POLISH STUDIES –
TRANSDISCIPLINARY PERSPECTIVES 17

Urszula Sowina

Water, Towns and People

Polish Lands against a European Background until the Mid-16th Century

PETER LANG
EDITION

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The book describes the functions of water in Polish towns from the late Middle Ages to the beginning of the Early-Modern Era against a wide European background. It presents the issue of water supply in the context of the town as a complex social and economic organism, taking into account social relations, administration and power as well as living and working conditions. Describing water supply devices, the author reconstructs the ways in which the techniques were transferred to the Polish lands. She analyses municipal court books and documents concerning towns of various sizes in the Polish lands from the 14th to the 16th century, with particular emphasis on Kraków. In addition, she also considers archaeological and iconographical sources. Her findings provide a new insight into the alimentary and hygienic uses of water, its importance for production and crafts, and its use as a source of energy, transport and communication. This is the first broad comparative presentation of the subject in Polish and European literature.

The Author
Urszula Sowina is an Associate Professor at the Institute of Archaeology and Ethnology at the Polish Academy of Sciences in Warsaw. This book is the result of her research in numerous Polish archives on the supply of water and its use in Polish towns.

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Introduction

Aqua est substantia actualiter humida aere materialior huius virtutem lauatinam et gurgitaturam et potatiuam auctorum, monstrorum matrix et piscium faciliter susceptiua impressionum omnium et maxie caliditatis et frigiditate ab equalitate dicta a mari suam trahens originem[1]

"[…] since a city requires a large amount of water not only for drinking but also for washing, for gardens, tanners and fullers, and drains, and – this is very important – in case of a sudden outbreak of fire, the best should be reserved for drinking, and the remainder distributed according to need."[2]

The above quotations from two works written almost at the same time, i.e. in the mid-15th century, reflect various ways of thinking about water in the times which will be discussed in the present work. The first quotation constitutes one of the belated attempts to define water in a manner proper to 13th-century encyclopaedias. The second quotation, although taken from a treatise, renders the reality of a 15th-century town and systematically, though briefly, presents these areas of life in which water – in large quantities – was most needed.

Among the most important factors organizing the town[3] in the pre-industrial era were always its hydrographic conditions which had a decisive impact on the establishment and later on the functioning of the centre. Natural watercourses or reservoirs on which a town was built contributed to its layout and to the social and economic organization of its space. The creation of artificial watercourses or reservoirs stemmed from the necessity to meet various needs of a particular town and its inhabitants. The basic ingredient of food and drink, performing a crucial function in production, energy and hygiene, water has always been essential for life. Nonetheless, acquiring a sufficient amount of water of an appropriate quality and later its distribution was one of the most difficult supply problems in towns of the pre-industrial era.

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1 BJ, Paulus de Praga, p. 177v. (Water is a substance actively humid [*umida* – water as one of the four elements, note: U.S.], more material than air, by virtue of cleaning and quenching thirst of people, creatures and fish, easily susceptible to all impressions, both warm and cold, taking its origin from the sea).

2 Alberti 1988, p. 331.

3 Town understood as a settlement unit, with a certain spatial, legal, social and economic structure proper only to the given town, which has been described many times – cf., inter alia: Bogucka/Samsonowicz 1986, pp. 5–17.

According to Leon Battista Alberti, whose words have been quoted above and who presented the kind of knowledge that was known and used, different needs should be met with the use of water of different quality. The necessity to make a choice testified to the existence of problems with acquiring water – not only the best water, i.e. for consumption, namely for drinking and preparing food, but also suitable utility water,[4] used mainly as a necessary element of craft production. The recommendation to make such a choice was addressed not so much to the inhabitants of the town, but to those who governed it. This obligation rested with the town authorities, however, complying with it also depended on the owners of the towns, chiefly as the ones who exercised power over the watercourses and reservoirs used by the town. At the same time, both for the town authorities and for the owners of the centre, managing the waters – understood as having control over them – constituted one of the manifestations of exercising power in and over the town. The problem was an important one: efficient water management was of paramount importance for the economic development of the centre: it facilitated reaching a high level of development of its crafts, which in turn enabled conducting trade in better-quality goods. Both the owner of the town and its local authorities benefitted from such a situation. The awareness of these interdependences resulted in the fact that providing water for the town and its inhabitants was perceived not so much as the owner's benevolence, his "pious deed", a manifestation of charity,[5] but mainly as a well-understood common interest – "a public good" ("utilitas publica/bonum commune"[6]). Such was also the significance of water supply in the so-called towns chartered with German law which became more and more widespread from the beginning of the 13th century in the Polish lands as financial investments made by the princes of the provinces of the period of feudal fragmentation. They were interested in an efficient functioning and a good condition of these centres, because they were to serve – in a new legal and spatial form, like their models in the Holy Roman Empire – the strengthening of the power of the princes over their territories.[7]

4 This expression – together with the division into drinking and utility water – has been consistently used in Czech literature – inter alia: Hoffmann F. 1992, p. 92; Jásek 2005, passim. According to this pattern also: Sowina 2005, passim.

5 Squatriti 1998, pp. 12 et seq.

6 About the evolution of the meaning of "utilitas publica/bonum commune" – Eberhard 2004, passim.

7 A thorough and in-depth analysis of these phenomena in German territorial landlordships and their comparison with similar conditions of establishing towns in the Polish lands was done by Sławomir Gawlas (1996, pp. 26 et seq.).

For local municipal authorities managing the waters entailed not only the obligation to build public water reservoirs and networks, but also effective judicial interventions aimed at resolving problems concerning the functioning of water devices in private space, so as to avoid any disturbances which could affect the everyday life and work. This ensured that the entire centre functioned efficiently.

In the area of municipal and burghers' finance, water supply constituted the source of income for the one who exercised power over it, and on the other hand acquiring water entailed expenses. Hence both water itself and all devices connected with water appeared in accounts not only as entries on the side of the town's revenues or expenditures, but also as the subjects of various public and private transactions, namely as a commodity either owned or managed by someone.

In research on particular towns the size of all undertakings connected with the management of waters – which depended on the financial possibilities of the town and its inhabitants (including the construction of public and private water devices) – should constitute one of the necessary indices on the basis of which the economic efficiency of a given centre, and thus its status, is evaluated.

In Germany, France, Italy, Spain, Belgium, the Czech Republic and Poland appeared numerous noteworthy publications concerning the role of water in towns, including water supply. Often, they were published after interdisciplinary scientific meetings: the best forum to exchange experiences from conducted research. Throughout the years one of the most lively topics was the problem of various mutual relations between the town and the river. One of such works is *Die Stadt am Fluß*, published in 1978: a collection of papers devoted to towns situated on rivers, presented three years earlier at one of periodical conferences organized by Sűdwestdeutscher Arbeitskreis fűr Stadtgeschichtsforschung.[8] Among presentations collected in the above-mentioned work, embracing the period from the Middle Ages until the 20th century, mediaevalists should turn their attention to those which describe the role of mediaeval bridges in towns on great rivers (e.g. bridges on the Rhine, bridges between Strasbourg and Kehl) and the meaning of the latter in long-distance transport and trade between cities (e.g. the importance of the Danube for the development of Regensburg), and various functions performed in towns by small rivers, most of all as the sources of energy for watermills.

In studies conducted during the next decades, rivers – even though they performed numerous functions – were perceived mainly as sources of energy for

8 Detailed bibliographic descriptions of works quoted in the present work are listed in "Bibliography (Sources and Literature)". To most of them references will be made also in individual parts of the book.

mills, whose importance for the feudal world, and also for mediaeval economy, cannot be overestimated, which fact was pointed out by Marc Bloch in his pioneering article published in 1935.[9]

Other works published concerned also the advantages of rivers in terms of communication, trade and supply offered to centres situated on a river or on canals branching off from a river. This was the case mainly in town monographs, but sometimes also in works devoted to the rivers themselves. However, from the 1980s rivers began to be perceived as water intakes that towns needed for their craft production and consumption. This in turn resulted in the revival of research on the supply of towns in general, and in particular on the ways of supplying towns with water. The former gave rise to at least two publications of post-conference materials: in 1981 – *Städtische Versorgung und Entsorgung im Wandel der Geschichte* (Villingen 1979) and in 1985 – *L'approvisionnement des villes de l'Europe occidentale au Moyen Age et aux Temps modernes*. The German publication contained papers concerning Central European centres, namely situated in south- western Germany, Hungary and Slovakia. The French collection included works on the supply of the Spanish town of Toledo, as well as of Dutch, western German, French and Italian towns. Supplying towns with water found its place in both of these publications: either as short mentions (e.g. in the case of Slovakia or France), or as entire articles devoted to this subject. Among the latter a significant role in subsequent years – for mediaevalists dealing with water in towns – was to be played by works by Heinz Dopsch, Ulf Dirlmeier and András Kubinyi, as well as by Dietrich Lohrmann.

However, by the time the latter of the above-mentioned collections was printed, two other works devoted entirely to water in towns had been published. In 1982 appeared a Dutch article by W.C. Wijntjes, who synthetically presented the methods and problems of water supply in mediaeval European towns. A fascinating image of a town and its waters, needed firstly to organize the centre, and then used for communication and defence, as a source of energy for mills and as an indispensible element of craft production (also in the form of channels-sewers carrying away wastewater from this production), André Guillerme's work entitled *Le temps de l'eau. La cité, l'eau et les techniques* was published in 1983. These works presented a wide panorama of topics in the subject in question; for many years, they determined the direction of research on water in towns. This kind of research became – especially from the early 1990s – an independent and strong

9 Bloch 1935, passim.

current in interdisciplinary studies, mainly in the domain of history, archaeology and art history, but also hydrogeology and biology (palynology and bacteriology).

