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11 Meeting Water Needs as a Major Challenge in an Urban Context

Examples from the Danube Region (1300–1600)

Abstract: Water appears as a powerful and influential medium in a tight network of relations between human action and the material world with complex impacts. The use, management and control of water constantly led to processes of negotiation regarding competence and responsibilities between the actors involved. It was not only about control and distribution, but also about protection against risks and how to manage them, about the control of abundance or scarcity and the evaluation of alterations in the landscape resulting from dams. This article will reflect on water as a medium and investigate the influence water had on urban communities in the Middle Ages by using the example of the towns Krems and Stein on the Danube. It discusses the system of planning, coordination and resource management required by the construction and maintenance of urban facilities as part of public infrastructure. From this viewpoint, water supply and its communal organisation it will raise questions about the social function of water infrastructure in an urban context.

Introduction

Composed at the end of the 15th century as a visual part of the canonization of the Babenberg Margrave Leopold III, the genealogical tree of the Babenberg family is one of Austria's most remarkable works of late medieval panel painting.[1] Created between 1489 and 1492 in a painter's shop led by Hans Part, the panel painting is considered an impressive example of how late medieval rulers represented themselves in the context of a monastic culture of commemoration.[2] While 46 female representatives of the dynasty, being wives and daughters, are arranged in the form of half figures on tendrils, the 27 male members of the Babenberg family are framed in medallions on the monumental central wing against the background of topographical scenes associated with them. Many of the margraves and dukes portrayed are shown in scenes where landscape painting occupies much of the picture. Representations of towns and cities (Freising, Regensburg, Salzburg, Vienna, Wiener Neustadt), abbeys and monasteries (Melk, Klosterneuburg, Heiligenkreuz, Kleinmariazell), or castles (Falkenstein, Gars/Kamp, Pernegg, Mödling) pin down important stations and events of the protagonists' rule in the topographical area of their influence. From the 11th century on, the measures of the Babenberg margraves (and later dukes) to consolidate their political power – be it in cooperation with or against aristocratic leader

1 It has been restored several times over the centuries, with the first restoration in the first third of the 17th century; restorers also worked on the depictions as such. The bottom part of the panel painting, which was fundamentally restored in the 19th century, was particularly affected. The depiction of the genealogical tree in the context of a work to represent the history of the Babenberg family, commissioned by Archduke Charles II of Inner Austria around 1550, offers an important reference to its original state: Austrian National Library (ÖNB) cod. 8700. Röhrig 1977, 11; Scheibelreiter 2005.

2 A group of young scientists is currently exploring the description and analysis of the canonization process and the context in which it took place, its historical phenomena and how they materialized before, during and after Babenberg Margrave Leopold III's canonization in the respective political and socio-cultural setting of the time, including its reception down to the 19th century, as part of a doctoral team grant from the Austrian Academy of Sciences: Performance of Holiness Using Margrave Leopold III of Austria as an Example <https://performanz-von-heiligkeit.at/> (19. 07. 2019).

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groups in the region – resulted in expansive foundation and settling activities. Triggered by the country's development and increase in population, the Duchy of Austria experienced a phase of rapid urban growth in the 12th and especially the 13th century. A number of settlements along the Danube, such as Linz, Melk, Dürnstein, Stein, Krems, Tulln, Klosterneuburg, Korneuburg, Vienna and Hainburg, owe the upgrade of their legal status to a town or city, mainly in the 13th and 14th centuries, to initiatives by territorial lords of the Babenberg and later Habsburg families. Other towns, including Eferding, Pöchlarn, Mautern or Großenzersdorf, were promoted by aristocratic or episcopal territorial lords.[3] The depictions of the Babenberg genealogical tree point to those formative events, places and circumstances in the lives of the margraves and dukes portrayed, which – similarly to the specific attributes assigned to saints – historiography of the time classified as characteristic. Locations on a river or at the foot or on the top of a hill became important 'markers' in the history of the Babenberg family – these at least seemed to be the idea of those people who ordered the work at the end of the 15th century.[4] Since the rule practiced by the Babenberg family was closely linked to the Austrian lands, it is not surprising that the Danube, as one of the main waterways leading through the territory, was a key motif in the scenes on display. Many far-reaching actions of the family members on display were tied to the river: depictions of the margraves, being dukes of Austria after 1156, Heinrich I, (reigned 994–1018), Adalbert (reigned 1018–1055), Ernest (reigned 1055–1075), Leopold IV (reigned 1136–1141) or Leopold VI (reigned 1198–1230), as well as Frederick II (reigned 1230–1246) or Henry II (reigned 1141–1177) show them in the context of their foundations – cities and monasteries – along the Danube, including Regensburg, Melk, (Kloster-)Neuburg, Stockerau and Vienna.[5] The effects on an urban space of its location on a navigable river, its shaping and how it was used, become noticeable in the towns and cities on the Danube. They carried out important functions in providing the infrastructure for transregional trade and the exchange of goods, as well as in harbouring important bases for the sovereign's influence. Leopold IV, for instance, was shown as a – as it would turn out later – successful town lord against rebellious citizens during the siege of his residential town of Regensburg[6] (Fig. 1). Depicting the town from a northern perspective brings the massive fortifications with the stone bridge across the Danube into focus. Frederick II, who reigned about 100 years later, was linked to the legendary battle of the Leitha River (1246) against Hungarian opponents. Again, combat action was shown with the residential city in the background – Vienna in this case. The view from the north displays the strongly fortified city and its direct access to the Danube.[7]

