramic development, they have contributed little to the understanding of the water supply system.

From the 1970s onwards there has been an increased focus on cisterns as part of the water supply, but this has not prevented the earlier material-focused approach from continuing:<sup>31</sup> even today the fills in cisterns tend to receive far more attention than the structures themselves.<sup>32</sup> In terms of studying cisterns as part of the water supply, John Camp's study *The water supply of ancient Athens* from 1977 is especially important due to its comprehensive approach, taking a holistic perspective including all types of water sources, as well as its ability to incorporate various forms of evidence.<sup>33</sup> In the same year Małgorzata Biernacka-Lubańska published the article 'A preliminary classification of Greek rainwater intakes' where she called for further studies on cisterns.<sup>34</sup> The next major work on cisterns in the Greek world was Werner Brinker's *Wasserspeicherung in Zisternen* published in 1990. While largely focused on Pergamon, the study attempted to explore cisterns in the whole Mediterranean from their first appearance to the Islamic era. The wide

scope, however, became an issue as it tended to draw the study towards generalizations and oversimplifications based on limited material. Also in 1990 Renate Tölle-Kastenbein's book *Antike Wasserkultur* included a chapter on cisterns.<sup>35</sup> These works were followed by two further contributions which focused on Piraeus and Eleutherna, respectively. The former is von Eickstedt's *Beiträge zur Topographie des antiken Piräus*, which includes a catalogue of 280 water supply installations, the majority of which were cisterns and various tunnels. The latter work, *Eleutherna* vol. 2:2, contains a short chapter on cisterns at the site.<sup>36</sup>

Since 2000 the interest in cisterns has been invigorated with numerous articles and a number of major publications.<sup>37</sup> In 2001 Günther Garbrecht's book *Stadt und Landschaft*, vol. 4. *Die Wasserversorgung von Pergamon* was published with an excellent chapter on cisterns in the city.<sup>38</sup> While largely based on Brinker's 1990 dissertation it is decidedly more informative. It can confidently be viewed as the first truly in-depth study of cisterns from a larger perspective. A similar study, but not as comprehensive in terms of cisterns, *Milet und das Wasser*, was published by Gerhard Tuttahs in 2007. The same year Christoph Olhig published an edited volume titled *Antike Zisternen*. While the articles in his book did not focus primarily on Greek cisterns, or indeed on structures considered cisterns following the definitions used here, it highlights the growing interest in water storage installations.

During the last decade an increased interest in cisterns can be observed, probably fuelled

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material with chronological or intrinsic value is found in the Olynthian cisterns and so they do not repay complete excavation."

<sup>30</sup> Miller 1974; Thompson 1962; Thompson 1934.

<sup>31</sup> Directly expressed in Keller & Schneider 2011, 101: "we realized that cisterns and wells are choice features to excavate when looking for a substantial deposit of pottery."

<sup>32</sup> Vogeikoff-Brogan 2000; Tolstikov & Zhuravlev 2004; James 2010.

<sup>33</sup> Camp 1977.

<sup>34</sup> Biernacka-Lubańska 1977.

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<sup>35</sup> Tölle-Kastenbein 1990, 106–114.

<sup>36</sup> von Eickstedt 1991; Guy & Matheron 1994.

<sup>37</sup> Keilholz 2017; Stroszeck 2014; Sazakli *et al.* 2015 (cf. Sazakli *et al.* 2007); Antoniou *et al.* 2014; Keilholz 2014; Bitis 2013; Van Liefferinge *et al.* 2011; Cadogan 2007; Keilholz 2007; Antoniou *et al.* 2006; Bildirici 2006; Murphy 2006; Connelly & Wilson 2002.