Another very important work was "Geschichte der Wasserversorgung", published between 1987 and 1991 by Geselschaft "Frontinus", consisting of three volumes devoted to ancient towns and of one volume containing the findings of the then latest historical and archaeological research on the technique of water supply in mediaeval monasteries, burghs, castles, palaces and towns of various parts of Europe,[10] with an acute lack of Italy and the Iberian Peninsula, as well as of the East-Central Europe. The year 2000 witnessed the publication of the fourth volume devoted to these subjects in the Renaissance. Among authors who contributed to the above-mentioned volumes were such outstanding scholars as: Paul Benoit, Klaus Grewe or Albrecht Hoffmann. Works dating from the turn of the 20th and 21st centuries, dealing with various water installations from the point of view of a historian, an archaeologist and an engineer,[11] can be counted among publications belonging to this "technical" current.

Starting from the early 1990s, the growing interest of mediaevalists in the issue of water in the town arose from the ever more detailed and in-depth studies on the mediaeval town: on its space, society, economy and – on the whole – sociotopography, but also on the town management methods used by the owners of the centre and by the municipal authorities. This was reciprocal: works concerning water inspired authors of town monographs to devote more attention to the waters of the centres under research.

In connection with such in-depth studies, in the relevant literature there appeared a very important subject of the control of waters used by the town, signalled as early as 1986 by Pierre Racine.[12] One of the first scholars who decided to investigate it was Duccio Balestracci. Having worked on detailed monographic studies on the mediaeval municipal organism (on the example of Siena), he turned to research on water management in Italian towns perceived as an instrument of power,[13] and voiced his opinion that "les eaux jouent un rôle de protagonisme absolu parmi les sujets qui contribuent à dessiner ce qui a été défini comme « reprise » économique – à partir du Xe siècle".[14] This view prevailed during the entire meeting in the scope of which it was aired, namely during one

10 Cf. also a review by: Lohrmann 1992, pp. 179–188.

11 Grabowski/Mührenberg 1994; Hoffmann A. (Hg.), 1995; Lohrmann 1999, pp. 267–282; id. 2000, pp. 117–143; Sowina 1998, pp. 81–87; eadem 2002c, pp. 283–297.

12 Racine 1986, pp. 9–32.

13 Balestracci 1992, pp. 431–479.

14 Balestracci 1994, p. 115.

of the sessions of the Eleventh International Economic History Congress in Milan in 1994. The colloquium was organised by Elizabeth Crouzet-Pavan, the author of a monumental monograph on the social and economic structures in Venice, and Jean Claude Maire Vigueur, the co-author (together with Henri Broise) of a monograph on late mediaeval Rome. It was already in the Introduction that they expressed the following opinion: "Les implications techniques de l'histoire du contrôle des eaux apparaissent bien sûr comme des problèmes de première importance. Mais ce thème de la maîtrise et de l'exploitation des eaux peut être également conçu comme un révélateur des structures économiques, sociales et politiques et de leur transformation".[15] This meeting proved to be one of the most important conferences devoted to this subject due to its programmatic character. The majority of papers presented there secured their place in literature and served further research on water control in European economy. This statement concerns, inter alia, a paper by Patrick Boucheron about Milan in the years 1200–1500, the second (after D. Balestracci's) presentation of the subject of water control in urban environments. Its second edition in 2001 (in English),[16] together with an article by Derek Keene about water in London ca 1300,[17] has made it possible to compare the ways in which water was managed and governed in two major centres of two different zones of development of European mediaeval economy. On the other hand, D. Keene' s work together with an article published at the same time by Urszula Sowina (2000 – Polish edition; 2001 – French edition) concerning the water supply systems of mediaeval Rouen (on the basis of an analysis of Jacques Le Lieur's *Livre des Fontaines* dating from the years 1524–1525) has enabled one to discover many organisational and legal similarities in terms of managing water

15 Crouzet-Pavan/Maire Vigueur 1994, p. 8.

16 Boucheron 1994, pp. 123–138; id. 2001, pp. 180–193.

17 By 2001 also this author had published thorough works in the field of mediaeval history of towns, including: *Survey of Medieval Winchester* (Oxford 1985), "The property market in English towns, AD 110–1600". In: *D'une ville à l'autre: structures matérielles et organisation de l'espace dans les villes européennes (XIII^{e}–XVI^{e} siècles). Actes du colloque organisé par l'Ecole française de Rome avec le concours de l'Université de Rome (Rome 1er–4 décembre 1986)*, édités par Jean-Claude Maire Vigueur. Collection de l'Ecole française de Rome. Palais Farnèse, Rome 1989, pp. 201–226; *A medieval Capital and its Grain Supply: Agrarian Production and Distribution in the London Region c. 1300* [with B.M.S. Campbell, J. Galloway, M. Murphy] (London 1993). The abovementioned article about water in London was the outcome of the author's participation in the 4th International Conference on Urban History, European Association for Urban History, Venice 1998, in a session entitled "Water and the City".

from the water supply networks in Rouen and London, associated with one another politically until 1204, and later – still – economically.

In the second half of the 1990s and in the early 21st century the issue of water in towns, including its management, became the subject of interest also of other scholars. First of all, Paolo Squatriti's work entitled *Water and society in early medieval Italy, AD 400–1000*, published in 1998, must be mentioned, as it broadened the existing field of research by including the early Middle Ages. While describing the use of water for various purposes (in houses, baths, farming, fishing and milling), the author showed the rules governing it and their origins, namely the ancient heritage and early mediaeval positive law.

In the same year and the following year post-conference materials from two subsequent congresses of historical and scientific associations (which had taken place in 1995 and 1996) were published in France. While in the scope of the first one, entitled "La ville au Moyen Age", papers concerning water in towns were presented only during one section called "Équipement urbain", the next congress was entirely devoted to "L'Eau et la Ville" from antiquity to the 20th century. In 1998 in Venice, within the framework of the 4th International Conference on Urban History, a session entitled "Water and the City" took place. It was organised by Giorgio Gianighian and Maria Isabel del Val Valdivieso. The latter scholar had been conducting extensive research on water in towns, also in a team with Spanish mediaevalists. This scientific team produced several significant publications in the years.[18] Together with U. Sowina, M. Isabel del Val Valdivieso also organised a session entitled "Power and Water Problems in European Cities in the 15th and 16th Centuries" within the scope of the 7th International Conference on Urban History, Athens 2004.[19]

In the new millennium among various currents of research on the role of water in Europe, studies on water in towns have been continued; they led to scientific meetings which in turn gave rise to publications. However, besides post-conference books also separate works have been published. For example, in 2002, i.e. one year after the three above-mentioned articles about water in Milan, London and Rouen, a synthetic work written by an urban historian, Jean-Pierre Leguay, entitled *L'eau dans la ville au Moyen Âge*, was published in France. On the basis of written, archaeological and toponymic sources, its author described the role of

18 Inter alia: *El agua en las ciudades castellanas*, 1998; M. Santo Tomás Pérez 2002; *Usos sociales del agua*, 2002, *Vivir del agua*, 2006.

19 Post-conference materials published in: Histoire urbaine, n° 22, 2008, also with a joint article: Sowina/Val Valdivieso 2008.

water in French towns and French fiefs from late antiquity to the threshold of the modern era.

Before presenting the state of research on water in Polish towns, let us turn our attention to this subject in another country of the "younger" Europe, namely in Bohemia. Firstly, it was precisely via Bohemian lands and cities, and often through their intermediary, that institutional and legal models of the towns "of the German law" came from southern German cities to Silesian towns and to towns in the Polish lands of the period of feudal fragmentation, and later to the cities of the Crown of the Kingdom of Poland. These models were followed by the transfer of many techniques, including those of building water supply systems.

Czech studies on water in mediaeval towns constitute an integral part of archaeological research, carried out intensively and systematically for years in many towns, both large and small. Among the impressive findings which have been published to date are those concerning all the possible ways of acquiring drinking and utility water (the latter for the purposes of crafts): from dug wells – public and private, through water supply networks, to using water dripping down the walls of cellars carved in rock – as was the case in the mediaeval town of Tábor, which had immense problems with water. In the year 2000 Radek Široký published an extensive, richly illustrated synthetic article presenting the state and the perspectives of Czech archaeological research on water in towns, in which he gathered the whole existing relevant literature including historical studies, helpful to archaeologists. Thanks to numerous references mainly to German studies (but also to Slovak, Polish and Russian research), the author provided a wide picture of the technique of water devices in Bohemian towns against the background of such devices in other cities of East-Central Europe (including the Hanseatic region). The diversity and high technological level of installations used for water supply in Bohemian towns match the same qualities of water installations in Bohemian mines, mills and ponds (Bohemian mining, milling and fishing economy belonged to the best-developed in Europe of that time), which situates them all on the highest European level.

As far as Czech studies on water in towns are concerned, they have been continued throughout the recent years. This statement can be confirmed not only by the emergence of new archaeological research projects, but also by the fact that in 2003 the Prague City Archives organised a conference entitled "Město a voda. Praha, město u vody [City and Water. Prague, a City by the Water]". This international meeting gathered also researchers from Germany and Poland, and its interdisciplinary character enabled the participants to exchange experiences from the domain of history, archaeology and water engineering.

