SHE SHALL WE GO «AD AQUAS»? PUTTING ROMAN HEALING SPAS ON THE MAP

¿NOS VAMOS «AD AQUAS»?: PONIENDO LOS BALNEARIOS ROMANOS EN EL MAPA

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Abstract
Bathing constructions are currently one of the better preserved and studied monuments of the Roman Empire. Nevertheless, there remains a significant research gap as to the nature of water exploited within. The mineral-medicinal waters, in fact, conditioned not only the location, but also the function and, consequently, the architecture of these features. Hence, one of the main objectives of our current study is to highlight some of the main architectonic and functional characteristics of these bathing complexes from a selection of the better preserved and/or better documented spas using mineral-medicinal waters in the Roman Empire (henceforth referred to as healing or thermal spas/baths). This paper thus presents an initial distribution map, reviews the current state of research on this subject as well as some of the drawbacks to their study.

Keywords
Healing spas; Ancient thermalism; Roman Empire; thermal architecture.

Resumen
Hoy en día los edificios de baños son uno de los monumentos mejor conservados y estudiados del Imperio Romano. Sin embargo, existe un significativo vacío en su caracterización en función del agua utilizada en ellos. Las aguas mineromedicinales, de hecho, condicionaron no solo la localización, sino también la función, y consecuentemente, la arquitectura de estos edificios.

De acuerdo con esa consideración, uno de los principales objetivos de este estudio es proporcionar una primera síntesis de los rasgos más característicos de estos complejos de baños, a partir de una selección de los edificios balnearios con aguas mineromedicinales mejor conservados y documentados del Imperio Romano. En ese sentido, se presenta un primer mapa de distribución, así como una revisión del

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estado de la investigación sobre estos establecimientos, atentos a algunas de las dificultades de su estudio desde una perspectiva global.

Palabras claves
Balnearios; termalismo antiguo; Imperio romano; arquitectura termal.

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1. INTRODUCTION

The last decades have seen a great amount of research on Roman bath structures centred on their identification and description. These general approaches have highlighted the great diversity of their constructions and functions, but have rarely focused on the question of the specificities of their water. In this regard, in spite of their obvious contrasts, that research has rarely included general studies of ancient bathing buildings exploiting mineral-medicinal springs (referred to in this paper as healing or thermal spas/baths). This problem could stem from the lack of familiarity with the multiple uses of these waters or to confusion with classical baths exploiting fresh water, but fortunately in modern studies, as can be seen in the bibliography added, this perception is changing.

As is well-known today, mineral-medicinal water use leads to specific topographical, technical and functional implications that must be considered in their research. These implications will, furthermore, have a direct impact on factors such as location, architecture and hydraulic makeup. They will also bear an influence on a number of organisational, administrative, social, economic, religious and political aspects of their respective territories. Consequently, particular features of complexes exploiting mineral-medicinal waters in some cases have not yet been correctly identified. Additionally, their research, at times, has suffered from applying theoretical concepts specific to classical baths that are not applicable to mineral-medicinal sites. Likewise, these misinterpretations have led to the erroneous identification of the nature of certain rooms in their buildings. Similarly, a number of publications have not applied an appropriate terminology to describe their architectonic reality and organisational features.

Recognition of this problem in the research of healing spas is not new. It has been highlighted in certain pioneering archaeological studies, from a historicist perspective, assembling and describing the archaeological and patrimonial evidence. In this regard, J.G.H. Greppo (1846), and particularly L. Bonnard (1908), although limited to a specific geographic area (France and surrounding areas of Switzerland, Belgium, Germany), produced catalogues and laid the guidelines to interpret and characterise the archaeological evidence of mineral-medicinal features. One of

2. The study of bathing culture has been analysed from multifactorial points of views. To consider some examples of architectonical studies from a comparative perspective, see in particular, HEINZ 1983; MANDERSCHEID 1988, 2000; NIELSEN 1990; YEGÜL 1992; BOUET 2003; THÉBERT 2003 or GARCÍA-ENTERO 2005, among others, with some specific considerations, for example, in DELAINE and JOHNSTON 1999 or KREINER and LETZNER 2011.

3. Certain specialists of Roman ‘hygienic’ baths have highlighted this problem. I. Nielsen, for example specifies that these types of baths were not included in her study because of their singularities. This author noted the following: «As the thermal baths serve a different purpose and, for that reason among others, have a different architectural form, I have found it reasonable to exclude them from further discussion» (NIELSEN 1990: 5). F. YEGÜL (1992: 92-127), likewise, signals this problem in a specific chapter in his general study of thermal baths in Antiquity. A. BOUET (2003: 193, 291-92, 297-99), in turn, not only places emphasis on the importance of taking into account the type of water when studying and developing the model of these types of buildings, but indicates that they merit study as independent units.

4. A reflection about modern terminology applied to these sites and their treatments can be seen, for example, in GÓMEZ PÉREZ et alii 2017, where a brief summary of the historical applications and uses of mineral-medicinal waters can be consulted.
their greater contributions to Roman thermo-mineral baths research was to record, throughout the 19th and early 20th centuries, the archaeological features brought to light during the construction or renovation of modern spas.