Some of the Danube-related scenes of the Babenberg triptych point to significant functions and uses of the watercourse. The detailed depictions of ships, bridges, water dams, water mills, or a fisher with a particular lift net used exclusively in the Danube region (called *gankwat* or Daubelnetz) allude to potential ways of utilising the waterway[8] (Figs. 2–3). The waterway served as a transport route, power station and food source, providing such things as freshwater fish. At the same time, the river was perceived as an obstacle and bridges had to be built or ferry connections established in order to be able to travel from one side of the river to the other. The Danube, however, was not only an important route of transport for trading. As a massive barrier in the natural landscape, it represented an enormous challenge for anyone who wanted to cross

3 See Rosner – Motz-Linhart 2005; Csendes 2000; Weigl 2013 for a survey.

4 Röhrig 1977, 13–17.

5 Cf. Weltin 1976; Zehetmayer 2014; Lutter 2017, on a summary of the Babenberg dynasty.

6 Röhrig 1977, 70.

7 Röhrig 1977, 94; Andraschek-Holzer 2012, 335–338.

8 Duke Albrecht prohibited this type of fishing in 1412, which was documented in 1429 in the collection of Crafts Code of the City of Vienna. The main reason was the fear of over-fishing of the whole fish stock in the Danube: Gneiß 2017, 364 no. 220; Hoffmann – Sonnlechner 2011, 116 f.

Fig. 1: Stiftsmuseum Klosterneuburg, genealogical tree of the Babenberg family, tryptic. The Babenberg Duke of Bavaria, Leopold IV, in front of his residence in Regensburg, detail.

Fig. 2: Stiftsmuseum Klosterneuburg, genealogical tree of the Babenberg family, tryptic. Water mill, detail.

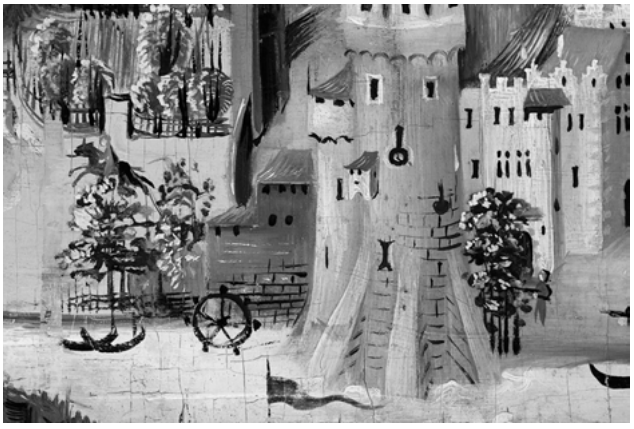

Fig. 3: Stiftsmuseum Klosterneuburg, genealogical tree of the Babenberg family, tryptic. Mill wheel, detail.

it from the north to the south or vice-versa.[9] Since sturdy wooden or even stone bridges were rarely to be found, numerous ferry lines were operated to connect opposite settlements by crossing the river. The numerous depictions of running water and their utilisation against the background of the Babenberg family genealogy poses a number of questions that address the issue of how water was perceived and dealt with in late medieval towns on the Danube. The development of an urban community required not only active people and institutions, but also a working infrastructure. This included the construction and maintenance of roads, squares, bridges, fortifications and public buildings like town halls and burgher hospitals, but also systems of water supply and sewage disposal, the cleaning of wells or measures to prevent flooding. The construction and maintenance of such installations not only offered town lords or wealthy townspeople the opportunity to position themselves through appropriate commitments to the town, but also belonged to the fundamental tasks of an urban community.

With the following considerations, I will, on the one hand, place the focus on some fundamental aspects of water management in an urban context in the Danube region. Access to water, using and regulating the power of water, bridging the water and harvesting from the river seem to be important issues, as they regularly appear as tasks or incidents in written sources, causing costs or keeping townspeople busy in a variety of ways. On the other hand, I will try to show which actions were provoked by dealing with and being close to water.

What does the medium of water mean for late medieval towns and their protagonists?