A review of Polish works (in comparison with the above-mentioned Western European literature) should begin with the second volume of *Historia Kultury*

Materialnej w zarysie [*History of Material Culture. An Outline*], a synthetic work edited by Anna Rutkowska-Płachcińska, published in 1978. This volume was devoted to the Middle Ages and it gathered the state of knowledge from the title domain with references to numerous earlier articles and monographs. Among the most important ones were studies on the role of rivers for mediaeval settlement, conducted mainly by Teresa Dunin-Wąsowicz, and also on the role of water in mediaeval economy in the Polish lands, chiefly in the technical aspect, in such domains as milling and pond fishing economy (Maria Dembińska), beer production (Stanisław Kutrzeba), and in such urban and rural crafts as tannery and weaving (Irena Turnau, Jerzy Wyrozumski), as well as for hygiene (Jan Tyszkiewicz). As far as water supply of towns is concerned,[20] the main focus of attention was – just like in Western European literature – on discussing the historically and archaeologically documented town water supply systems (Franciszek Giedroyć, Łucja Charewiczowa, Elżbieta Ligęza); the authors usually associated the establishment of such networks with the requirements of beer production. Some of the works from the field of material culture history brought out after 1978 were the continuation of the above-mentioned studies (Agnieszka Samsonowicz, Andrzej Klonder). In 1993 a work entitled *Poznań. Dzieje miasta wodą pisane* was published. Written by Alfred Kaniecki, a geographer and a hydrologist, the history of this town described from the perspective of water proved important for the present studies. In 2004 it was brought out in a considerably extended version.

As to the presentation of water in numerous town monographs, the authors most often confined themselves to describing natural watercourses or reservoirs existing in close proximity to the town and the benefits they presented (e.g. in terms of fishing or the functions of an inland port). However, this did not result in a more detailed discussion of the ways of water supply within the space of a given town. In order to present the economic structures, the authors usually described individual crafts without reflecting on the possibilities or limitations of their development or specialisation depending on the abundance or lack of water of a suitable quality. For that reason, to a considerable extent central issues such as the range of goods and their quality (e.g. luxury production or its lack) were not examined, although, inter alia, they determined the economic potential of the centres and – together with other factors – the importance of the towns and the character of urbanisation. While describing the society of a given centre the authors mentioned the role of water rarely, fragmentarily and in general terms – on the level of domestic

20 Although chronologically it does not belong to the scope of the present work, a monograph concerning the water supply of 18th-century Masovian towns, written by Elżbieta Balcerzak (1968), deserves being mentioned.

life (hygiene) at the most, never as a factor which shaped social relations or as an instrument of power in the town. Another issue that was not taken into consideration was the social and professional status of the people who built or repaired water devices; at best, their presence was mentioned. One of the important reasons for at least some of these deficiencies was the fact that the basic sources for studying urban morphology, namely town court books, were either used only to a limited extent, or were not used at all. It has to be admitted that this was not always possible, as many of them had been destroyed or missing (owing to frequent fires, but also as a result of the destruction and requisitions from the period of the Swedish Deluge in the 17th century, as well as of the German and Soviet operations during the Second World War). Socio-topographical studies on late mediaeval Poznań carried out by Jacek Wiesiołowski, in whose footsteps followed a number of other Polish scholars who undertook such studies on Sieradz, Elbląg, Wrocław, Toruń, Warta, Świdnica and Krosno, involved making use of this type of sources. It was mainly on the basis of town court books that the researchers recreated the changing relationships and interdependencies between the town's social structures and its space, carried out the social valorisation of this space and – as a result – defined the economic status of the centre, its social and economic potential, functions and directions of development. In this socio-topographical picture, the role of natural watercourses and reservoirs was perceived as a factor which organized the social and economic space of a given town. Only in the case of Świdnica also dug wells were mentioned as performing this function.

Having conducted socio-topographical studies of one of the towns (Sieradz), the present author undertook monographic research on water in late mediaeval and 16th century towns. The choice of the subject was dictated by the fact that no such studies existed in the output of Polish historians. The focus was to be on the towns in the Polish lands in the period between the second half of the 14th century until the 1560s, with a particular accent put on Kraków. The chronological scope depended on the source base: on the one hand, town court books came into wider use in the 15th century, on the other hand, the number of mentions concerning the role of water devices in the town space increased in the 16th century. The author used all types of preserved written sources pertaining to as many centres as possible (cf. the sources listed in the bibliography), including two *civitates maiores*: Kraków and Poznań. Among the court books which were subjected to archival research there were all of their surviving types, namely town councillors' books, books of the tribunal of *advocatus* and echevin books. In the case of Kraków, the archival research embraced also books of the councillors being in charge of the town's money (*Lohnherren*) and books of the Town Hall governor (*praefectus praetorii*), as well as separate books of testaments and town account books, kept

by the Kraków city council. A vast majority of the town books from all of the centres are manuscripts. The author used published town books only in the case of Poznań, Płock and partly Kraków. Court books of the towns of the Kingdom of Poland were usually written in Latin, with the exception of Poznań and Kraków books which were also written in German.

Archaeological evidence concerning water devices proved to be immensely helpful and constituted a valuable complement of sometimes excessively laconic written sources. The archaeological evidence was drawn from Polish urban archaeology, which has developed rapidly during the last 30 years, producing numerous publications pertaining to Wrocław, Kołobrzeg, Elbląg, Toruń, Gdańsk, Lublin, Płock, Krosno and other towns, although earlier works must not be forgotten, e.g. Kazimierz Radwański's research on Kraków or Józef Kaźmierczyk's study devoted to Wrocław. Some of these works became a direct inspiration for detailed historical analyses of the subject of water in towns, e.g. valuable articles written by Mateusz Goliński (the author of works devoted to the socio-topography of mediaeval Wrocław and Świdnica) pertaining to one of Wrocław's water supply networks and to the co-ownership of deep wells in Świdnica.

Apart from written and archaeological sources, also iconographical sources were used, as well as the scanty material evidence that has survived.

Owing to the fragmentary character of the written sources the author decided to present the title issue against a European comparative background (with references to relevant literature and published sources). This resulted not only from the will to extend the research questionnaire in relation to Polish towns by problems which were not addressed directly in Polish sources, but also from the will to find the possible models and routes of the transfer of techniques (know-how, savoir-faire), particularly from those centres which were situated in countries from which they could reach Poland through direct or indirect contacts between the centres or their inhabitants (e.g. together with patterns of chartering towns with German law or as their consequence, or in connection with trade contacts). In some parts of the work, the fulfilment of these plans resulted in a clear predominance of the "European background" over the situation in towns in the Polish lands. Nevertheless, thanks to a detailed presentation of this "background" it was easier to evaluate the character and the dimensions of the same phenomena occurring in centres in the Polish lands.

The present work constitutes a research proposition which focuses not only on the description of various ways of water supply in the public and private space of a given town, but also on capturing the social and economic relations established in connection with it. It also attempts to provide answers to questions which have not been asked before in the above-mentioned town monographs.

As a result, the present work concentrates on showing the problems concerning the possibilities and limitations of various ways of water supply as well as how water was managed and how it was used to manage late mediaeval and early 16th century towns in the Kingdom of Poland.

The starting point is the first part of the work, in which opinions about the quality of water, depending on its kind, were presented. A detailed analysis of the readings of people who expressed these opinions was made to demonstrate the continuity of these views at least from Ancient Greece. Since they were the result of experiences gathered by observation of the invariable nature of water, of the conditions of its occurrence in environment, and of its demand, the opinions remained up-to-date throughout centuries and as such were repeated and passed down as common knowledge.

Making the river and its water the main subject under consideration in the second part, the author attempted to show the ways in which this water was used to the benefit of both the owners of the rivers and the town community. The activities and facilities using water from rivers were described from this perspective.

In the third part the author presented the building methods (with necessary references to classical antiquity) of all types of artificial reservoirs and watercourses in the town space, the ways of using them, and their role in the social and economic life of the town. Rainwater tanks and cisterns, dug wells and water supply systems were described in this manner. As a complement of the above, the importance of a direct supply of water from all water reservoirs, both natural and artificial, was explained.

The work was written at the Institute of Archaeology and Ethnology of the Polish Academy of Sciences. In the years 1953–1993 the Institute was called the Institute of History of Material Culture. Consequently, this domain also contributed to the character of the present work. The present studies were enhanced by the fact that the author had the chance to participate in the scientific life of the following scientific groups: the Mediaeval Society and Culture Section of the Institute of History of the Polish Academy of Sciences under the guidance of Professors Hanna Zaremska and Halina Manikowska; the Centre d'Histoire des Techniques et de l'Environnement at the Conservatoire National des Arts et Métiers in Paris, headed by Professor André Guillerme; the team working under the guidance of Professor Paul Benoit from the Laboratoire de Médiévistique Occidentale de Paris (LAMOP), Université Paris I – Sorbonne; research groups from the Departamento de Historia Antigua y Medieval Universidad de Valladolid with Professor Maria Isabel del Val Valdivieso, from the Departamento de Historia Medieval Universidad de Córdoba with Professor Ricardo Córdoba de la Llave, and from the Archaeological Institute of the Czech Academy of Sciences

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Part I. Opinions concerning the quality of water in the Middle Ages and at the beginning of the early modern period

In the years 1524–1525 Jacques Le Lieur, a patrician from the Norman town of Rouen, a local echevin and one of the royal notaries and secretaries to the King of France, Francis I, described the water supply system of Rouen and underlined the major importance of water supply systems for every centre.[21] In the foreword to his work, he stated: "Les philosophes et phisiciens qui grandement ont travaillé pour subtillement chercher, enquérir et cognoistre, tant par raisons naturelles que par longues et laborieuses expérienses, les proprietés et utilités des choses créés, uniformément et par sentence commune ont escript que l'élément de l'eaue entre les autres élementz et corps éléméntaires est tant proufitable, utile et necessaire à tous vivans, que la vye humaine ne pourroit estre de longue durée et persistence sans usage d'iceluy… oultre ce qu'il est nécessaire, est très décente et convenable pour rendre la vye humaine plus délectable, plus gaye et en meilleure disposition, en mundifiant, purgant et nétoyant les infections des lieux et places oú il flue et habonde, donc l'air est faict plus salutaire et moyns corruptile".[22] These words constitute a perfect summary of what had been written about the importance of water before J. Le Lieur. They resulted from what Le Lieur, a well read and educated man, had read himself, which is why they contain opinions formulated much earlier, i.e. in antiquity, and prevailing throughout the centuries, including the analysed period. Perhaps he wrote these words having read the beginning of the eighth book of Vitruvius' treatise *De architectura libri decem*,[23] in which one can find the following observations: "But Pythagoras, Empedocles, Epicharmus, and other physiologists, and philosophers, maintained that there were four elements, air, fire, water, and earth; and that their mixture, according to the difference of the species, forms a natural mould of different