Fortunately, the pioneering surveys in France were followed by a series of specific studies by A. Grenier (1960), A. Pelletier (1985) and R. Chevallier (1992) that include advanced notions that serve even today as excellent introductions to the subject. It was precisely in the 1990s when archaeological studies of the buildings of mineral-medicinal baths experienced a great impetus due, among others, to the inclusion of a chapter on this subject by W. Heinz (1983: 157-175), the bibliographical references of H. Manderscheid (1988), G. Garbrecht and H. Manderscheid (1994: A, 83-87; B, 327-385), and mainly the studies of F. Yegül (1992: 92-127) who analysed the architectonical evolution of some of these buildings. These authors offered preliminary overviews of the architectural features of these types of sites. This leap in research was bolstered by the proceedings of several scientific meetings focused only on this subject celebrated in France (Pelletier 1985; Chevallier 1992; Grange 1997), followed by the proceedings of meetings in Italy (Gasperini 2006) and in the Iberian Peninsula (Peréx Agorreta and Bazzana 1992; Peréx Agorreta 1997). Research on this subject was boosted once again by the convergence of the revitalisation of the sector of modern thermal spas at the end of the 20th and early 21st centuries with an increase of publications of modern preventive stratigraphic archaeological interventions.

The outset of the 21st century experienced a keen renewal of ancient thermal bath research with new projects striving toward obtaining a broader perspective of their characteristics and archaeological evidence, and focusing on advancing the understanding of the multiple historical implications linked to their use. These studies were nonetheless designed mostly along the lines of either modern
or Antique geographical limits (i.e. countries or regions or Roman provinces). Among the more notable are those carried out in Italy, France, Germany and Switzerland, Portugal, Spain, the Middle East and North Africa.

With some exceptions, the most common approach to the study of mineral-medicinal bath sites has been focused on their religious facet due to the presence of ex-votos or epigraphical elements. Nevertheless, it must be recognised that the recovery of these types of artefacts does not always unequivocally designate a mineral-medicinal water exploitation as these deposits are also characteristic of other types of Roman sites such as water sanctuaries.

However, a global and deeper review from an architectural and functional approach to these sites, by contrast, that can reveal key aspects serving to identify and understand the buildings of these mineral-medicinal complexes, has yet to be carried out. It is also noteworthy that a wide ranging survey of these types of complexes spanning the totality of the Roman Empire is yet to be published. Only a few studies have attempted to discern their general spread in Roman times, thus limiting identification of their regional architectural and functional features.

Despite these drawbacks, there is a growing interest in these complexes and analyses of a number of new finds are altering their overall view. Among them are, for example, the recent archaeological interventions in Chaves (Figure 1), São Pedro do Sul, Archena and Fortuna, Caldes de Montbui, Lugo and

5. We could consider some exceptions such as the Symposium Aquae (Chaves –Portugal- 2014) coordinated by S. Carneiro, or the recent publication by Bassani et alii 2018, in which some studies about different areas of the Roman Empire were compiled.
6. Obviously, this is the area of the Roman Empire which has been studied more in depth: for example, in Allen 1998; Guérin-Beavais and Martin 2007; Bassani et alii 2011; Ghedini et alii 2012; Bassani et alii 2013; Annibaleitto et alii 2014; Guérin-Beavais 2015.
13. See the studies, among others, Jouffroy 1992; Wilson 1997; Petteno 1998; Allen 2001; and recently Köhler 2018.
14. For example, see interesting approaches in Heinz 1983; Yegul 1992; Köhler 2002; 2003; 2006; Broise 2015. Also, from a social and cultural perspective, some researchers have proposed interesting approaches to this subject mainly considering descriptions of classical authors (Allen 1998; Dvorjetski 2007; Campbell 2011: 330-368; Guérin-Beavais 2015, among others).
15. See Table 1 for some of the most relevant bibliographical references.
16. Archaeological digs were directed by S. Carneiro to who I am grateful for his helpfulness and kindness. See the last publication about this site in Carneiro 2017.
17. New archaeological research is being carried out at this site by P. Reis, to whom I am thankful for her indications.
18. Archaeological studies have been done in Archena and Fortuna in the last years directed by G. Matilla Séiquer. My thankfulness for his kindness and discussions about these sites. See Matilla 2017, Matilla and Oviedo 2017.
19. New archaeological digs have been carried out in 2017.
20. I would like to thank the directors of the Thermal Spa of Lugo; to M. Crecente, archaeologists and other colleagues, for their helpfulness and collective effort in the study of this Roman spa. Crecente and González Soutelo 2016.
Ourense\textsuperscript{21} (in the Iberian Peninsula) as well as the new discoveries in Burgas\textsuperscript{22} or Hissarya\textsuperscript{23} (Bulgaria), Baden (Switzerland)\textsuperscript{24}, Varadinske Toplice (Croatia), Bansko (North Macedonia)\textsuperscript{25}, Sarikaya (Turkey)\textsuperscript{26}, Montegrotto Terme (Italy)\textsuperscript{27} and Jebel Oust (Tunisia)\textsuperscript{28}, but we are sure that the examples will greatly increase in the coming years.

The aim of this article is therefore to draw up a series of preliminary conclusions as to the singularity of Roman minero-medicinal baths. Specifically, this study compiles a number of notions as to the identification, current state of research, some architectonical characteristics and conservation of the buildings of Roman thermal spas as a starting point to determine the origin and significance of the first golden age of thermalism. This study also offers an introductory map of the distribution throughout the Roman Empire of some of the better preserved and documented examples of spa buildings (from an architectonic point of view) linked to thermal mineral-medicinal waters considered in this article (Table 1).