In his contribution to 'Water as substance and meaning', Hans Peter Hahn analysed the manifold interdependencies and entanglements regarding water with his 'concept of material culture' in mind,[10] stating that 'Water is everywhere. It is part of nature, [...] but it is also part of culture [...]'.[11] Starting from this reflection, it seems appropriate to direct our attention to water as a medium and investigate the influence water had on urban communities in the Middle Ages. How did water shape people's interactions with landscape? In what way did the material properties of water affect their working practices? Which properties of water needed to be 'managed' for what purposes? With the necessity of interacting with water in order to ensure necessary supplies, to use it as a driving force, or to prevent the destruction of buildings, facilities or living quarters, water appears as a powerful and influential medium in a tight network of relations between human action and the material world, with complex impacts.[12] Interestingly, most activities in the context of water relate to its economic or everyday use or control. Even if archaeological findings repeatedly reveal indications of systematic water supply, flood protection or embankments, these appear to be in the scope of everyday use. The same applies to the written records of the local administration. The case study of the aqueducts of Syracuse, sketched by Sophie Bouffier, shows a different point of view. Prestigious hydraulic structures, such as the swimming pool and fishpond built by the inhabitants of Acragas, refer to another aspect of water use: that of the representative demonstration of power, wealth and influence.[13]

9 From the perspective of environmental history, Verena Winiwarter's interdisciplinary research team approached the history of the Viennese Danube basin, starting from its first phase of regulation at the beginning of the 16th century. For their long-term study on river management they also evaluated administrative records, but their focus was on the Modern Period starting in 1500 and lasting until the 1890s. Winiwarter et al. 2013; esp. Hohensinner et al. 2013; Sonnlechner et al. 2013.

10 Hahn 2005; Cless 2014, 21.

11 Hahn 2012, 23.

12 Knoll 2014, 196 f.

13 See Bouffier, this volume.

From my source-based approach as a historian, focusing on written material, resource management of late medieval towns is often seen through the lens of institutions. This is due to the fact that most of the material relating to towns has its roots in the respective administrations. Virtually all documents that I have used for my studies were created as part of the administrative work of secular or religious authorities, such as the town council, the parish church or monasteries, as well as institutions in an economic context, such as trade fraternities and guilds. With the randomness of remaining sources to be considered an important element of what conclusions we can draw for organisational aspects of water management, this material nevertheless draws a comprehensive picture of the activities in which municipal administrations and their actors were involved. Against this background, it has – until today – always been a paramount task of authorities to ensure the water supply of a town and its inhabitants, in terms of finances and infrastructure, know-how and accessibility. Running water requires a complex framework of political, technical and social infrastructure to transport water from its source to the houses and discharge it after use – safely, reliably and at reasonable cost.[14] Some, but by far not all practical and organisational aspects of water management in late medieval towns were recorded in account books and normative sources. They provide an insight into construction work and terms of use, how conflicts about access to water or other regulations regarding water management were handled, but also into preventive or protective measures against fire. These issues of distribution usually led to negotiation processes between urban actors and the groups involved.[15]

Some of these relations, with mutual impact between human protagonists and their actions resulting from the specific properties of water, can be described in their intertwined complexity. This knowledge can be used to understand urban structures both in a social and a material context.[16] The reason why I chose most of the examples from the area of the towns of Krems and Stein on the Danube is not the particularly profound documentation of sources, but the specific constellation of different players on both sides of the Danube that had been forced, over the entire medieval period, to develop concrete methods of how to deal with water, due to their topographical location on the Danube. The towns of Krems and Stein in the immediate vicinity of each other on the left bank and Mautern on the right bank of the Danube represented important traffic hubs on either side of the Danube, with varying intensity in the course of time. They were subject to the political influences of different rulers. While the burghers of the towns of Krems and Stein had gained their town rights under the influence of the territorial lords from the 12th century at the latest, those of Mautern on the opposite side were under the rule of the Bishop of Passau. Due to its extensive rights as a parish, the nearby Benedictine Abbey of Göttweig was also perceived as an influential actor. This setting of territorial influence and political power being separated by a river in combination with the joint utilisation of the region in the Danube section under review, and the necessity to exchange goods, with interaction and mediation across the river being verifiably practised for at least half a millennium, led to a considerable number of written documents.

Access to water

'Water is life'.[17] This is the concise definition which the publishers of the current volume of articles dealing with the use, the perception and symbolism of water in medieval culture have

14 Cless 2014, 32.

15 For an overview concerning Austrian towns, see Scheutz 2016; see Magnusson 2001, for a general overview of the issue of water technology in an urban context.