21 For more information cf. Cerné 1930, passim, Sowina 2000 (in Polish), Sowina 2001 (in French), passim.

22 Le Lieur 1911, p. 1.

23 Jacques Le Lieur might have got acquainted with Vitruvius's work e.g. in the library of King Francis I, to whom he was one of the secretaries. This library must have contained Vitruvius's treatise: either among manuscript copies imported or done by the King's order or in its printed version. Cf. Baszkiewicz 1978, p. 225, who mentioned that the royal library contained, inter alia, books brought from Italy – from military campaigns.

qualities. (…) As it is the opinion of physiologists, philosophers and priests that all things proceed from water (…) it is of infinite importance, for the purposes of life, for pleasure, and for our daily use. (…) nothing is more necessary than water. For such is the nature of all animals, that if they do not receive a supply of grain, they can subsist on fruits, flesh, or fish, or something of those sorts; but without water, neither the body of an animal, nor even food itself can be raised, preserved, nor provided."[24] Created between 27 and 13 BC, i.e. Vitruvius' treatise was known in the Middle Ages, and became even more popular in the Renaissance. According to the character of the work, the author systematically presented the state of theoretical and practical Greek and Roman knowledge he was acquainted with, mainly in the domain of architecture and building construction, including the construction of water devices, e.g. watermills, aqueducts, wells and cisterns. Book VIII, entitled "Water", contains an ample account concerning the quality and properties of water depending on the source and on the way of obtaining it. In this account, as well as in many other parts of the treatise, one can note a strong influence of Greek philosophers most highly estimated by Vitruvius, which fact he explained as follows: "(…) the doctrines of Pythagoras, Democritus, Plato, Aristotle, and other sages, the result of their daily application, and undeviating industry, still continue to yield, not only to their own country, but to all nations, fresh and luscious fruit (…)."[25] This remark also refers to the present study: Aristotle's works (mainly excerpts from his "Physics", "Meteorology" and "Politics"), via various ways of reception, became the source from which people drew many opinions and examples concerning the nature of water and its social role being hard to overestimate. It was Aristotle who wrote in his *Rhetoric*: "what is often useful surpasses what is seldom useful" and quoted Pindar's saying: „The best of things is water."[26] While describing rules according to which cities should be established, Aristotle referred to the importance of water in his *Politics*: "(…)it must possess if possible a plentiful natural supply of pools and springs, but failing this, a mode has been invented of supplying water by means of constructing an abundance of large reservoirs for rainwater, so that a supply may never fail the citizens when they are debarred from their territory by war. And since we have to consider the health of the inhabitants, and this depends upon the place being well situated both on healthy ground and with a healthy aspect, and secondly upon using wholesome water-supplies, the following matter also must be attended to

24 Vitruvius VIII, Introduction, chapter 1.1 and chapter 3.28 – Latin text and English translation.

25 Vitruvius IX, Introduction, 2. Web.

26 Aristotle, *Rhetoric*, Book I, 7. Web.

as of primary importance. Those things which we use for the body in the largest quantity, and most frequently, contribute most to health; and the influence of the water-supply and of the air is of this nature. Hence in wise cities if all the sources of water are not equally pure and there is not an abundance of suitable springs, the water-supplies for drinking must be kept separate from those for other requirements."[27]

Coming back to the above-mentioned Jacques Le Lieur, studying learned books: praising water supply systems, he referred *expressis verbis* to yet another ancient erudite, namely Pliny the Elder (Gaius Plinius Secondus 23/24–79 AD), and quoted his opinion about the uniqueness of Roman aqueducts and that nothing on earth was more worthy of admiration than they were.[28] Pliny expressed this opinion in his monumental work entitled *Naturalis Historia* (*Natural History*). It represented a genre of ancient writings used in the Middle Ages, different from Vitruvius' work, namely encyclopaedic works in which their authors tried to gather all human knowledge. Perceived as the most comprehensive ancient encyclopaedia, it includes much content from an earlier encyclopaedia written by Marcus Terentius Varro (116–27 BC).[29] It also resulted from the fact that Pliny read works by many other authors; the list of these works together with the table of contents form Book One.[30] Among frequently quoted authors was Aristotle, whose works (including *Physica/Physics* and *Meteorologica/Meteorology*) Pliny used when he was writing 15 books of his treatise (out of 37 in total). Pliny's work or its shortened version by Gaius Julius Solinus[31] was used in mediaeval encyclopaedias, to which fact testify e.g. the early mediaeval *Ethymologiae* (*Origines*) by Isidore of Seville (ca 570–636), *De natura rerum* (*On the Nature of Things*) by the Venerable Bede (672–735), or one of three most popular 13th-century encyclopaedias, namely *Opus de rerum proprietatibus inscriptum* (*On the Properties of Things*) written by a Franciscan, Bede's countryman, Bartholomeus Anglicus. Just like works written by his contemporaries Thomas of Cantimpré and Vincent of Beauvais, Bartholomeus Anglicus' encyclopaedia constitutes a work representative of the knowledge and

27 Aristotle, *Politics*, Book 7, section 1330b. Web.

28 Le Lieur J., 1911, p. 1; Pliny the Elder, *The Natural History*, book XXXVI, chapter 24. Web.

29 Pliny the Elder, op. cit, passim, in which Varro was mentioned as a source in 29 out of 37 books.

30 Cf. Pliny the Elder, op. cit., book I, passim.

31 Namely *Collectanea rerum memorabilium*, written soon after the year 200 by Solinus, also called *Polyhistor*.

opinions of its time, due to its being typical of its period.[32] This typicality can be seen in trying to embrace the whole existing knowledge, in imitating the form and the content (mainly *Ethymologiae* by Isidore of Seville, and thus also Pliny the Elder and Aristotle), in its compilatory character[33] (which enabled him to collect

32 In the present work the following were used: Bartholomeus, 1519 and Bartholomeus-Corbechon, BNF, MS Fr. 22532 – liber XI, cap. VII, "*De pluuia*"; liber XIII, cap. I and II: "*De puteo* (du puis)", "*De fluuio* (du fleuue)", cap. X: "*De lacu in generali*", cap. XIIII, "*De piscina*"; liber XVII, cap. XCV: "*De legumine (de granis a faire potages)*". Two other "great encyclopaedias" of the 13th century were *Opus de natura rerum* by Thomas of Cantimpré, the writing of which took the author 20 years, dating from ca the mid-13th century, and *Speculum Maius* by Vincent of Beauvais, created ca 1250. Both of the authors were Dominican friars: Thomas (1201–1272) in a monastery in Leuven, Vincent (ca 1190–1264?) in the following monasteries: in Paris, Beauvais and Royaumont. Their master was Albert the Great (1190–1280), also a Dominican friar, who received his mathematical and medical as well as philosophical and theological education at Italian universities (e.g. in Padua and Bologna); from 1226 he lectured in various German towns, between 1245 and 1248 – in Paris, and from 1248 – in Cologne. Together with his disciple, Thomas Aquinas, he contributed to the adoption of Aristotelian philosophy within Christianity and created the system of Christian Aristotelianism (cf. Tatarkiewicz 1978, pp. 255 and 272); he is thought to be the author of the first Latin commentary to Aristotle's *Meteorology* – cf. Arystoteles 1990, p. 439. Albert the Great was also the author of one of the most important mediaeval treatises about gardens: *De vegetabilibus et plantis*. Among his other students were Roger Bacon, Robert de Sorbon, Wilhelm de Saint-Amour, Jan de Sacrobosco, Arnald da Villanova.