2. THE DRAWBACKS OF ATTEMPTING SURVEYS OF ROMAN THERMAL SPAS: ASPECTS TO BE CONSIDERED IN THEIR STUDY AND UNDERSTANDING

The distribution of the thermal-mineral bath complexes designated by the map reveals a limited and unequal spread throughout the Empire (Figure 2). This disparate distribution obviously derives from the fact that mineral-medicinal springs are limited to very specific settings where these types of waters emerge from the ground. Indeed, the choice of these specific locations to construct large Roman thermal spa buildings is subject to three basic aspects: 1) the technical capacity of adapting the architecture to the hydrological, geographic and geomorphological characteristics of the mineral-medicinal spring and to the water’s essential physical-chemical properties (composition, temperature, type of usage), 2) the symbolic and strategic function of some of these springs, and 3) the attributes linked to health associated with certain water sources that will result in their transformation into centres of veneration and pilgrimage. These factors undoubtedly conditioned the

\textsuperscript{21} For a summary about this site, see RODRÍGUEZ CAO and EGUILETA FRANCO 2017. My gratitude to these authors.
\textsuperscript{22} My thankfulness to the staff of the Regional Historical Museum of Burgas (Bulgaria) for their indications.
\textsuperscript{23} A new thermal spa complex (closer to the building published by PRESS 1984) has been excavated by the Archaeological museum of Hisarya over the last years. I would like to thank Dr. Radka Nankina for her indications.
\textsuperscript{24} A complete publication about the last archaeological excavations will be published in the next years. Our thankfulness to A. Schaer for her explanations and indications.
\textsuperscript{25} I would like to thank V.P. Sekulov from the Institute for Protection of Cultural Monuments and Museum of Strumica for his kindness and his comments about this site.
\textsuperscript{26} My gratitude to H.K. Şenyurt, from the Yozgat Museum, Ministry of Culture and Tourism of Turkey, for his information about this archaeological site.
\textsuperscript{27} For further information, see the \textit{Aqua Patavinae} project (http://www.aquaepatavinae.it/portale/) and the derived publications (BASSANI et alii 2011, 2013; ANNIBALETTO et alii 2014, among others). My gratitude to the authors for their discussions.
\textsuperscript{28} A new publication about this site is in progress. See, among others, the latest publication (BROISE 2015; CURIE et alii 2018). I would like to thank to H. Broise and other colleagues for their indications.
FIGURE 2. DISTRIBUTION OF THE BETTER PRESERVED AND/OR DOCUMENTED ROMAN THERMAL SPAS CONSIDERED IN THIS RESEARCH. THEIR NUMBERS AND CLASSIFICATION CORRESPOND TO THE SITES LISTED IN TABLE 1.
constructive characteristics of these sites and differentiated them from the other types of Roman baths.

Certain mineral-medicinal springs gained fame preceding the Roman period.\textsuperscript{29} Pre-Roman interest in these waters was, in fact, linked to territorial aspects as these waters played an active role in the subsequent development of settlements and their control over the surrounding lands (Plin., \textit{NH} 31, 1-2). Thus, the therapeutic value of the waters recognised by pre-Roman populations and the progressive arrival of visitors-pilgrims could also be linked to strategic factors. Yet it was only after the Roman conquest that these sites were progressively equipped with infrastructures, at times monumental, leading to an adequate and comfortable usage of their waters. The geomorphological criteria of these springs near rivers and valleys served, in fact, as decisive factors in the development of the main thoroughfares of the Roman Era and thus bolstered the development of \textit{mansiones} or stopping places along the Roman itineraries commonly evidenced by the toponym \textit{Aquae}. Moreover, the development of thermal complexes was pivotal in the rise of the settlements and towns frequently identified in Ptolemy’s \textit{Geography}, in the Antonine Itinerary, in the Ravenna Cosmography, and particularly in the Peutinger Map\textsuperscript{30}.

The study of these sites at the local, provincial and global scale is nonetheless plagued by serious barriers. These problems of identification are due mainly to two factors: The first is that these sites have been exploited for more than 2,000 years and consequently were subject of transformations which damaged or concealed their earlier Roman features. The superposition over time of new structures exploiting their waters also led to the destruction, transformation or concealment of the older Roman phases. Thus, although Antique written sources suggest the existence of many eminent thermal sites, the truth is that, with some exceptions, evidence of these features are rare due to their poor conservation. The second problem is the lack of research and bibliographical references. Moreover, the older few existing studies of individual sites either do not include stratigraphic descriptions nor explanations about different building phases. Additionally, access to this information is generally difficult as publications were made in local magazines or books.

Likewise, although fortunately certain ancient texts yield data as to the nature of the infrastructures before their disappearance, these sources are most often partial and handicapped by erroneous and subjective interpretations. Consequently, we consider that the study of the architectural structures associated with thermo-medicinal waters needs a wide survey to reconsider all these aspects.

\textsuperscript{29} See, e.g., \textit{Samama 2015} or \textit{Guérin-Beauvois 2015}, for reflections on this question in Greek culture.

\textsuperscript{30} Some considerations regarding this aspect, can be seen in \textit{Allen 1998; Allen 2003; Jouffroy 1992; Peréz Agorreta and Rodríguez Morales 2011}. 
3. AN OVERVIEW OF THE MAIN FEATURES OF HEALING SPA BUILDINGS, ACCORDING TO SOME OF THE BETTER KNOWN ROMAN SPAS

Although there are many healing spas evidenced in publications by monumental infrastructures or constructions all around the Mediterranean world, only 87 buildings or structures were retained for this study31. The criteria serving for this retention are: identification of their type of mineral-medicinal waters, a good state of preservation, well-recorded thermal bath structures and/or the existence of a complete floor plan. It goes without saying, therefore, that some healing spas have not been included due to a lack of information about them. Other thermal bathing complexes that conserve only a few poorly documented characteristic features or with waters that are not yet clearly defined have been confined to a subsequent study.