16 Knoll 2014, 203.

17 Huber-Rebenich et al. 2017, 1.

used to outline the meaning of this fundamental medium. Individual organisms, social formations, and cultural achievements depend on water, making it a life-sustaining, but also destructive force, it 'connects and divides, absolves and dissolves'. This comprehensive array of properties is the reason why 'society as a whole and individual institutions alike need to engage with, and adapt to, these ambivalent aspects of water'. Urban communities are confronted with these facts, too. One of the most costly and complex tasks of municipal administration has always been supplying the town with water. Drilling wells and laying water pipes to provide fresh water or discharge waste water were important, but also expensive tasks of a town's administration, and they fill the account books of all towns and cities – provided that they have been transmitted.[18] In his study on the issue of urban risk management, Ulf Christian Ewert stated some time ago that the supply of water belonged to the 'vital components of the quality of life that could be enjoyed in medieval towns'.[19] Systematic access to and provision of water in the form of fresh water containers, wells, water pipes and flowing channels, as well as the disposal of waste water via sewage channels or the phrasing of cleaning regulations and the like, were the responsibility of a town's administrative bodies, that were entrusted with the related tasks. Taking care of water as an essential element to ensure social order was a task of the urban community which was not to be underestimated, being mainly a matter of organisation. Surprisingly enough, the issue of water management, for instance in medieval Vienna, was initially addressed in a completely different context, namely precautions for fire protection and firefighting. The town charter of the early 13th century already included provisions on how to proceed in the event of a fire, with the threat of penalties in case of violations. However, fire protection was not regulated and organised by the town council until the middle of the 15th century (1454). It can, of course, be assumed that people arranged fire protection measures individually. But the reported events of fire throughout the Middle Ages testify to uncontrolled incidents. The regulation released in the middle of the 15th century was expected to implement a systematic procedure of firefighting. The entire community was called upon to store vats filled with water in attics and courtyards. Joiners and bathers were obliged to be the main organisers of fire protection, and members of 30 other crafts had to assist them by ensuring the water supply. A manually operated piston pump might have already been used at that time to provide water. It was not until the big fire in July 1525 – which started from the princely armoury – that the construction of a major water pipeline was initiated in Vienna, which was completed in 1565. Starting from a freshwater source about 8 km on the outskirts in the village of Hernals, the water was piped into the city to prevent a lack of water in the event of a fire.[20] Preserved municipal invoices first of all testify to expenses that were necessary to build wells and lay water pipes and sewage ducts. First expenditures, for instance, were recorded in 1455 for the construction of the *Fischbrunnen* at Hoher Markt in Vienna, which was equipped with pipes. Work on the stones sourced from the nearby quarries in Sievering, Guntramsdorf, Mannersdorf am Leithagebirge and Breitenbrunn in the stonecutter's at the *Schweinemarkt* (Pig Market, now 1st district, Lobkowitzplatz) lasted for almost a year from February until December.[21] The *Fischbrunnen* on Hoher Markt was one of the most important wells in medieval Vienna.[22] Fish caught in the Danube and other major rivers were kept in constructed basins to be offered for sale. The sources also mention a well at the 'Jews' Gate' and another well located at the butchers' sales tables that supplied the required fresh water. In recent years, wells for the supply of drinking water and used water have also been documented archaeologically, with one of the oldest dating from the 13th century.[23] Account books of Krems also record expenditures in 1516 for the installation

18 Rippmann 2008; Baeriswyl 2008; Malamud – Sutter 2008.
19 Ewert 2007, 223.
20 Krajicek 2016, 37–39; Sakl-Oberthaler – Ranseder 2009.
21 Uhlirz 1896, 157–159, esp. 158 no. 15291; Brunner 1929, 390 f.
22 Gneiß 2017, 498 no. 331.
23 Krause – Sonnlechner 2013, 155.

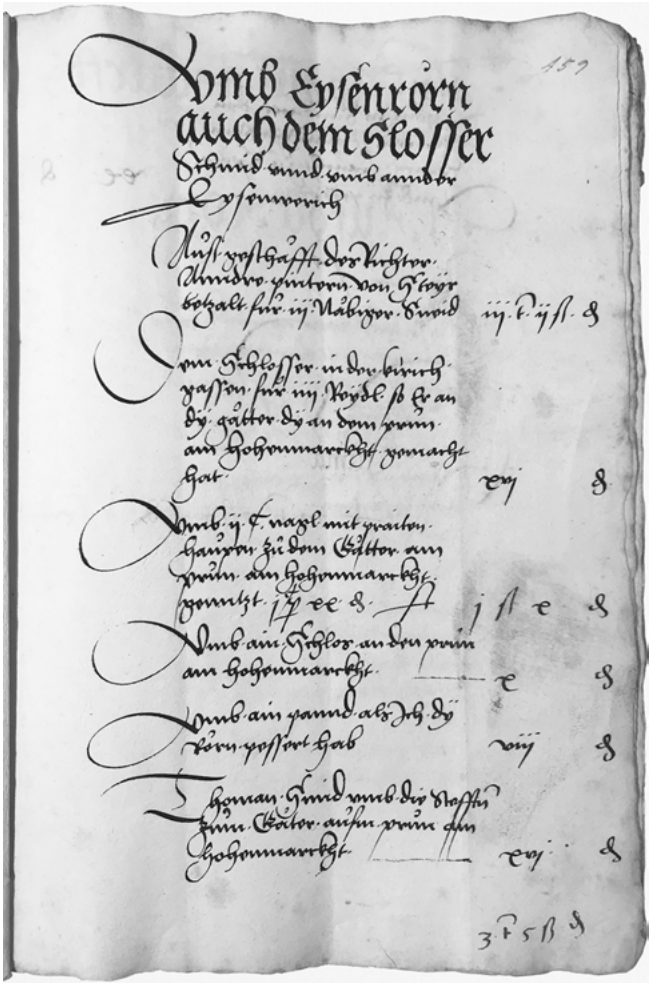

Fig. 4: Municipal Archive of Krems, account book AD 1516, fol. 159.