33 Cf. Bartholomeus 1519, an unnumbered page after the Introduction, with a list of 37 "authors" and 68 "philosophers". Among the former the majority were early mediaeval Christian writers, including the Church Fathers, the Saints: Ambrose, Augustine and Jerome, and also – obviously – Isidore of Seville, and the Venerable Bede, the imitator of his encyclopaedia, and Alcuin's disciple – Rabanus Maurus (ca 780–856, head of a monastic school at Fulda, archbishop of Mainz, the author of an encyclopaedia entitled: *De Universo* – cf. Szymański W., 1973, pp. 406 and 408). Among "philosophers" the majority were the ancient thinkers: Pythagoras, Euclid, Plato, Aristotle, Varro, Virgil and – obviously – Pliny (erroneously called Pliny iunior – the mistake must have resulted from the fact that Pliny the Elder was called Secundus) and Solinus, and also physicians: Hippocrates and Galen (although without Celsus). Among "philosophers" were also Arab philosophers-physicians (including Avicenna, Averroes and Rhazes), but mainly Constantinus medicus, who should undoubtedly be identified as Constantine the African (1020–1087), born in Carthage, a monk from the abbey of Monte Cassino, a representative of the Chartres school (which later became the main centre of the "renaissance of the 12th century), also connected with the medical school in Salerno, for which he translated the principal works of Greek and Arab medicine (cf. Seńko 1973, pp. 278–279 and Rutkowska-Płachcińska A., 2001, p. 408).

the existing opinions and ideas) and in its prevalence.[34] An analysis of what the Franciscan Bartholomeus Anglicus read shows that apart from Isidore, who was the model, there were other sources that could have influenced his work, namely the naturalistic rationalism of the School of Chartres and opinions spread by the medical school in Salerno. Both these schools belonged to the most important European storehouses of knowledge of the period. The School of Chartres aimed at combining the philosophy of nature with logic and expressed the opinion that the essence of knowledge is the cognition of the outside world.[35] The school in Salerno produced the famous *Regimen Sanitatis Salernitanum*, a collection of rational rules of such conduct as to preserve the best possible health. In the list of what Bartholomeus read are representatives of the two above-mentioned schools and also authors whose works served them as sources. Apart from Constantine the African who was connected with both these schools, we can find two of the most prominent scholars from Chartres, namely Gilbert de la Porrée (among "authors") and William of Conches (among "philosophers"), and Salerno was represented by Salernitanus, i.e. Urso of Calabria, also one of the leading figures of the school.[36] Both the schools drew on the works of the authors mentioned by Bartholomeus Anglicus, e.g. Aristotle and the physicians: Hippocrates and Galen, and also on Arabic works devoted to mathematics, nature and medicine translated in the 11th century by the above-mentioned Constantine the African[37] and by Adelard of Bath, an English philosopher close to the School of Chartres.[38]

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34 Bartholomeus Anglicus' encyclopaedia was widespread in Europe from late Middle Ages until the early 16th century: from Spain to Hungary, from northern England to southern Italy – cf. Salvat 1984, p. 331 (loc. cit. – the creation of this work dated at the time between 1240 and 1270). There was also its French translation entitled: "Livre des proprietés des choses", executed in 1372 by Jean Corbechon, the Chaplain of King Charles V (1364–1380), the King-bibliophile, by order of the latter for the royal library in Paris. In the author's homeland, translated into English in 1398, printed in 1495, it was considered the first printed English encyclopaedia – cf. Bartholomeus-Trevisa 1975–1988 – Introduction.

35 Cf., inter alia, Szymański 1973, p. 439. Tatarkiewicz 1978, pp. 238, 240 and 356; id. 1989, pp. 185–192.

36 About medicine and philosophy of nature at the school in Salerno in the 12th century, mainly about the use of Aristotle's philosophy of nature, and about the fact that his "Physics" was read in the original version, and not in the Latin version translated from Greek by James of Venice or the Latin version translated from Arabic by Gerard of Cremona – cf. Jacquart 2005, passim.

37 Jacquart 2005, pp. 402–403.

38 Tatarkiewicz 1978, pp. 238 and 241; Szymański 1973, pp. 439 and 559.

An analysis of Bartholomeus' reading material can arouse suspicion that he drew on the listed ancient and Arabic works indirectly, e.g. via Constantine the African acting as a translator of both the former and the latter works. However, for the sake of the present research this does not undermine the worth of Bartholomeus' encyclopaedia, especially if we consider that Constantine's writings constituted a compilation of knowledge of the two great civilisations (in which, *nota bene*, water played a significant role), so that mediaeval Christian Europe could acquaint itself with it in its scientific, intellectual and economic growth, i.e. in the 12th and 13th centuries.

As the basis for the presentation of the opinions about the nature and quality of water the author of the present work chose – besides the above-mentioned 13th-century encyclopaedia – also two treatises in which such opinions could be found: *Ruralia Commoda* (*The Book of Rural Benefits*) written by Pietro de Crescenzi of Bologna ca 1305, published in print in 1471, perceived as the first printed treatise on agriculture,[39] and a treatise on architecture entitled *Libri de Re Aedificatoria decem* (*On the Art of Building in Ten Books*) by Leon Battista Alberti of Florence, written between 1447 and 1452, first published in print in 1485 in Rome[40] Both these Renaissance treatises drew heavily and directly on the knowledge of ancient authors: Crescenzi mainly used Palladius' work *De re rustica*, written in the 1st half of the 5th century,[41] whereas Alberti mainly used Vitruvius' treatise. Only Crescenzi referred to mediaeval authors (e.g. to Albert's the Great botanical findings and to Avicenna's works).

One can thus acknowledge that the three above-mentioned works which presented the state of knowledge prevailing at the time of their creation were based on findings and observations recorded in antiquity. These findings were a sum of experiences that resulted from the observation of the nature of water and its being a

39 In the present work the author used the following editions: Crescenzi 1548, passim and a Polish translation (partly supplemented) by Andrzej Trzycieski – Crescenzi-Trzycieski 1549, passim. About this translation as being partly adapted to Polish conditions and considered as the first economic treatise published in Polish – Zarębska 1986, pp. 109–(112)–116. However, Crescenzi's treatise had been known and read in Poland in the original version much earlier; e.g. in 1439, for the needs of the monastery of the Order of the Holy Sepulchre in Miechów, it was rewritten by a local monk called Andrzej of Sempolno, by the order of the provost Jan Oczko, and included in one of the local codices written on paper (these findings in: Wyrozumski 1976, pp. 665–666).

40 In the present work the author used the following editions: Alberti 1960 (Polish translation) and Alberti 1988 (English translation).

41 In the present work the author used the following editions: Palladius 1807 (English translation) and id. 1898 (Latin translation); cf also id. 1999 (Polish translation).

part of the environment, so they remained up-to-date throughout centuries and as such were repeated and passed on also as common knowledge. This is why despite a different time of creation, character, aims and functions of the selected works, all three of them contain the evaluation of the quality of water depending on the type of water and from where it was acquired, as well as identical, basic, organoleptically[42] tested criteria of the quality of water such as its being suitable for drinking and preparing food. The relation between the quality of water and the health of the people consuming it in any form was always noted.[43]

According to Bartholomeus Anglicus, who referred to Aristotle, Bede and Constantine the African while describing the nature of rain, rainwater was the lightest, because it was created from the lightest particles which were warmed and lifted by the heat of the Sun; the lightest and therefore the most delicate and the purest,[44] and as such it was perceived as the best of all kinds of water for digestion. Quoting Constantine, he wrote about the changing qualities of rainwater which naturally pure and full of advantages, due to its lightness became easily polluted and contaminated; if it avoided being polluted, it was sweeter and harder than other kinds of water. If normal rain fell, i.e. moderate in terms of quantity, it carried high-quality water and the benefit of it was infinite (the best water came from light rain). However, when "bad" rain fell (*pluvia mala*), it carried contaminants and dangers, the destruction of fruit and crops, as well as illnesses.[45]

When it comes to the quality of river water, Bartholomeus deemed it to be superior to lake water (*lacus autem stat in loco nec fluit*), the latter being heavier than river water and less commendable as drinking water, because its regular consumption resulted in numerous ailments of the body (*Aqua autem lacualis (…) est grossior et aquis fluvialibus ad potandum minus laudabilis experitur: nam talis potus sepe assumptus multas generat in corpore passiones*). He reminded the reader what Isidore of Seville had written, namely that lake water assumes the qualities of the soil and the place where it collects. Bartholomeus Anglicus, quoting Isidore

42 This resulted from the state of knowledge at that time, based on observation and practice – cf. also Squatriti 1998, p. 36 et seq. – in reference to early mediaeval works that also assessed the features of good water organoleptically.

43 Cf. Vitruvius VIII, 3.28. Web: "The utmost diligence and labour, therefore, should be used in choosing springs, on which the health of mankind depends."

44 Bartholomeus 1519, lib. XI, cap. VII, *De pluvia*. It can be noted that Constantine's opinion, to which Bartholomeus made direct reference, was cited by the former from Aristotle's *Meteorology* – cf. Aristotle, *Meteorology*, Book I, 9 and 13; Book II, 3. Web.

45 Bartholomeus, 1519, lib. XI, cap. VII, *De pluvia*.

of Seville, described lakes as a reservoir of hidden water in which water accumulates, that the Greeks called swamp or pond, underlining the stagnant, or even a swampy character of the water. Sources run into rivers and rivers flow in their beds, whereas water in lakes stands still, it does not flow, which is why – here he cited Isidore for the etymology – *dictus est lacus quasi aque locus* (the lake is in a way the place of water). It only takes the water that is flowing into it, but does not pass it on. The water that comes into a lake renews its waters, protecting it from becoming spoiled. At times when there is too much water flowing in, it washes the shores away. Having compared the quality of water from lakes, rivers and springs, i.e. from the three main types of natural reservoirs, Bartholomeus advised to use river water to prepare *legumen* (*potagium*)[46] that was the basis of mediaeval diet,[47] he also added that the only water that was better to this end than water from a river was water drawn from a spring.[48] Referring to Constantine the African, he did not advise water taken from wells, as it was hard to digest because of both the soil salinity and the distance between the well water veins and the air.[49] Here again he quoted Isidore of Seville that *puteus est lacus defossus*,[50] but he shortened the second part of this sentence in which Isidore explained the etymology of the word *puteus*: *(…ex quo hauritur aqua, a potatione dictus* – that was Isidore's version; *a putu dictus ut dicit Isidorus* – as Bartholomeus phrased it). He added that a well, i.e. an underground, deeply located lake, is created by evaporation taking place inside the earth. The result of this evaporation, namely well water, flows through underground water veins; once saline, later it becomes fresh, depending on how earth evaporates moisture. However, he classified it as drinking water and described it as water that is cool in summer, but that never freezes in winter, the best is drawn from deeply dug wells.[51]

Bartholomeus Anglicus' encyclopaedia supported by the authority of the "fathers of medicine", including Hippocrates and Galen, quoting their numerous opinions, leaves no doubt as to the fact that water was drunk unboiled, both cold and warm. The latter, drunk on an empty stomach, was perfect to rinse out