Even though research on ancient thermalism must be approached from multiple perspectives (e.g. epigraphy, toponymy, classical sources, territory), this study focuses on the formal description of the different characteristics of their buildings, an essential aspect to distinguish their structures and functions. However, although

31. Depending on their state of preservation and study potential, buildings selected for the current analysis have been classified into three general categories (Table 3): a) The better-documented thermal bath that are totally or partially preserved and can be visited (group A). This group also includes sites subject to recent archaeological excavations applying modern methods that provide rich information about their buildings. This is the case, as we have already mentioned, of Varadinske Toplice, Aachen, Agnano, Montegrotto Terme, Bansko, Burgas, Chaves, São Pedro do Sul, Alhama de Murcia, Archenaho, Caldes de Montbui, Fortuna, Lugo, Ourense, Jebel-Oust and Sarikaya (Figure 3). This group also exceptionally includes Alliano, a monumental, well-preserved complex subject to extensive analysis that since 2010 is flooded under the waters of the Yortanli dam (YARAŞ 2004; 2011), and Baden, although the archaeological site has only preserved a small section of the Roman building in the end; b) Noteworthy thermal bath buildings of uncertain preservation and visit (group B). This group comprises well-published sites that although often illustrated by floor plans, are difficult to interpret, recognise or visit. Moreover, in certain cases there are doubts as to if the archaeological remains still exist. These uncertainties arise from factors such as location, abandonment, subsequent transformations, or the difficulty of accessing recent publications defining their current status; c) Destroyed or disappeared thermal bath buildings (Group C). This last group includes well-documented sites that were either destroyed or no longer visible. It cannot be ruled out, however, that future archaeological research might recover part of their structures.

The omission of other sites such as, for example, Pamukale (Hierapolis, Turkey), undoubtedly one of the main thermal centres of Antiquity (D’Andria 2013), is due to the fact that it reveals no characteristic buildings linked to a thermal spa. Nevertheless, they will be considered in future studies. Finally, this group also excludes a series of Roman buildings without sufficient evidence of the use of mineral-rich waters in them, or others exploiting waters with both low temperatures and levels of mineralisation that, in spite of being identified in publications as healing spas (e.g. Fontaines Salées, France. BONNARD 1908; RENÉ 1943; DELOR 2002) could evoke other type of structures, like water sanctuaries, due to their architecture (a difficulty which has already been detected and pointed out by different authors, like CAZANOBE and SCHEID 2003). This aspect, nonetheless, remains unclear and merits further in-depth analysis. See Table 1 for a selection of references of each site cited in this text.
this study attempts to establish an overview of their general constructive features, the
details pertaining to each site require consulting the original publications as the sites
are *unica* linked to specific hydrogeological, cultural, historical and social realities.

Common constructive and architectonic characteristics of the thermal buildings
considered in this paper can be analysed according to:

### 3.1. LOCATION

The whereabouts of mineral-medicinal water spas are linked essentially to
hydrogeological conditions. Yet the location of their emergence to the surface,
often in low topographical areas (zones of hydraulic discharge) such as river beds or
valleys along tectonic faults (which can also be affected by earthquakes), is not always
conducive to raising constructions. Their position near fluvial courses therefore
leads to two frequent phenomena.

On the one hand, the thermal spas are subject to the fluctuations of river levels
which can lead to occasional flooding or obstruction of the flow of the springs.
Roman engineers adopted several solutions more or less successfully to deflect the
force of the rivers. These countermeasures included, for example, raising retaining
walls (e.g. Lugo, Archena, Valcheta, Rennes-les-Bains and Hammam es-Salihinne) or
constructing *opus caementicium* and/or *signinum* beds or bases of different thickness
as in the case of Lugo (Figure 4), Chaves, Plombières-les-Bains, Saint-Honoré-les-
Bains and Évau les-Bains that raise, protect and isolate the mineral springs from
river filtrations. This is likewise a factor to be taken into account when studying and
preserving thermal heritage due to the construction, since the 20th century, of dams
that have drowned many Roman healing spas, the most recent and controversial,
as mentioned above, at Allianoi (Yaraş 2011).

![Figure 4. Roman thermal spa of Lugo. The basement of the Roman structures in *opus caementicium*
and *opus signinum* is still preserved.](image-url)
On the other hand, although the proximity of thermal complexes to rivers can often lead to calamities, this topographical position can be beneficial as a strategic element in the development and monumentalisation of many of these sites. Thus, mineral-medicinal springs often can became points of interest when developing road acting as the nuclei of future mansions, settlements and road crossings that often gave rise to strategic settlements. This is evidenced, in particular, in the Peutinger Map, as these types of sites are listed by their toponyms (i.e. Chaves, Aqae Flaviae; Caldes de Malavella, Aqae Voconiae; Aix-en-Provence, Aqae Sextiae; Aachen, Aqae Grani; and Montegrotto Terme, Aqae Patavinae). Furthermore, the Peutinger Map has served as the starting point of several analyses of thermal complexes linked to road itineraries.33

3.2. CONSTRUCTIVE QUESTIONS

Bearing in mind, therefore, that location plays a determining role in the choice of the building of these mineral-medicinal complexes, the following organisation and constructive issues should be taken into account:

3.2.1. Water supply

The question of the mineral-medicinal water supply is without a doubt an aspect that merits detailed analysis. The existence of thermal waters emerging at the surface is the main element of a bath complex and the reason for its construction. The characteristics of the waters and their point of emergence will, in fact, determine the location of these features, as well as the complexity of their constructions, and/or distribution and position of each of their structures. At the same time, the water supply system offers elements to identify the most sacred and protected points of the buildings related to the main spring.

There are a number of architectural solutions linked to the different means of exploiting the main spring. The source of water, to be exploited to its full advantage, must be either near or within the confines of the building. Depending on the area’s geology and topography, as well as the characteristics of the water, it is possible to determine the following catchment water types: 1) springs gushing from a mine or cave as is the case of the baths of Lipari, the minor thermal baths of Baia (Fig. 5),

32. With reference to this proposal see, e.g., Rodríguez Colmenero et alii (2004: 47-48); or according to the methodological approach in Güiml-Fariña and Parcero-Oubiña 2015, it can be considered a nodal factor, for example, on the road to Chaves –Aqae Flaviae–. Additionally, some conclusions regarding this subject can be viewed in Campbell (2012: 330-368); Guerin-Beauvois (2015: 300) for Italy; and Matilla Séiquer and González Soutelo 2017), in some articles, for the Iberian Peninsula.