<sup>38</sup> Listed as *AvP* 1:4 in the bibliography.

partly by a modern connection to concepts such as sustainability and resilience.<sup>39</sup> In terms of important studies during this period Kai Wellbrock's 2016 publication of the water supply system, including the cisterns, in the area of the *Stadtgrabung* in Pergamon stand out.<sup>40</sup> This work is especially important due to its impressive treatment of the material and all aspects of the water supply system in a large sector of the city. An article by Stella Chrysoulaki and her colleagues relating some preliminary insights into the impressive remains, including many cisterns and wells, found during the new Metro excavations in Piraeus is also worth mentioning.<sup>41</sup> While brief, it shows the wealth of available material. The most comprehensive recent work on cisterns in the Greek world is Patrik Klingborg's 2017 study *Greek cisterns. Water and risk in ancient Greece, 600–50 BC*.<sup>42</sup> Based on substantial analysis of 410 cisterns from 49 sites in the Greek world, the study explored how these functioned, were used and viewed by the population. This is followed by a study by Klingborg where the chronological significance of material deposited in cisterns for their period of use is explored.<sup>43</sup> Currently there are further studies on cisterns underway: in particular Ioannis Bitis' investigation of the 80 cisterns at Doric Thera is highly anticipated. The final publication of the recent Metro excavations in Piraeus will also provide a great deal of new evidence. Looking back at the general trend during the last decades in the research of cisterns it seems clear that studies of material found in them are becoming less common while interest has largely shifted towards work exploring

how cisterns functioned and were used in their context.<sup>44</sup>

## WELLS

From at least the 1930s studies of excavated wells have similarly focused on the material deposited in them.<sup>45</sup> As with cisterns it was realized that these closed deposits offered great potential for the creation of ceramic chronologies, while the architectural structures themselves received little or no attention.<sup>46</sup> Importantly, deposits from cisterns and wells came to complement each other. Cisterns tend to have large volumes of contemporary material dumped into them all at once or on a limited number of occasions after the end of the use as a water source, creating large chronologically limited deposits. Wells on the other hand are usually filled up gradually during their period of use as cleaning is difficult, creating a chronological sequence of material. Following this they may have one or more secondary fills, as in the case of cisterns.

Beyond interest in the material recovered, some studies have focused on wells as part of the water supply system. Moving beyond the focus on finds in wells, the preliminary publication in 1970 of the Dipylon Well in Athens was divided into two parts: the first dealt with the well itself and its context, the second with the finds in the fill.<sup>47</sup> From this point onwards the development of the study of wells in ancient Greece closely follows that of cisterns, including the important works by Camp, von Eickst-

<sup>39</sup> See Mays *et al.* 2013; Mays 2010; Koutsoyiannis *et al.* 2008. See Knight 2014 for a similar, but unusual approach for wells.

<sup>40</sup> Wellbrock 2016.

<sup>41</sup> Chrysoulaki *et al.* 2017.

<sup>42</sup> Followed by an article (Klingborg & Finné 2018) discussing the water supply capacity of cisterns in Olynthos and Dystos.

<sup>43</sup> Klingborg 2019.

<sup>44</sup> For recent studies treating the fill in cisterns see James 2010; Le Quééré 2018.

<sup>45</sup> Kimmey 2017, 44. See studies dedicated to the fill in one or more wells: James 2010; Åström 1998; Anderson-Stojanović & Reese 1993; Jordan 1985; Braun 1970; Coldstream 1960; Brann 1956; Vanderpool 1946; Talcott 1935.

<sup>46</sup> E.g. the ten Archaic–Classical wells at Lerna which were hardly documented (*Lerna* 8, 111–112).