46 Bartholomeus, 1519, lib. XVII, cap. XCV, *De legumine.*

47 More about this in Polish literature cf. Rutkowska-Płachcińska 1988, p. 24.

48 Bartholomeus, 1519, lib. XVII, cap. XCV, *De legumine.*

49 Bartholomeus, 1519, lib. XIII, cap. I, *De puteo*.

50 IsidoriEtym., 1911, liber XIII, cap. XXI, 5.

51 Bartholomeus, 1519, lib. XIII, cap. I, *De puteo*. Paolo Squatriti (1998, p. 27) pointed out that only in very deep wells water maintained a sufficiently low temperature so that no biological life (including contaminants) could sprout. He also stated that at below 8°C there was little risk of infestation.

and to clean the stomach, especially when the person had eaten or drunk immoderately the previous day. On the other hand, one should avoid drinking too much cold water, especially if it was no longer fresh, because it caused fever. It is worth mentioning that *Regimen Sanitatis Salernitanum* that Bartholomeus was acquainted with, was drawn up as a special, exemplary diet and pointed out that unboiled water hindered the digestive process because it cooled the stomach.[52]

In his treatise on agriculture written several dozen years after Bartholomeus Anglicus' work, Pietro de Crescenzi noted that a different kind of water is suitable for people, and different for plants.[53] As far as potable water is concerned, he deemed rainwater to be good, but relying on the authority of physicians, he considered water flowing from a spring in the ground or in a rock as the best[54] The latter was of an even higher quality than the former, because mould and rot from the ground did not permeate it. Having sprung from the ground, water should flow exposed to the sun and to the wind, because that way it gained a more noble character.[55] This is the beginning of the description of the qualities of river water. It was good when it flowed in a silty but clean river bed, but it was better when it flowed in stony river bed. But it was the silt that freed water from foreign bodies that mingled with it, purifying it this way. Stones could not do this, especially when there was a lot of water and it flowed with great force. Just like Bartholomeus Anglicus, Pietro de Crescenzi thought that these three types of water were superior to water drawn from a well.

Leon Battista Alberti began the description of how to find water that would be "the best", quoted Celsus, a Roman physician: "Celsus, the physician, said of water that the lightest was rainwater, the second springwater, the third river water, the fourth well water, and in the last place melted snow or ice."[56] Water of the highest quality, according to Alberti, who expressed it most fully, is water "which is clear, transparent, and light – so that when strained through white cloth it leaves no mark, when boiled no sediment – and which, wherever it flows, leaves the riverbed free of moss and the rocks without stain. Good water should also produce tender vegetables when used for cooking, and good bread when used in baking."[57] He

52 RegSalerno, XXVI. *De potu aquae. Potus aquae sumptus fit edenti valde nocivus, infrigidat stomachumque cibum nititur fore crudum.*

53 Crescenzi 1548, liber I, caput IIII, p. 5.

54 In this respect in Crescenzi's treatise a greater influence of ancient Greek writers can be noted: according to them the best water was spring water (Argoud 1987, p. 210).

55 Crescenzi 1548, liber I, caput IIII, p. 5. Cf. also Argoud 1987, p. 210.

56 Alberti 1988, p. 331.

57 Op. cit., p. 14.

also pointed to the interdependence between the quality of water and the functioning of the human body: "The best water, then, we might call that whose nature contains nothing foreign, nothing bad. For this reason, unless it is very pure, uncontaminated by any viscous element, and free of all defect in taste or smell, it will undoubtedly be very detrimental to health, by choking the internal respiratory tracts, so to speak, making the veins turbid, and stifling the spirit and the ministers of life." This is why people say that water from a light rain like a delicate mist would be the best, if it weren't for the fact that collected, such water becomes quickly spoiled and has a foul smell, and when it becomes thicker, it causes constipation[58] (this coincides with what Bartholomeus Anglicus wrote about rainwater: again, this probably resulted from the same reading matter). To sum up his opinions about the qualities of good water, Alberti stated: "it [water] should be very light, limpid, fine, and clear."[59] He believed: "Let the site therefore […] be well endowed with all the useful and pleasurable things of life, such as water, fire, and food". However, he added immediately that "Care should be taken, however, to ensure that it contains nothing that might prove harmful to the inhabitants or their possessions. Springs should be laid bare and sampled, and their water tested by fire to check that it contains nothing sticky, putrid, or difficult to digest that might make the inhabitants ill." Considering this interdependence as obvious, he quoted ancient authors, including the opinion of the "father of medicine", the Greek physician Hippocrates of Kos (ca 460–377 BC), also shared by Vitruvius: "those who drink untreated water that is heavy and unpleasant to taste will develop a hot and swollen belly, while the rest of their bodies, their elbows, shoulders, and faces, will become remarkably weak and emaciated. They will also suffer adverse clotting of the blood from defective spleens, falling prey to many infectious diseases".[60] He underlined: "But this much at least is obvious, and should not be overlooked: water provides nourishment for all that grows, plants, seeds, and anything that shares vitality, and by which we are refreshed and sustained." This led him to the conclusion that "We ought, therefore, to inspect with the greatest possible care the quality of the water available in any locality where we intend to live."[61] and we should also define – by applying the organoleptic method – the above-mentioned qualities of good drinking water. It appears from the quoted text that these qualities referred to water that sprung from the ground or that was found in the ground, namely spring water, river water and well water.

58 Op. cit., pp. 331–332.
59 Op. cit., p. 335.
60 Op. cit., p. 13.
61 Op. cit., p. 14.

As regards the quality of well water, one can notice that Alberti did not hold a low opinion about it, as he deemed it to be close to spring water, writing that a well was also a spring, only a deep one, and further on: "[…] wells have almost exactly the same requirements as springs. Wells and springs are related, and differ only in the way they flow, although you will not infrequently find a well whose veins move with an abundant flow".[62]

The quality of water depended not only on its kind, but also on the way it was acquired and stored, which fact was underlined by Alberti, who quoted ancient writers. According to the latter, the quality of rainwater depended among other things on the season and on the way it was gathered from the roof. "Thus some prefer to collect rain from a roof rather than from the ground, and consider rain collected on the roof unhealthy if it is diluted with any previous rain;" next Alberti cited Columella's opinion that "rainwater will not go bad if it is drawn down earthenware pipes into a covered cistern, as it tends to grow infected when it is in the open and exposed to the sun. Water also becomes defective if stored in a wooden vessel."[63] In another fragment concerning the construction of rainwater cisterns by "good architects" Alberti wrote: "The naturalists maintain that those open to the sky produce the purest and most natural water […]."[64]

Bartholomeus Anglicus and Pietro de Crescenzi, also following ancient authors, pointed to the high quality of rainwater, when in summer it fell together with thunder.[65] However, Crescenzi warned that such water quickly becomes spoiled due to its lightness, and drinking it might cause illnesses. "Because all subtle things change quickly", as Andrzej Trzycieski,[66] the author of the Polish translation of Crescenzi's work, explained it to the Polish readers. The changing nature of rainwater was described in a similar way by Bartholomeus Anglicus, who quoted ancient masters: Hippocrates and Aristotle. Both Crescenzi and Alberti referred to various ways of treating even bad water (irrespective of its provenance), including its purifying and boiling. Referring to the former, Crescenzi expressed it as *sublimatio et distillatio* that reduced its weight (because the lighter the water the better).[67] However, in the Polish translation of Crescenzi's work A. Trzycieski described the process rather as

62 Op. cit., p. 334.
63 Op. cit., p. 333.
64 Op. cit., p. 32.
65 Bartholomeus, 1519, *De pluvia*, Crescenzi 1548, lib. I, cap. IIII, p. 6, Crescenzi-Trzycieski 1549, book I, p. 10.
66 Crescenzi-Trzycieski 1549, book I, p. 10; cf. Crescenzi 1548, lib. I, cap. IIII, p. 6.
67 Loc. cit.

filtration.[68] In Alberti's treatise this was rendered as "boiling and distilling".[69] *Alambick cum patella subtus pro distillanda aqua*, enumerated among objects belonging to Agnieszka Ciołek (the mother of the Bishop of Płock Erazm Ciołek, who had died two years earlier) in her last will written in 1524,[70] testifies to the fact that the *sublimatio et distillatio* was not filtration, but distillation used to clean water for everyday use.[71] And this was done at least a quarter of a century before Trzycieski's translation was created.

As far as boiling water is concerned, Crescenzi explained its purposefulness, claiming that water that has been boiled causes lesser distension and quickens digestion (because it passes faster through the body), because boiling a substance makes it delicate and therefore purer (lighter); it makes heavy particles gather on the bottom, because they easily separate from delicate substances.[72] By boiling water people purified it and thus removed possible pathogens (contaminants).[73] This was especially important in the cramped conditions of mediaeval towns, where water intakes were often found in direct proximity to sewage pits.

From the early Renaissance treatises written by Crescenzi and Alberti, as well as from the mediaeval encyclopaedia by Bartholomeus Anglicus and *Regimen sanitatis Salernitanum*, it undoubtedly appears that people drank unboiled water despite its being hard to digest. Apart from numerous fragments from these

68 Crescenzi-Trzycieski 1549, p. 12.

69 Alberti 1988, p. 342: "Certainly boiling and distilling will purify water."
In both of these treatises one more method of purifying water was mentioned (described by Palladius), namely by letting fish into still-water reservoirs (cisterns), so that they create constant movement, thus making the water resemble running water. There exist written sources from the turn of the Middle Ages and the modern era concerning the use of this method, which will be discussed further in the present work.