33. See note 28. For some specific studies about spas and the Tabula Peutinger, among others, Allen 2003; Perex Agorreta and Rodríguez Morales 2011; Fodorean 2012; Morandini 2013.

34. Regarding this subject, see specifically, some preliminary considerations in González Soutelo 2015; Ramón Sánchez and González Soutelo (forthcoming).
Agnano and Alhama de Murcia, where the building is adapted to exploit the natural steam or thermal water; 2) spring catchment in the form of a well or castella at times designed with different infrastructures and with platforms of opus caementicium so as to isolate them from discharges or overflows of nearby rivers or springs. This is the case, for example, of Lugo, Chaves, Nériss-les-Bains, Bagnoires-de-Luchon, Balaruc-les-Bains, Borbonne-les-Bains, Plombières-les-Bains, Luxeuil-les-Bains and Évaux-les-Bains; 3) springs emanating from natural fractures in the bedrock where the flow is associated with sacred spaces, e.g. Fortuna, Gréoux-les-Bains, and Jebel Oust; and 4) springs emerging directly through narrow fissures or crevices feeding tanks or pools, e.g. Chaves, Aix-en-Provence, Hammat Gader, Varazdinske Toplice, ¿Menthon?, ¿Caldas das Taipas?, ¿Niederbronn? and Hammam Berda, that serve mostly for collective bathing or as castellum aquae to distribute water.

Another aspect to take into account in the models of exploiting springs is the distance between the point of water emergence and the building itself. This factor can require the adoption of complex solutions, especially when exploiting waters with exceptionally high temperatures such as at Chaves (73ºC), Caldes de Montbui (73ºC), Acqui Terme (74ºC), Plombières-les-Bains (85ºC) and Hammam Meskoutine (98ºC). Thus, as pointed out by Seneca (QNat. 3, 24-25), water temperature could be regulated by piping it through a circuit of pre-determined length allowing a progressive cooling before its arrival in the pools. This could explain the long stretch of pipes at Hammam Es-Salihinne (Laporte 2006: 199-200) and Jebel Oust (Broise 2015). Moreover, this method goes beyond the traditional technique of mixing hot and cold waters (as appears to be the case at Fordongianus. (Taramelli 1903: 475) and maybe at Hammat Gader (Hirschfeld 1997: 46), a method that would not have been
common as it provokes a loss of the beneficial properties of the mineral-medicinal waters. Another cooling method put to use until recent times, identified at Hammat Gader by Antoninus of Placentia in the 6th c. A.D. (Yegül 1992: 124), consisted of controlling the arrival of the thermal water into the pools, especially at night, so as to naturally reduce their temperature.

In any case, it is compelling to analyse the question of the subsequent reuse of many of the features of hydraulic supply associated with these springs after Roman times as they confirm their quality and durability in spite of being made, in some cases, of perishable materials, notably wood.35

### 3.2.2. Water distribution and evacuation

It is essential, when determining the organisation and function of thermal bath complexes based on the above notions, to assess temperature, water type and usage. Data of this nature can be gleaned from the survey of Broise (2015) and from the publications of certain well-preserved sites such as Chaves (Carneiro 2016; 2017) Jebel-Oust (Broise and Curie 2014), Hammat Gader (Hirschfeld 1997; Broise 2003) (Figure 6), Hammam es-Salihinne (Gsell and Graillot 1893; Laporte 2006), Bath (Cunliffe 1971: 50) and Stará Zagora (Nikolov 1968; Garbrecht and Mandersheid 1994: Vol. A, 83-87; Vol. B, 327-385; Broise 2015). These publications shed light on an aspect essential to understanding the functions of the different rooms and pools, and their different temperatures that result from the circulation of water from either its point of emergence or from its mixture with waters from other springs or pipelines.

Likewise, the nature of the water exploited at a number of these sites has conditioned the preservation of certain hydraulic infrastructures that distributed its flow. The properties of water can then be a factor serving to elucidate certain aspects, for example, linked to the different renovations and constructive phases. Calcareous rich waters, for example, leave concretions on the surface of features that can offer information as to certain transformations in buildings as these deposits tend to obstruct channels and pools. Nevertheless, these type of waters can also be a positive factor as they can serve to identify the site’s water circuit and result in a stratigraphic sequence that facilitates the interpretation of the function of their buildings.36

Finally, water evacuation features are another element offering data to understand a site’s organisation. In general, after regulating the course of the water toward the pools by means of sluces and channels, the overflow must be evacuated. This hydraulic system can be seen in São Pedro do Sul (Frade and Beleza

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35. This aspect identified in Roman spas is brought up in the pioneering studies of Launay (1899) and Mollière (1893). Also see the notions on this phenomenon in González Soutelo 2014, 2015; González Soutelo and Ramón Sánchez 2016; and Costa Vaz et alii 2015.

36. The recent study of Jebel Oust published by Broise and Curie (2014) offers significant data on this question. The doctoral thesis of J. Curie (2013) is focused on this aspect. See, also, the examples of Caldes de Malavella and Varaždinske Toplice.
Moreira 1992: 527), Chaves (Carneiro 2016: 294–295), Hammat Gader (Hirschfeld 1997: 38 and fig. 29) and Bath (Cunliffe 1971: 24), for example, and the overflow is directed toward a nearby river or stream. This is often the case, as noted above, as most of these thermal complexes were raised near water courses. Yet, the overflow could also at times be diverted for use in agriculture or production after reducing its temperature and lowering its level of mineralisation.