<sup>47</sup> Braun 1970; Gruben 1970.

edt, Tölle-Kastenbein and Tuttahs mentioned above.<sup>48</sup> Camp's study on the water supply of Athens was largely focused on the development in the area of, and around, the Athenian Agora.<sup>49</sup> He also contextualized the wells by suggesting that the increasing depth during the Classical period indicated a period of repeated droughts.<sup>50</sup> This view has since become popular, but has also recently been challenged.<sup>51</sup> As for cisterns, von Eickstedt's study on the topography of Piraeus included a wealth of information about wells and Tölle-Kastenbein wrote a section surveying wells in the ancient world overall.<sup>52</sup> Tuttahs' study of the water supply in the area of Miletos is particularly useful for wells due to its focus on the material with informative data and illustrations.<sup>53</sup> An unpublished Ph.D. thesis in three volumes by Laure Chevalier titled *Les puits dans le monde grec. Recherches sur les usages profanes et religieux de l'eau souterrain* also merits mention.<sup>54</sup> There are, however, differences between how wells and cisterns have been treated. Foremost, wells tend to have been viewed as a more natural part of the water supply system than cisterns. This is manifested by how they were deemed to warrant their own chapter, written by Trevor Hodge, in Örjan Wikander's *Handbook of ancient water technology*. There is no corresponding chapter devoted to cisterns.<sup>55</sup>

In addition to these studies focused on wells as water sources, other works pursue different angles. In 1949 Mabel Lang published an interesting study on wellheads from the Athenian Agora.<sup>56</sup> At Thasos Hervé Duchêne discussed an inscription regulating the construction of wells in the city, published in 1992.<sup>57</sup> Another inscription, from Halicarnassus, recording the construction costs for a “φρέαρ” (probably a well, see Klingborg below, *Chapter 8*) was treated in detail by Signe Isager in 2002.<sup>58</sup> This is interesting because it provides unique insights into the cost of constructing this kind of water supply installation.

Recently a number of important studies on wells have been published. The most significant is Jutta Stroszeck's *Wells in Athens. The contribution of the Kerameikos wells*.<sup>59</sup> In this study she treats, based on numerous excavated examples, themes such as water quality, construction technique, water-drawing vessels and devices, as well as chronology. At the same time, the study never loses sight of the context and activities around the wells, ensuring that it contributes significantly to our understanding of how these installations were used. As for cisterns, Chrysoulaki *et al.* provide some preliminary results from the recent Metro excavations in Piraeus, giving a glimpse into new and exciting material.<sup>60</sup> But despite recent interest in wells as part of the water supply system, most studies continue to focus almost exclusively on their deposits. In 2017 Stephanie Kimmey defended her Ph.D. dissertation *The Nemean wells. Sanctuary context and ritual activity in the Northeast Peloponnese*, based on deposits from ten wells in the Sanctuary of Zeus at Nemea. In 2018 Maria Liston, Susan Rotroff and Lynn Snyder

<sup>48</sup> Tuttahs 2007; von Eickstedt 1991; Tölle-Kastenbein 1990; Camp 1977.

<sup>49</sup> Camp 1977.

<sup>50</sup> Camp 1977, 250–259.

<sup>51</sup> Avgerinou 2016, 451–452; Christaki *et al.* 2017, 393–394; Mays 2014, 41; Crouch 1996, 131. For a contrary view, see Klingborg 2017, 129–131. See Finné & Labuhn in this volume, *Chapter 2*, for a perspective on the climate development based on recent scientific methods.

<sup>52</sup> von Eickstedt 1991; Tölle-Kastenbein 1990. See also Karadédos 1991, about wells in ancient Dion, albeit focusing on the Roman period.

<sup>53</sup> Tuttahs 2007, 65–94.

<sup>54</sup> Chevalier 2001, *non vidi*.

<sup>55</sup> Hodge 2000b; Wikander 2000.

<sup>56</sup> The study also included a smaller number of cistern *puteals*.

<sup>57</sup> Duchêne 1992.

<sup>58</sup> Isager 2002.

<sup>59</sup> Stroszeck 2017.

<sup>60</sup> Chrysoulaki *et al.* 2017.

published the long-anticipated volume on the Bone Well on the Kolonos Agoraios in Athens, where the remains of more than 450 infants were found. 2018 also saw the publication of Brice Erickson's *Lerna 8*, largely discussing material from ten wells at the site. In conclusion, then, it seems that the study of wells has often not moved beyond the material found within them, and that this still remains the central focus in most cases. There is consequently a considerable research lacuna to be filled in terms of the use and function of wells.