70 ANK, SC 10, p. 552; CA II/1, 1936, p. 202.

71 Water was heated in a wide vessel (*patella*) placed under the alembic, which consisted in a narrower vessel and a wider one above it. Steem from the water boiled in the bottom vessel condensed under the bottom of the top vessel and trickled into a small vessel placed in the middle. This was precisely water purified by distillation.

72 Crescenzi 1548, lib. I, cap. IIII, p. 6. Cf. also the Polish translation: Crescenzi-Trzycieski 1549, book I, p. 10.

73 Numerous early mediaeval and mediaeval dishes, including *potagium*, were prepared by prolonged cooking various, usually vegetable ingredients in water, with bringing them to the boil. As a result – as was noted by P. Squatriti (1998, p. 43) – early mediaeval cooking was highly dependent on water: people believed that water preserved food in good condition and protected it from rotting, and besides, they were very keen on boiled dishes.

treatises (also those quoted above) referring to this indirectly (about testing water organoleptically to check whether e.g. it is not tart; about making bad water usable by boiling, from which fact we can infer that good water did not require boiling, etc.), to this conclusion testify mainly excerpts that state it *expressis verbis*. Crescenzi wrote that for healthy people moderately cold water is better than any other, although it does harm to the veins and the bowels, nevertheless, it increases the appetite and strengthens the stomach. Decidedly warm water hinders digestion by making the food float in the stomach; it also causes oedema and tuberculosis, and ruins the body. Slightly heated water causes vomiting; however, a little more heated and drunk on an empty stomach it rinses out the stomach and relaxes the belly, but it is not advised to drink it too often, as it makes the stomach lazy.[74] Referring to the opinions of physicians, Alberti wrote: "[…] cold water, especially when drunk after a meal, is supposed to fortify the stomach of the healthy. But if only slightly too cold, it will induce stupor even in the fit, make the bowels rumble and the nerves shake, and by its rawness extinguish the digestive process."[75] Therefore, in the early Renaissance treatises by Crescenzi and Alberti we find the same or similar opinions concerning drinking unboiled water (both cold and warm) as in the dietary advice from Salerno and in the mediaeval encyclopaedia by Bartholomeus Anglicus. This testifies to a common source of this knowledge, namely writings of ancient physicians collected as still prevailing and repeated by their fellows from the Middle Ages both from the Islamic and the Christian world.

The authors of the analysed treatises, namely Bartholomeus Anglicus, Crescenzi and Alberti, were unanimous in considering drinking still waters (also called dead waters, as opposed to living waters, i.e. potable waters) as highly detrimental (e.g. from ponds and swamps). Bartholomeus Anglicus wrote that they cause liver and stomach illnesses and are responsible for kidney stones and gravel in urine.[76] If no other source of water was to be found, it was necessary to use still waters, but boiled. Bartholomeus borrowed this opinion from Avicenna, as

74 Crescenzi 1548, lib. I, cap. IIII, p. 7. Cf. also the Polish translation: Crescenzi-Trzycieski 1549, book I, p. 12.

75 Alberti 1988, p. 331.

76 Salvat 1984, p. 337.

was noted by Michel Salvat.[77] Crescenzi[78] described the disadvantages of still lake water[79] and wrote that it was bad and heavy, because in winter it cooled only by snow, which is why it caused phlegm. In summer sun heats it and it begins to rot, and therefore (drinking it) causes gall bladder illness. Due to its being thick and mixed with soil and because of the fact that its delicate particles existing in every kind of good water were destroyed, it does harm to those who drink it: their entrails become swollen and their members become thin, including arms and neck, their hunger becomes greater than their thirst, and their stomachs shrink, they experience problems with vomiting; sometimes it causes oedema, because water collects inside their bodies, also lung and spleen ulceration can occur, as well as dysentery, or the liver can fail. Drinking such water also entails other numerous sufferings: women rarely become pregnant and give birth with great effort; sometimes the foetus is malformed, and the children are born disabled, with ulcers, especially on the legs (shins), and feverish; also old people develop fever after having drunk such water. In the further part of his treatise Crescenzi stated how to diminish the adverse effects of drinking still water. He underlined the need to eat garlic, onion, vinegar and lettuce, i.e. products that had antiseptic properties; he also highlighted the importance of alum that purified such water.[80]

The description of ailments resulting from drinking still water done by Crescenzi is very similar to the one done by Alberti, who in turn quoted Hippocrates (and Vitruvius); the illnesses were caused by drinking all kinds of contaminated and foul-smelling water. However, the evaluation of lake water as drinking water done by Alberti was not as unambiguously negative as Crescenzi's. Following the physician Celsus, he placed it at the end of the list of kinds of drinking water ("Heavier still was lake water, but the worst of all was that of a marsh."[81]), but he

77 Loc. cit. and p. 341, footnote 6, where the author pointed out that quoting Avicenna's opinions, Bartholomeus Anglicus never referred to him in the text. Religious considerations might have played a part in this, as well as the fact that Bartholomeus read Avicenna's writings via Constantine.

78 His role model, Palladius, began his description of healthy water by stating: "The salubrity of the water is thus proved: first, that it is not conveyed from ditches [*a lacunis*: from ditches or puddles of standing water] or from fens" (Palladius 1807, book I, 4, p. 3).

79 Crescenzi 1548, lib. I, pp. 6–7.

80 Crescenzi 1548, lib. I, cap. IIII, p. 8 and Crescenzi-Trzycieski 1549, book I, p. 13. It were probably the disinfecting properties of "squill vinegar" that Alberti had in mind when he wrote that ancient physicians recommended its use "as a cure for the Roman fever" caused in his opinion by the waters of the Tiber which were "constantly turbid" and "drunk by almost everyone" – cf. Alberti 1988, p. 331.

81 Loc. cit.

shared the opinion of those who believed that "there can never be any water perpetual and continuous, as the expression goes, that is not influenced by the flow of some nearby river or torrent."[82] Discriminating between lakes and ponds (the former being permanent, the latter – temporary), Alberti defined three types of lakes: "the first (…) stationary, content with its own waters, and never overflowing [the echo of opinions gathered by Bartholomeus Anglicus is clearly visible here]; the second pours forth its water, to create a river; the third receives water from various sources and discharges into a river."[83] He also commented on ponds: "Finally, the pond is not always thought a curse in every respect; for wherever eels are plentiful, the water is considered not altogether useless. The worst sort of stagnant water is said to be that which supports leeches; which has a layer of scum on top; which gives off a nauseating smell; which is black or livid in color; which remains thick even after it has been put into a vessel; which is slimy, heavy, or sluggish; or which, when used for washing your hands, takes a long time to dry."[84]

Although in the present work we focus on the opinions concerning the quality of drinking water depending on the type of the reservoir from which it was drawn, it is worth mentioning that water meant for other purposes than drinking was sometimes evaluated according to different criteria. Crescenzi's note that a different kind of water was suitable for people, and different for plants, referred mainly to still waters as to those which were the best for plants as opposed to running waters which were not advised as they cooled the plants too much, which hindered their growth and prevented them from ripening. On the contrary, still swamp water that was warm and full of fumes created optimum conditions for plants.[85]

The harmony between the mediaeval and the early Renaissance opinions about drinking water, resulting from ancient works which formed the medical canon, was noted in the whole Europe of that period, also in Poland: Polish physicians acquired their knowledge at universities in Montpellier,[86] Bologna and Padua. In

82 Op. cit., p. 335.

83 Loc. cit.

84 Loc. cit.

85 Crescenzi 1548, lib. II, cap. XIII, p. 41 – a long and detailed description of such advantages.

86 Among graduates from medicine at Montpellier were e.g.: Brother Mikołaj from Poland and Jan, archdeacon of Głogów, authors of medical treatises – cf. Malewicz 1980, p. 85: more about the participation of Poles in Western European university life of the 13th and 14th centuries as "a stage in the development of Polish science". Op. cit. also about 14th-century treatises on astrological medicine by Thomas of Wrocław, bishop of Sarepta,

the library of one of the most outstanding physicians of the early Renaissance in Poland, namely Matthias de Miechów (1457–1523), the alumnus of medical faculties of the universities in Bologna and Kraków, were the same works which were used – directly or indirectly – by Bartholomeus Anglicus, Pietro de Crescenzi and Leon Battista Alberti, including medical treatises that – as noted Leszek Hajdukiewicz – constituted a collection of official treatises included in the curriculum of the medical faculty:"[87] several volumes of Hippocrates' treatises, including the famous and frequently quoted *Aphorismi*; a copy of the 1490 Venetian edition of Galen's collected works (which served as the basis of Matthias' de Miechów lectures conducted in 1500 at the Jagiellonian University in Kraków[88]), along with the generally commented *Ars parva* and *De morbo et accidenti* by the above-mentioned Roman physician; Avicenna's *Canon medicinae* (and other works); and a wide selection of works by Rhazes[89] and Mesue.[90] Matthias de Miechow also owned works by Celsus and Pliny the Elder;[91] apart from this, in his library were numerous commentaries and elucidations from the 13th–15th centuries of medical works, including Arnaldus de Villa Nova.[92]

The scholars who research into Matthias' de Miechów library, and thus into his interests, point to the character of Matthias' de Miechów education which was mediaeval, scholastic and rooted in the 13th-century encyclopaedism.[93] According to these researchers, the fact that apart from the above-mentioned mediaeval medical canon his library included also the encyclopaedia by Vincent of Beauvais[94] confirms their thesis. They also emphasize that Matthias de Miechow, one of the most influential and opinion-forming people, taught medicine at the

Premonstratensian, and Jan of Grodkowo, as well as about the medical activity of Janko of Czarnków, Polish chronicler.