3.2.3. Bathing spaces: pools and other infrastructures

Mineral-medicinal waters were exploited (e.g. by consumption,37 steam baths or thermal muds) in a number of different ways to treat and cure a wide variety of ailments in function of their composition and temperature.38 Yet most of the evidence gathered in this study points to their use to fill large immersion pools (with or without individual small adjacent basins) set in the centre of rooms.

Another aspect is that the protagonism of fire-fuelled hypocaust heating systems disappears in healing spas (contrary to baths using fresh water). Thus, with few

37. The architectural remains of sites linked to drinking water are poorly known, for example, as they need less infrastructures and are more easily destroyed. As most of them are not identified as bathing buildings, these structures have thus been excluded from this inventory, although they will be considered in forthcoming studies. See sites like Vichy (CORROCHER 1982), and other sites possibly linked to sanctuaries such as Fontaines Salées (RENÉ 1943; GALLIOT 2006) and Saint-Honoré (VURPILLOT 2013).

38. For example, physicians such as Herodotus (2nd century A.D., known through the work of Oribasius, X, 5, 1), aware of these differences, recognised the necessity of the correct use of these spring waters according to their physical-chemical properties.
exceptions, fire-fuelled hypocaust systems are occasionally present in subsequent construction phases. The few cases of this type probably served to progressively offer a greater capacity or other services (e.g. Alhama de Murcia, Badenweiler, Bath and Royat). Moreover, as advanced by Bonnard (1908: 40-45), and hypothesised by Fagan (2001: 423), the origin of hypocausta could have originally been linked to the exploitation of natural hydrothermal phenomena. In these cases the buildings took advantage and channelled hot water sources emerging along steep slopes through floors and double walls where the water’s natural vapour heated the steam bath rooms (as in the case of laconica).

This use (such as a sudatorium or laconicum) is confirmed at sites in volcanic districts such as the celebrated thermal baths of Baia or where the springs are well-known for their high temperatures such as at Plombières-les-Bains (Greppo 1846: 44), Hammam es-Salihinne (Laporte 2006: 311), Bansko (Taseva and Sekulov 2017: 10-11) and Caldes de Montbui (Miró i Alai 1992: 268).

In any case, as noted above, the most characteristic features of thermal baths exploiting mineral-medicinal waters are the vast rooms furnished with large central pools fed by a constant flow of water circulating throughout the complex. Hence the necessity of an adequate system of water collection and distribution.

As indicated in a previous study (González Soutelo 2011a), these types of buildings are furnished primarily by either rectangular or circular pools. The choice of shape depends on functional and other organisational factors.

The circular pools on the map feature flights of steps along their perimeter that vary in number of steps (e.g. Montegrotto Terme; Hammam Berda; Baden-Baden;
Bagnères-de-Bigorre; Bourbon-Lancy; Caldas das Taipas; Évux-les-Bains; Burgas; Jebel Oust). Moreover, these pools are also frequently placed in the centre of circular rooms and at times flanked by four apses (e.g. Alange, Baños de Montemayor, Hammam es-Salihinne, Néris-les-Bains –South building–, Allianoi, Averno, Baia). Their diameters range greatly from 35 m (Hammam Berda) to 2,08 m, such as that of Baños de Fitero, probably destined for individual use.

Rectangular pools, the more common type of immersion feature, also occupy the central area of rectangular rooms and are often surrounded by an ambulatory. Examples are known at Bath (main pool), Améli-les-Bains, Nérís-les-Bains, Bains-les-Bains and Caldes de Montbui (Figure 7). Although they usually feature steps along their perimeter (Amélie-les-Bains, Badenweiler, Caldes de Montbui, Acqui Terme, Chaves –piscine B–, Hammam es-Salihinne, Hammam Meskoutine, Fortuna, Wiesbaden, among many others) they were also accessed from their two smaller sides (e.g. São Pedro do Sul, Hissarya –old building–, Bath –pool B–). Another option was to place flights of steps only at one side (e.g. Termé Taurine; Aachen; Chaves –pool A– Hammam Beni Guecha) or semicircular or triangular steps at the angles (e.g. Hammam es-Salihinne, Bansko, Haskovo and Montegrotto Terme). In the case of the steps along the perimeter of these pools, in addition to serving as access, they probably acted as rest areas for the bathers, as noted by the classical author Antyllus (Oribasius X, 3). The larger dimensions of rectangular pools also vary, for example, from 23,3 x 12,8 m at Sarikaya (Şenyurt 2016: 111) to 20,5 x 9 m at São Pedro do Sul (Frade and Beleza 1992: 524).

Square or pseudo-square pools are much less common (Caldes de Malavella; Bansko; Nérís-les-Bains, south building; Plombières-les-Bains). These are most often accessed by flights of steps along three or four of their sides. There are also
cases revealing complex shapes such as the rectangular pools flanked by one or two apses on their smaller sides at Casale dei Bagni, Ficoncella, Hammat Gader and Aachen, and pools of diverse geometrical shapes at, for example, Aix-les-Bains, Hammat Gader, and Hammam Guerguour.

Besides the large central pools linked to collective use for different numbers of bathers (according to the nature and temperature of the water, clientele expectations, or anticipation of a large influxes of local population, ill travellers or pilgrims), there were also small pools intended for individual or selective treatments. These structures are identified at, for example, Hammat Gader, Terme Taurine, Badenweiler (Figure 8), Chaves, Amélie-les-Bains, Hammam-es-Salihinne, and probably Caldes de Malavella. Similar even smaller features, such as foot baths or ablation basins, are also known at Hammat Gader, Terme Taurine (Figure 9) and Jebel-Oust. Likewise, certain treatments could be linked to baths equipped with showers or jets as appears to be the case at Jebel Oust (Broise 2015: 61), Badenweiler (Bonnard 1908: 463) and Évaux-les-Bains (Grenier 1960: 420). It must be noted, nonetheless, that the poor preservation of the elevation of the walls of these buildings greatly hinders their observation.