## Future directions

Despite an increased interest in both cisterns and wells during the last decade, there are still substantial gaps in our understanding of these installations. Primarily, it can be argued that, considering the dominance of fountains and aqueducts in modern scholarship, we simply cannot adequately understand the water supply in ancient Greece without more research on cisterns and wells. Based on this state of affairs three avenues of research in particular seem fruitful.

First, there is still an urgent need to publish excavated cisterns and wells in order to provide a firm empirical basis for further research. Currently the limited number of installations which can be found in the modern literature makes it difficult to compare newly excavated cisterns and wells with the extant material. One consequence of this is that a small number of published and well-known cisterns and wells, in particular around the Athenian Agora, have become a sort of standard despite being far from representative.<sup>61</sup> Ideally a larger corpora should be assembled in order to make comparative material readily available.

Secondly, there is a need for more studies that attempt to investigate the whole water supply system at a site or even a complete region, rather than individual installations or types. The advantage of this approach is evident in both Camp's study of the water supply in the area of the Athenian Agora and Wellbrock's recent study on the water supply in part of the *Stadtgrabung* area in Pergamon.<sup>62</sup> Moreover, it is critical that besides artificially constructed water sources, the use of watercourses, lakes and springs is investigated and incorporated into studies—these have rarely been treated as water sources due to the ephemeral nature of the evidence. Yet it is often suggested that the presence of such natural water sources was imperative for the foundation of early settlements.<sup>63</sup> There can be little doubt that these were all used in various ways during later periods as well.

Thirdly, parallel to the necessity of publishing material, there is a need to move beyond this and focus on the use of water supply systems, including cisterns and wells, in their context. How were water sources used in different settings? In what ways did the complex nature of the water supply system affect ancient society? What does the ever-changing nature of the water supply system reveal about the ancient world? In the end, it is important to remember that the primary motivation for studying the ancient water supply should be to learn about ancient societies and the people living in them, not the stones, bricks and linings forming the installations themselves.

## Contributions in this volume

The authors contributing to this volume cover a wide span of interests, ranging from climatic

<sup>61</sup> In particular the cisterns and wells in Thompson 1934; Lang 1968; Rotroff 1983.

<sup>62</sup> Camp 1977; Wellbrock 2016.

<sup>63</sup> Johnson 2004; Crouch 2003; Johnson 1996; Crouch 1993.



Fig. 3. Map of sites discussed in the present volume. By Patrik Klingborg, basemap by Google, ©CNES/Airbus, European Space Imaging, Landsat/Copernicus, Maxar Technologies, Map data 2021.

ology and ethnology to ceramics and aqueducts. Through their different backgrounds they take unique approaches to cisterns and wells in the ancient world, what aspect to focus on, and how to present the material. The geographical area covered is mapped in Fig. 3.

Following this introduction Martin Finné and Inga Labuhn set the scene by discussing the climate in ancient Greece, aiming to provide a general insight into the hydro-climate from c. 700 BC–AD 300 based on the currently available evidence from the Aegean and surrounding areas. In doing so they pay particular attention to what we do know about the ancient climate, as well as how the available data can be used in order to understand freshwater availability in ancient Greece. This is important because of the many potential methodological pitfalls when classicists use

climate studies in order to interpret their own findings, especially due to the different scholarly traditions between the humanities and natural sciences.

The third contribution, by Yannis Lolos, is based on his long field experience in Corinthia and focuses on the water supply in Corinth and Sikyon, comparing the situation at the two sites with a focus on wells and cisterns. In particular, Lolos stresses the extensive nature of the water supply at Corinth while also pointing toward the plurality of sources available to the inhabitants of the city. Impressively, the city flourished without tapping distant external sources for almost a millennium. While considerably less is known about ancient Sikyon, current evidence suggests a much different situation whereby the inhabitants of the Hellenistic and Roman city relied largely on wells.