of pipes at the well at Hoher Markt (Fig. 4). Apart from separately listed iron pipes, expenses were mostly caused by wooden pipes which had to be drilled, repaired or replaced. Like water vat inlets, the pipe connections were sealed with hemp.[24] During excavation work in the south-east of the medieval town of Krems (Drinkweldergasse/Ringstrasse), a paved courtyard with a stone well was uncovered. A basin clad with loam to make it impermeable to water could have been used as a pool to raise fish or keep it fresh.[25]

An instruction in the fishers' order of 1579 to offer fish for sale in fish troughs at the market and not on boats on the Danube leads us to the conclusion that vats must have also been available in Krems for the selling of fish.[26] The purchase of a lockable iron grating suggests that the well was not freely accessible at all times.[27] Expenditures for the wells at the *Täglicher Markt* (Daily Market) and the *Korngrieß*, the trading place of corn (now: Körnermarkt) were made in the same year.[28] Providing fresh water was closely connected to taking care of functioning sewage systems. The account books of Vienna document numerous construction and repair works on sewage drains, for instance under butchers' vending tables, near Hafnerturm, at the

24 Municipal Archive of Krems, Account book 1516, 159 f.; Hoffmann 2000, 101–124; Rippmann 2008; Baeriswyl 2008, 57–61.

25 Hinterwallner 2013, 188 (schematic layout plan of the excavated area). 190 f.

26 Brunner 1953, 234.

27 Municipal Archive of Krems, Account book 1516, 162–173.

28 Municipal Archive of Krems, Account book 1516, 174 f.

fish market or at the *Graben*. In the meantime, archaeological explorations have been able to retrace the routing of individual channels.[29] The town councils had to deal with legal and ecological aspects of trades that needed water and whose waste water had to be discharged, with the shops of leather workers, tanners, or butchers being the main causes of water pollution. Complaints about blocked or smelly sewers, dirty water or rainwater splashing from neighbouring houses presumably were a recurring problem, in particular in the neighbourhood of bathing facilities. Vienna, for instance, had about 25 to 30 baths between the 14th and the 16th centuries, distributed over the whole city; a few were also in the suburbs. In the inner city, these places mostly were at market corners and important streets, with seven on the Alserbach, a small brook running through the city. This, however, changed during the 15th century, when the brook was diverted into the moat. What remained was the topographical description 'at the former bathhouse'.[30] As prominent and generally known points of orientation, baths were used in virtually all towns and cities as a spatial reference to describe the topographical position of individual buildings. 'Opposite the Höll bath' in Krems is only one of numerous examples of this kind used in municipal deeds to describe locations.[31] Only scarce information exists on the baths mentioned in the 14th century for Krems and Stein: the Höll bath, the bath on the *Reisperbach* (a brook) and one in Stein.[32] In 1396, Hans der Bader for the Höll bath purchased a vineyard from Josef from Ybbs and his wife, both burghers in Krems and members of the Jewish community.[33]

The example of Mautern on the Danube shows another problem a settlement on a river could be confronted with. Originally located on the northern side of the town wall near the Danube, the local bathhouse was literally flushed away. A note in the deed of foundation succinctly states: *per Danubium effluxum*.[34] There is evidence that a number of settlements that were originally mentioned in deeds of foundation and chronicles of the 12th century as possessions of Göttweig Abbey could not stand the recurring flooding over time and were abandoned. An island in the Danube mentioned in 1108 with the name 'Mutheimer Werd', which later became the property of the Benedictine Abbey of Göttweig, was flooded several times during the centuries. In the 18th century it was finally abandoned.[35] The settlement of Klebdorf near Hollenburg, which was mentioned in the deed of foundation of the Göttweig church, met the same fate when it was abandoned already in the 14th century due to repeated Danube flooding.[36] The Danube also swept away the settlements of Marquardsurfahr and Strunzenreut further downstream.[37] Christian Rohr's survey on extreme natural phenomena deals with the effects of disastrous environmental events – like floods – on urban administrations in Austrian towns in a comprehensive way.[38]

The topographical location of Krems at the confluence of a tributary to the Danube led to a number of other tasks regarding water management. Several entries in the account books of the town of Krems reported, during the 15th century, expenses for wooden constructions in the Kremsfluss (a brook). The wooden piles fixed in the water close to the inner town bridge over the stream probably served to safely move and pull ashore logs transported on the water and to protect man-made structures against colliding ice floats.[39] Wooden constructions for embark-

29 Smetaczek 2005; Sudera 2005; Krause et al. in press.
30 Hötzel 2016, 82–86; Horn 2005.
31 Brugger – Wiedl 2010, 70 no. 589 (1347 May 20).
32 Kühnel 1967, 21.
33 Brugger – Wiedl 2018, 169 no. 2115 (1396 May 28).
34 Maroli – Plöckinger 1983–1985, 179.
35 Fuchs 1901a, 32 no. 18.
36 Fuchs 1901a, 6 no. 5.
37 Fuchs 1901a, 95 no. 83.
38 Rohr 2004; Rohr 2007; Rohr 2013.
39 Jaritz 1976, 24.