3.2.4. Other rooms or halls

Unfortunately, chambers adjacent to «pool rooms» are not very well documented and it is difficult to define their function. Certain thermal spas were provided with large lateral rooms featuring a bench running along a wall. These types of features are, in some cases, interpreted as spaces to practice sports (palaestrae).
Nevertheless, the advice of modern physicians to users is to avoid strong physical activity during the use of mineral-medicinal waters. Hence this study proposes that these courtyards or porticoes, identified at the archaeological sites of São Pedro do Sul, Lugo, Termes Taurine, Badenweiler, Chaves, Hammat Gader, Hammam Guergour and Néris-les-Bains, could have been intended, as in the case of peristyles, lobbies or large accesses, for outdoor rest and leisure.

Small rooms at certain spas are also associated with the use of thermal water for diverse types of treatments or rest. The examples of Amélie-les-Bains, Bagnères-de-Bigorre, Évaux-les-Bains, Alange, Caldes de Malavella and Baia tend to support the notion of these functions despite the lack of archaeological evidence and the problem of the overlap of constructive phases complicating their interpretation. Features interpreted as dressing rooms, such as those at Banskó (Taseva and Sekulov 2017: 8), Badenweiler (Yegül 1992: 119), Hammat Gader or Bath (Cunliffe 2000: 84, 89) are also poorly identified elements at Roman spas.

3.2.5. Sanctuaries or sacred areas

The mineral-medical waters of Roman thermal centres are also known to have been endowed with sacred qualities. Evidence of features linked to sacred areas or religious cults are present for the most part at centres exploiting thermal waters, although sanctuaries have not always been well identified. The sites of Bath, Fortuna, Jebel Oust, Chaves and Mont-Doré, in addition to the presence of temples or sacred precincts linked to their waters, share other elements revealing that they were considered sacred places. These other elements mainly include ex-votos depicting human and animal anatomical parts (e.g. Chamalières, Luxeuil-les-Bains, Montegrotto Terme), coin deposits in the main spring—which would be the most sacred point in the building— (more than 4,000 coins were collected, for example, at Bourboune-les-Bains. Grenier 1960: 449; Sauer 2005), and largely votive altars (e.g. 14 altars were located in Lugo, most of them dedicated to the nymphs. Herréz Raigoso and Meijide Cameselle 2000; Crecente Maseda and González Soutelo 2016; or 21 altars in Baños de Montemayor dedicated to the nymphs, Fontana and Salus. Roldán Hervás 1965; Díez de Velasco 1998, 2002).

43. Some studies have been carried out regarding this subject. For some proposals, see, e.g., Jackson 1990; Oró Fernández 1996; Allen 1998; Dvorietski 2016; Kohler 2016.
44. As suggested by Yegül 1992: 121; and Brose 2003: 227 in the long corridor of Hammat Gader.
45. Some considerations about this subject can be seen in Scheid 2015, Golosetti 2016: 71 and Bolder-Boos and Calapá 2018, where the identification about sacred places or sanctuaries cannot be so easily detected in archaeology. Also, for the link between thermal spa architecture and religious areas see, for example, some proposals in Bassani et alii 2018, including Carneiro and González Soutelo 2018 in the Iberian Peninsula; Zanetti 2018 in Germaniae and Raetia; Marcato 2018 in Gaul; or Bassani 2013, 2018 in the Italian Peninsula.
46. This site, most likely a water sanctuary, is not included in the list of spas as it lacks characteristic features. It is, nonetheless, one of the most significant examples of the cult to mineral-medicinal waters due to the numerous finds of wooden figurines (Audin et alii 2000).
47. Surveys of these votive deposits in the Iberian Peninsula see, e.g. Díez de Velasco 1998 and Oró Fernández 1995. For Italy, see especially Allen 1998 and Bassani 2013.
3.2.6. Lodgings for bathers

A last aspect to take into account in the study of thermal complexes, in particular those distant from larger settlements, is the presence of buildings or annexes interpreted as having accommodated the sick, pilgrims or simply bathers attracted to the complex by the fame and prestige of the waters. Examples of these types of lodgings, that evidence the arrival of outsiders for more than just a simple daily sojourn48, are attested, among others, at the bathing complexes of Archena (Matilla Séiquer and Ovejero 2017), Terme Taurine (Köhler 2007, 2011), Fortuna (Matilla Séiquer 2017), and possibly Jebel Oust.49

3.3. THERMAL COMPLEX CHRONOLOGY

Assigning a broad chronology to thermal complexes is an arduous task as each site is subject to its own historical and geographical conditions, as well as to different degrees of archaeological scrutiny and number of phases of construction.

It is evident that the beneficial properties of thermal waters were known very early to local populations as indicated by discoveries of artefacts next to a series of thermal springs in both Prehistoric (e.g. Bagni di Vicarello. Gasperini 2008: 92) and Etruscan contexts50. Yet the widespread, deliberate exploitation of thermal bathing complexes evidenced by elaborate constructions did not take place until after the Roman expansion. Roman structures begin to appear, in fact, in early contexts possibly at the outset of the 2nd century B.C. in the Italian Peninsula at sites such as Baia (Dubois 1907; Guérin-Beauvois 2015: 127–131) or Terme Taurine (Köchler 2007: 116). Their expansion throughout the provinces took place progressively in the 2nd to 1st century B.C. as evidenced by features at Caldes de Malavella (Llínàs i Pol and Nolla i Brufau 2011: 106) and Allianoi (Çekirge and Gürdal 2011: 152). However, it was not until the end of the 1st century B.C., in particular in the Imperial period, that saw the first monumental constructions raised throughout all the provinces of the growing Empire.