In the next chapter the use of wells and cisterns is explored in a very differently situated city, as Pavlos Karvonis turns to the material on Delos, specifically taking up the water supply in Late Hellenistic private houses. This was provided by wells, cisterns and infiltration wells, the latter being a hybrid water source relying both on groundwater and rainwater. Following a discussion on the material, Karvonis continues by considering other important factors such as the distribution of water sources, how water was drawn, used, and its quality.

Moving away from entire cities, the following chapters focus on limited sites and sanctuaries. In her contribution Jutta Stroszcek investigates the cisterns at Kerameikos in Athens. In doing so she pays particular attention to the location, layout and interconnections of the cisterns as well as building techniques and chronology. Following this she discusses the purpose and abandonment of the cisterns. Through her well-informed approach, rich documentation and large number of illustrations, an important body of material is now available for further studies. Moreover, in combination with Stroszcek's recent paper on the wells in the same area, the water supply of Kerameikos may now be viewed as the best understood in Athens, if not the entire Greek world.<sup>64</sup>

After Stroszcek's chapter the next two contributions discuss material from major sanctuaries. First Stephanie Kimmey studies the wells in the Sanctuary of Zeus at Nemea. She has previously dealt primarily with the deposits contained in these.<sup>65</sup> Now, she largely turns away from this material in favour of a focus on the construction and spatial distribution of the wells. The fills are then used to discuss deposition processes and what the material can tell us about the wells as water sources and how they functioned in their context. As such she man-

ages to produce a new picture of life at one of the most important Pan-Hellenic sanctuaries.

Following this Johanna Fuchs explores the water supply at the Heraion at Samos based on recent archaeological work by the Deutsches Archäologisches Institut, Abteilung Athen. In particular, the chapter focuses on the project's methodology—how can the water supply in a major sanctuary be properly explored?—as well as the various wells found at the Heraion. She also, importantly, takes a critical perspective when exploring various installations which have previously been identified incorrectly.

Moving away from the archaeological evidence, Patrik Klingborg investigates the previously unexplored literary testimony for wells and cisterns during the last millennium BC. In particular, the chapter aims to elucidate what this evidence can tell us about how these installations functioned, their place in the water supply system, and how the meaning of various terms changed over time. In doing so he highlights the terminological issues when investigating these installations, how this shapes the conclusions that can be drawn regarding how they were used, and how the elite perspective of the ancient authors did not facilitate views primarily relevant for the use of wells and cisterns in Greek societies.

Following these studies of the ancient material Hamish Forbes brings us back to modern times by discussing the use of cisterns and wells on the Methana peninsula in Greece in the early 1970s. At the time of Forbes' ethnological fieldwork the community in which he stayed had received electricity and running water only two years earlier, and it was still lacking in areas of the peninsula. Consequently, much of the know-how and traditions related to the use of cisterns and wells were still present and alive, providing a unique perspective on their use and significance.

In the final contribution Dylan K. Rogers turns to the social side of water collection—how can the study of the water supply elucidate daily

<sup>64</sup> Stroszcek 2017.

<sup>65</sup> See Kimmey 2017.

life in ancient Greece? Exploring four aspects (gendering of water collection, water and prostitution, water in religion, as well as the usefulness of ethnographic studies) the author argues that the places where water was collected functioned as nodes in the urban landscape, inviting individuals to stop there, use the water and socialize.

Together these contributions offer new evidence, as well as a wide range of new perspectives on the use and function of wells and cisterns in ancient Greece. Considering the ubiquity of these installations in every type of setting during antiquity, from pan-Hellenic sanctuaries and civic centres to domestic workshops and remote farmhouses, it is hoped that this breadth of interest among the authors will allow other scholars to advance their own work further, illuminating new and exciting aspects of life in ancient Greece.

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