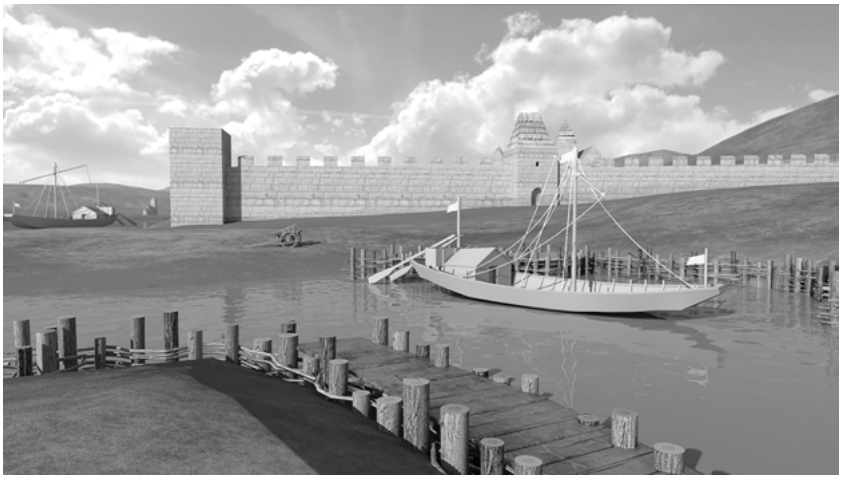

Fig. 5: Reconstruction of the excavated pile system near Stein/Donau.

ing and bridges had to be repaired and renewed on a regular basis. This was also true for a quay on the former estuary of the Alaunbach (a brook), a silted-up branch of the Danube between Krems and Stein. During excavation work in January 2017 for the foundation of the State Gallery of Lower Austria, numerous logs were uncovered and subsequent archaeological investigations revealed that they belonged to a complex pile system (Fig. 5). The finds were under a layer of Danube gravel almost six metres thick. It can be assumed that boats berthed on this reinforced bank. Small metal clamps (as they are still used today for barges) testify to this. The reinforcement consisted of many round piles arranged in several rows that were dendro-dated to 1250–1350. The branch eventually silted up with material washed in from the Danube and the Alaunbach brook, and eventually disappeared completely.[40]

Using and regulating the power of water

In general, written documents relating to the issues discussed here of how water was dealt with in the region of Krems, Stein and Mautern exist only from the 14th century onwards. The operation of mills, however, is documented much earlier. As one of the most important sources of energy for the medieval economy, hydrodynamic power is particularly prominent in the context of milling facilities and in designing the legal framework for terms of use and operation.[41] Mention of a mill in Krems owned by the hospital ward of the convent in Melk and unrightfully in pawn was made as early as 1216.[42] As in other places, mills in Krems were located outside the town walls, along the Krems brook or the Kamp running downstream of the Danube further to the east.[43] Documents testify to a number of mills *sub lapide* to the east of the town, such as the one owned by the Convent of the Dominican nuns of Imbach,[44] those mills of the Benedict-

40 Pieler 2018. I thank Karin Kühtreiber for her many pieces of oral information on the preliminary results of the excavation. A detailed report on the excavation will be available in 2019.

41 Petersen – Reitemeier 2017; Vadas 2017; Vadas 2019.

42 Winner – Herold 2001, no. 27 (1216 May 27).

43 Fuchs 1901b, no. 1175, 249 f. (1433 February 2); no. 1287, 364 f. (1442 October 14).

44 Haus-, Hof- und Staatsarchiv, Imbach, Dominikanerinnen (1259 March 1); (1282); Haus-, Hof- und Staatsarchiv, Imbach, Dominikanerinnen (1351 February 24); Zajic 2007, 42. 56.

ine Abbeys of Melk,[45] Göttweig[46] and Admont[47] whose location was not detailed, and more, otherwise unspecified mills on the Krems brook. Typically, the mills owned by cloisters were leased, which, in turn, entailed agreed revenues and levies. In the middle of the 14th century, the obligations linked to renting the mill of the Benedictine Melk Abbey were extended. In addition to the customary annual service and construction work needed to maintain the building, the tenants were obliged to provide accommodation for convent members, including nightgowns, wardrobes, stables, lights, presses, tubs and vats. These obligations were passed down to the next tenant and continued. Their concrete implementation might have occasionally led to conflicts, since in 1454 the new tenant, for instance, limited his accommodation obligation by excluding board, fodder, hay, bedding and light.[48] For a mill on the Krems brook in a village situated upstream not far from Krems, the different usages which the running water offered are documented. A fish pond in the moat obviously was dammed up with a sloped reinforcement driven into the brook to keep away floating sheets of ice. The mill tenant held the fishing rights for the pond, but had to share the revenues of the annual pond emptying with the owner. Furthermore, a bathhouse was linked to the mill.[49] The example of the mill illustrates the interplay of material and social processes. On the one hand, water power is used by the mill to drive a grinding plant; the necessary installations create a calm water basin that enables fish farming; the accumulation of running water allows the running of a bathhouse.