Therefore, it was common in the 1st century A.D. that thermal sites exploiting hot flowing waters were transformed into monumental constructions deliberately designed for reasons of health, as a reflection of these waters reputation51. Over time they were subject to different renovations and extensions resulting in substantial alterations of their features. These reconditionings were most often linked to maintenance (mainly due to malfunctions caused by mineral concretions), but also intended to offer larger facilities, newer services and amenities, adapting at

48. It is frequently cited in classical authors that ill people and pilgrims flocked to Hammat Gader, and a residential quarter was identified towards the north of the thermal spa (Hirschfeld 1997: 8).
49. Ben Abed et alii 2001: 538; Ben Abed et alii 2004: 706-712, including a discussion about the interpretation of the building associated to this Roman spa as a hospitalia or residence.
50. See, e.g., Regione Lazio 2007; Bassani 2012; Bassani 2013.
51. Some considerations about this aspect have already been discussed in Yeğül 1992: 110-116 and more recently Guérin-Beauvois 2015: 352.
times facets characteristic of thermal complexes exploiting common water. By way of example, as suggested by Yegül (1992: 111-116), certain transformations in later centuries incorporated fire hypocausts so as to expand their facilities and offer more services (e.g. Bath and Alhama de Murcia). These later sites also integrated pools of cold water, a type of feature recorded, for example, at the second phase of Bansko (Taseva and Sekulov 2017: 8) (Figure 10) probably following fashions and customs established throughout the Roman Empire.

![General view of the late Roman thermal spa of Bansko, Strumica](61). Photo courtesy V. Sekulov.

With the exception of destruction resulting from either natural phenomena such as floods or earthquakes (e.g. Archen. Matilla Séiquer and Ovejero 2017: 239-240; and Chaves. Carneiro 2017: 65) or misfortunes such as fires (Hammam Guergour. Wilson 1997: 325; and Varazdinske Toplice. Gamulin 2001: 1; CIL III 04121) or abandonment due to lack of maintenance, certain thermal sites persisted far beyond Roman times. In the better cases, they were adapted to new cultures and traditions as, for example, the complex of Hammat Gader and Alhama de Murcia that became an Arab thermal spa. In the cases of abandonment, by contrast, these waters nonetheless continued to serve after undergoing minimal modifications or improvements in Roman buildings until their rediscovery, integration or reuse during the second golden age of hydrotherapy between the 18th and 20th centuries. It was this period that saw the greatest destruction of the older Roman features.
4. SUMMARY AND FUTURE RESEARCH

As we have tried to show in the previous discussion, the interpretation of Roman healing spas has to face numerous issues and difficulties derived from their own constraints. It goes without saying that new study approaches that take into account their many unique characteristics will be a key aspect in their research.

As noted in this article, the chance to bring together, put on the map and compare the best-known buildings of Roman spas from a global interdisciplinary perspective, can allow us to recognize some of the main characteristics of these buildings. Therefore, a detailed approach will be carried out in the coming years.

Fortunately, as we have seen, there are a large number of well-preserved sites and new archaeological digs are being developed in the last years. Furthermore, we are convinced that the number of Roman spas which can be placed on the map will increase in the coming years thanks to new meticulous archaeological excavations combined with thorough architectural studies. Our aim in this article has been to put down on paper some of the most representative Roman spas as a starting point to bringing these buildings out of their isolation and therefore, reach a deeper understanding of them. The final objective of our project will be to recognize the architectonic characteristics of these types of features in the framework of Roman architecture.

Acknowledgements

I would like to thank the archaeologists, historians, hydrologists, hydrogeologist and diverse specialists from many different countries who have discussed and shared their articles and knowledge with me. My gratitude also to the reviewers and colleagues for their suggestions about the different aspects considered in this paper. Their help, kindness and professionalism make this research possible.
Table 1. Table listing the better preserved/documented thermal spas in the Roman Empire considered in this research. The list, sorted by country, includes their ancient names, some of the main bibliographical references and assigned category.

<table>
<thead>
<tr>
<th>No</th>
<th>Country</th>
<th>Roman spa</th>
<th>Ancient name</th>
<th>Some of main bibliography</th>
<th>Main remains</th>
<th>Cat.</th>
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<td>ALC</td>
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<td>Vallet 1943; Wilson 1997; Thibert 2001</td>
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<td>Fiorini 1935; Hanriot 1911; Jouffroy 1922; Wilson 1997</td>
<td>Pools</td>
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<td>ALC</td>
<td>Hammam-es-Salhinne / Chenchela / Henchir d-Tamman</td>
<td>Geel and Graillet 1893; Hanriot 1911; Birebent 1964; Wilson 1997; Laporte 2006</td>
<td>Building</td>
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<td>ALC</td>
<td>Hammam Guergour</td>
<td>Guery 1966; Wilson 1997</td>
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<td>ALC</td>
<td>Hammam Maskourine / Hammam-Cheliti</td>
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<td>Civitas Taurinum</td>
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* Recently, under the waters of the Yortanli dam.
REFERENCES


Allen, T.J. 1998: Roman healing spas in Italy: a study in design and function (Ph.D. diss.). University of Alberta.


C consistentemente falta el nombre del autores.


Cosentini, C. and Pavone, F. 1966: Descrizione e interpretazione dei ruderi della Termine di Santa Venera al Pozzo, Memorie e Rendiconti, Serie 1, Vol. VI.


Drazheva, T. 2010. «Akve Khalide-therma, the city of the hot mineral baths (Burgas, Bulgaria)». Nis i Vizantija VIII: 433–440.


JUTIER, P. and LEFORT, J. 1862: *Études sur les eaux minérales et thermales de Plombières... Bureau de la Compagnie concessionnaire*. Paris, Plombières.