Harvesting from the river

Using the Danube as fishing grounds (*Fischweide*) and the related fishing rights as one of the sovereign rights had to be permitted by the territorial lord. In 1362, the Benedictine Abbey of Melk was granted the right to fishing grounds in the Danube that extended from the middle of the Danube to the river bank. The penalty imposed for a violation of this right of utilisation was high, amounting to 100 pounds of gold.[50] The fishers in Krems were granted a similar right, which was documented by instructions of the territorial lord in 1455 and 1459.[51] Such provisions regularly led to disputes like the documented conflict between the burghers of Krems and Stein on one side of the Danube and the town of Mautern, subject to the Bishop of Passau, on the other. The burghers of Krems and Stein were accused of having denied the Mautern citizens the utilisation of the fishing grounds in episcopal possession. The burghers of Krems and Stein argued that they had used both the flood plain and the fishing grounds together with Göttweig Abbey for years. They, in turn, accused the townspeople of Mautern of having prevented them with heavy weapons from using their rights, namely fishing and harvesting ice in winter. There is no evidence on the final outcome of the conflict. The parties' arguments make it clear that opinions regarding fishing practice and the use of Danube water/ice apparently differed. While Krems and Stein adhered to the territorial lord's instructions of prudent utilisation of the water, the use of special fishing devices caused significant damage by damming water.[52] About 20

45 Winner – Herold 2001, no. 147 (1303 January 1); Winner – Herold 2001, no. 317 (1318 May 1); Winner – Herold 2001, no. 675 (1357 September 1); Winner – Herold 2001, no. 720 (1363 July 4); Winner – Herold 2001, no. 798 (1383 July 4); Winner – Herold 2001, no. 830 (1388 April 24).

46 Fuchs 1901a, 541 no. 609 (1364 March 31).

47 Winner – Herold 2001, no. 248 (1314 November 11). According to a note on the back of the deed, this mill was located on the Ledergasse in Krems. Jaritz 1976, 19, n. 3.

48 Winner – Herold 2001, no. 1486 (1454 August 23).

49 Fuchs 1902, 226 no. 2012 (1487 December 15).

50 Winner – Herold 2001, no. 713 (1362 January 22).

51 Brunner 1953, 114 no. 186 (1455 June 19), 118 no. 194 (1459 September 4).

52 A similar conflict was also documented in the area of influence of Klosterneuburg Abbey: Hoffmann – Sonnlechner 2011, 124.

years later, the territorial lord felt impelled to restrict uncontrolled fishing in the entire Austrian part of the Danube. Laying down a closed season that ended on the 29th of September was meant to limit extensive fishing. This, however, was not quite successful, because 1506 saw another reaction to the still existing nuisance and a regulation was decreed to protect specific fish indigenous to the Danube.[53] The urban community was in charge of the concrete implementation of these instructions. In 1546 and 1579, they issued an order for fishers. In addition to general guidelines on the practicing of the trade and quality assurance, basic conditions for the selling of fish were laid down.[54]

Bridging the water

It is obvious that bridges had important functions in the Middle Ages.[55] They represented an indispensable component in road networks and traffic connections and created transport links particularly vital for towns and cities. As installations that could be used by a large number of people for crossing, they contributed to the exchange of goods and information, but also to the proliferation of danger and disease.

Dating back to the 14th century, Viennese account books list numerous expenses for construction work spent on the maintenance of bridges. In the north of Vienna, many wooden bridges were built in the Danube flood plain to connect the inner city to the surrounding area. The reasons why bridges were built were manifold: many commercial businesses, such as leather production or viticulture, were located in the regions to the north of the city. Cattle from Hungary grazed at the so-called *Ochsengries* before they were sold at the market or continued on their way to Upper Germany. Agricultural products from the areas on the northern bank of the Danube were also brought into the city on these access ways. Documents repeatedly emphasised the common good to justify the construction of bridges.[56] The provisions of Duke Albrecht II, for instance, laid down in 1439 for the Vienna Danube Bridge toll that the bridge should be made accessible to anyone who could ride, drive, walk or carry goods. Everyone was free to choose the traditional form of crossing on ships below the bridge, or the way over the bridge on foot or on horseback. The construction of the bridge was justified by the fact that many inhabitants and visitors had to cross the river to pursue their business. Both their goods and their own lives were exposed to dangerous situations. In view of the high costs involved in the construction, maintenance and securing of bridges and their connecting routes, mandated fees had to be paid.[57]

The permission granted by the Austrian duke to the towns of Krems and Stein to build a bridge across the Danube represented an important milestone in the development of transregional trading routes. Around the middle of the 15th century, the town of Krems-Stein obtained a number of rights that fundamentally changed its position as a centre of trade and crafts. The staple right bestowed in 1462 and the permission for direct trading with Venice using the road towards the south via Mariazell were the start of a phase of favoured conditions. Apart from

53 Hoffmann – Sonnlechner 2011, with sources; Simon-Muscheid 2006, 30 on water protection and fish as a resource in general.

54 Brunner 1953, 234 f.

55 See Maschke 1977; Hirschmann 2005; Becker 2010; Fouquet 2018 for a survey of significance, functions and construction of bridges with various evidence, and Gruber 2019 to the connecting and separating properties of bridges.

56 This idealised concept was expressed in urban buildings and objects that served a common purpose and held a symbolic value such as town walls, bridges, or the town's main well at the square – often decorated for representational purposes. Isenmann 2010, 109 f.; Gruber 2017, 41 f.; Zajic 2014, 398–426.

57 Brunner 1929, 383; Lessacher 2016, 156–162.

Vienna, no other town had these rights. The already long existing privilege that restricted the reloading of wine, grain and other goods on the left bank of the Danube between Grein and Korneuburg exclusively to Krems, together with permission to build the bridge, made the town an economic hub. Presumably, the bridge itself was not built before the end of the 15th century. In the section of the Danube in the Duchy of Austria, the conditions for building bridges were difficult. The width and flow velocity of the river required special measures to be able to create a stable structure. At least for the bridges in Linz, Enns and Krems, the use of a pile driver is documented. This mechanical fixture was used to drive in the wood piles that would carry the bridge. A heavy, iron-strengthened wood pile was driven into the river bed using a rammer that was positioned on rafts. The construction of this device was not only elaborate, but also expensive. The construction invoices of Enns testify to many expenses for the procurement of material that was needed to build the device. Debarked round oak piles were fixed together with iron ferrules to form a mallet to which an iron base plate was attached. It took six weeks of preparatory work until the fixture was ready to use. There is a background to the manufacture of this device that is important when exploring bridges as objects and their connections. In 1492, Frederick III had called upon the burghers of Enns to return this important device to Stein; it had been used in building the bridge in Stein and that had arrived in Enns under various circumstances; it was to come back to Stein, where it was urgently needed to complete the bridge.[58] Bernhard Karlinger, an influential burgher of Krems and mayor, town magistrate, council member and toll levier in Stein, had turned to Frederick III with this request. This last-mentioned function might have been the reason why he wanted the absent pile driver be returned to the ownership of the townspeople of Stein. In recognition of their contributions to Göttweig Abbey, Karlinger and his first wife Martha were admitted in 1475 to the abbey's fraternity.[59] He and his second wife Maria Magdalena donated many masses in the churches of Krems and Stein. The side wings of the Altar of the Holy Trinity in Stein depicted him and his two wives as donors.[60] The urgent need of a device that was indispensable for the construction of a bridge and that could not be reproduced for every single application, owing to the expense of manufacturing, not only brought together the protagonists who actively wanted the pile driver to be returned to Stein, namely Bernhard Karlinger as the burghers' representative, Frederick III as territorial lord and the citizens of Enns.

At the beginning of the 18th century, Zedler's encyclopaedia described bridges as the 'most elegant works of architecture' that 'link a country to another being separated by deep valleys, streams, rivers, and crevices'. The associated advantages influence both 'human society' as a whole and 'the trades'.[61] Zedler did not mention any disadvantages. He also ignored the question of how missing bridges influenced potential access options. His interest focused on the existence of bridges as the result of human intervention. A spatial connection between the two sides of topographical situations, such as bodies of water, that otherwise were very difficult to overcome or only with much effort, enabled a secured and easier crossing, thus promoting the exchange of goods and information, but also the proliferation of danger and diseases. The construction, maintenance and repair of bridges required a great deal of investment of financial, human, material and non-material resources.

Following the water

Water as one of the matters that are fundamental for the existence of living things entails not only a variety of possible interactions between people and nature, but it also compels action and

58 Katzinger 2014, 117–119.
59 Fuchs 1902, 81 no. 1844 (1475 March 31).
60 Görg 1961, 29–31.
61 Zedler 1733, 1537.

intervention under varying circumstances. 'Water can be controlled, channelled and contained, equally water runs free, wild and uncontrolled, with the ability to devastate and destroy, or otherwise trickles away and dries up, taking with it its life-sustaining powers'.[62] As of late, discussions dealing with the materiality of things have increasingly addressed these conflicting interrelations. 'Water provides a useful focus for thinking about relationships between things and persons and between material properties and meanings'.[63] This interaction can be on a personal level or organised in community settings. Due to the internal structures of their administration and the way in which they organised their living together, towns, convents and castles, in particular, allow conclusions to be drawn with reference to the interaction between water and people. Examples from the region of Krems, Stein and Mautern have been used above to outline various aspects of how water was used and dealt with, as well as to illustrate actions caused by water. They also show 'how the agency of water shaped peoples' interactions with and within the environment'.[64] The use, management and control of water constantly led to processes of negotiation regarding competence and responsibilities between the actors involved. It is not only about control and distribution, but also about protection against risks and how to manage them, about the control of abundance or scarcity, and the evaluation of alterations in the landscape resulting from dams, canals, etc.[65] As part of public infrastructure, the construction and maintenance of urban facilities such as bridges, wells, rainwater drainage or sewage ducts required a complex system of planning, coordination and resource management, including manpower and a common perception of communal acting. From this viewpoint, water supply and its communal organisation raise the question of the social function of water infrastructure in an urban context.

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Fig. 5: Augmented Reality App Kremser Hafen, Niederösterreichische Landesregierung.

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62 Steel 2018, 6.
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65 Cless 2014, 33 f.

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