87 Hajdukiewicz 1960a, pp. 229–230; cf. also Bilikiewicz 1960, pp. 181–182.

88 Hajdukiewicz 1960a, p. 230.

89 Loc. cit.

90 Bilikiewicz 1960, p. 188.

91 Loc. cit.

92 Op. cit., p. 187.

93 Op. cit., p. 182 and Hajdukiewicz 1960a, pp. 229 et seq.

94 Hajdukiewicz 1960a, pp. 238 and 242, footnote 140. The fact that this encyclopaedia had been read and in circulation a century earlier among the court and ecclesiastical elites of Kraków and Miechów can be evidenced by a conflict from the years 1423–1424 over its first, historical part, between a royal notary on the one part, and Michał, the provost of Miechów, and Jakub, the prebendary at St Martin's Church in Kraków on the other part – cf. CA Suppl., 1985, no. 230, pp. 102–103 and no. 241, pp. 106–107.

Kraków University and practiced according to mediaeval rules; however, the same rules prevailed at the universities of Bologna and Padua at that time.[95]

In the library (unfortunately only partially known) of another professor of the Kraków University, the royal physician Piotr Wedelicjusz of Oborniki,[96] the burgomaster of Kraków "in the time of plague",[97] who died in the city during the plague of 1543,[98] were works by the same authors as in Matthias' de Miechów library. They included: *Ars parva* by Galen, Hippocrates' *Aphorismi* edited by Galen, one undefined work by Avicenna,[99] *De medicina libri octo* by Cornelius Celsus, and a handbook on diagnosing illnesses by Hippocrates. These were the works in which the opinion about the interdependence between bad water and illnesses was expressed. Perhaps it was following the advice of Piotr Wedelicjusz that in the letter of 1533 from King Sigismund I to Piotr Kmita, the Crown Marshal, and to Seweryn Boner, the burgrave of the Wawel castle and the governor of the Royal domain of Kraków, concerning carrying sewage away from the then neglected Kraków, the following words were written (in the Aristotelian spirit): "it is known from experience that the cleanliness of towns and rivers leads to the cleanliness of unpolluted air, and what is more, to the health of people."[100] In the King's surroundings, including his chancellery, existed the consciousness of this interdependence. Another example testifying to this fact is the excerpt from the 1541 privilege granted by King Sigismund I to establish a water supply system in the small town of Szadek, stating that water should be not only useful, but also healthy [for this town].[101]

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95 Bilikiewicz 1960, p. 180.

96 About this library – Marciniak 2001, pp. 426 et seq.

97 Karpiński 2000, pp. 83 and 84.

98 Cf. his testament of 4 August 1543: ANK, LT 772, pp. 334–337 (13 February 1544).

99 Known about from the posthumous inventory of Piotr Wedelicjusz from the year 1543 – cf. CA II/2, 1937, no. 1118, p. 431.

100 Małecki 1994, pp. 38–39. Latin text of the entire letter – Acta Tomiciana, vol. XV, 1957, no. 301, pp. 414–415: […] *inter omnes alias civitates Maioris et Minoris Poloniae praecipuam et primariam esse illamque in plerisque locis eius et fere plateis omnibus sic negligenter et foede provideri et gubernari, ut nedum nos verum etiam hospites sordibus in ipsis plateis collectis, quarum magna pars prima et ultima quaque noctis vigilia ex fenestris funditur, plurimum offendantur experimentisque edocti munditiem civitatum et fluminum cum ad aeris sinceritatem non inficiendam, tum maxime ad hominum salubritatem longe conducibilem esse […].*

101 AGAD, MK 62, p. 272v.: […] *aqua, ex qua non solum fructus et emolumenta sed etiam salubritas eidem oppido provenire solet* […]

What is most important for the present research concerning the opinions about the quality of water in the Middle Ages and at the beginning of the early modern period, is that these opinions remained unchanged, which resulted from the fact that the same works, mainly ancient writings (this was caused by the same type of mediaeval education, at least until the end of the 15th century), were read everywhere and throughout the period in question, and also (or rather mostly) from the fact that – as was noted above – these opinions resulted from ever the same conclusions drawn from practical observation of the nature of water. One of the most important conclusions was the above-mentioned interdependence between the quality of water and its influence on human health. This knowledge was spread beyond the circles of medical schools of Salerno, Montpellier, Bologna, Padua or Kraków,[102] inter alia by the town notaries who had university education.[103] Stanislaus *baccalarius Egidii*, identified as the town notary in Little Poland's town of Pilzno and the author of a fragment of the so-called *Spominki*

102 In Kraków, before the establishment of a university there, or e.g. in Wrocław, in which town no university existed, elements of natural science and medicine might have been taught at cathedral, collegiate and monastery schools in which besides the *trivium* also the *quadrivium* was taught, the latter, however, to a limited extent. In both of these syllabuses *Etymologiae* by Isidore of Seville played a very important role. More about teaching at such schools in the 11th–15th centuries – cf. Malewicz 1980, pp. 87–89; op. cit., p. 88: a remark that "ca 1320 Nanker, the Bishop of Wrocław, issued a reminder that only in cathedral schools, and not anywhere else, could the syllabus covering the 7 liberal arts be followed". Hilde-Marie Gross (2006, p. 184) noted that in Wrocław schools the "German Salernitan Book", created ca 1230, was used, which observation applies to all of the above-mentioned schools. The use of a handbook containing rules from the Salerno medical school points to the conclusion that the opinion about teaching in cathedral, collegiate and monastery schools, especially within the scope of the *quadrivium*, that it included "only the elements which were indispensable to determine and understand the liturgical calendar" (thus Malewicz 1980, p. 87 and the literature quoted there concerning the mediaeval schools and upbringing) – should be revised.

103 This probably concerned graduates from cathedral, collegiate and monastery schools, in the light of what was mentioned above about teaching in such schools. This would be indicated by e.g. the activity of Mikołaj Suledo, son of a miller from Warka. Mikołaj was a scribe and the burgomaster of this small town in Mazovia, a graduate from a collegiate school in Łowicz, in which in 1433 he rewrote a commentary on Aristotle's writings concerning natural sciences, to the dictation of magister Maciej of Orłowo – cf. Potkowski 1991, p. 272; loc. cit. also about the circulation (mutual borrowing) of specialist books, e.g. on law and medicine, in Polish late mediaeval small-town society.

Pilzneńskie (*Pilzno Memoirs*), written immediately after 1487, can serve as an example. In this excerpt concerning the praise of the construction of the water supply system in Pilzno, we read the following words: "our body will be such as will be the nutritional substances we feed it, and among these the foremost are air and water. If they are healthy, the body will be healthy and in good condition."[104] The opinions presented above, first concisely phrased by Aristotle in his *Politics*, find their clear reflection in this statement.

Finally, it is worth adding that also in early modern times people spread the same ancient opinions and observations concerning the quality of water depending on the type of intake[105] or the illnesses caused by bad water, the latter being invariably associated with still water.[106]

Having presented the opinions about the quality of water as the foreword to the present research concerning water in towns and having noted their continuity from antiquity to early modern times, let us return to Aristotle and close this part by quoting Teresa Zarębska's valuable observations about the 1605 Polish translation of Aristotle's *Politics* done by Sebastian Petrycy of Pilzno, a Kraków physician and philosopher.

In the course of her analysis of Petrycy's *Przestrogi* (*Admonitions*), i.e. commentaries and elucidations referring to the translated text of Aristotle's *Politics* (including its fragment, cited above, describing rules according to which cities should be established), T. Zarębska also quoted the words written by Petrycy, showing the Kraków reality of that time: "There is no heed taken of it in Kraków, where one water is used for everything: for cooking, for brewing beer, for throwing out rubbish, for latrines/waste pits."[107]

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104 Spominki pilzneńskie 1961, pp. 247–248: *Talia enim corpora nostra fieri necesse est, qualibus nutriuntur. Aër enim primum et aqua, si clemencia sint et salubria, corpora clementata incolumnia reddunt*. Cf. also Giedroyć 1907, p. 104–105 and Kowalska-Urbankowa 1986, pp. 446–448 and p. 455.

105 Cf. e.g. Jean-Francois 1653 and 1665, chapter III, 1. Des Puys, 2. Des Cysternes, pp. 25–33, chapter IV, 3. La maniere de connoistre les qualitez des Eaux, pp. 44–49. About other early modern treatises – cf. Guillerme 1983 (2nd edition 1997), pp. 242 et seq.; from Polish works patterned on ancient writings cf. e.g. Solski 1959 (1st edition 1690), p. 278.

106 For more information in Polish literature cf., inter alia, Kuchowicz 1979, p. 266; Klonder 1983, p. 50, who quoted Simon Sirenius's botanical atlas ("Zielnik"), published in 1614; Karpiński 2000, p. 44.

107 Zarębska 1986, p. 185.

Part II. The town and the river

Bartholomeus Anglicus advised preparing *potagium* with the use of river water (as well as spring water), and thus he acknowledged its high value as far as consumption is concerned. In a book devoted to the river, *De fluvio*, he underlined it once more by stating that drinking water from the river invigorates and refreshes the thirsty: *fitientes potu reficit et recreat*.[108] He wrote: *fluvius a fluendo est dictus secundum Isidori*, and pointed to the everlasting character of the river that will never cease to flow, unless it is cut off from its source: *enim est perennis fluxus que continue fluit et nisi eius intercipiatur origo fluere non desistit*.[109] It flows in its main river bed (still bearing its own name), it is fed by tributaries, and the further it flows from the source, the more water it gets.[110] It takes on the qualities of places it flows through, including the colour, the taste and the smell. Praising the qualities of the river, Bartholomeus highlighted the numerous benefits it brings to both animals and humans: *habet etiam flumen sive fluvius quo ad effectu multiplice utilitate humanis usibus congruentem… unum tam iumentis quam hominibus tam parvis quam maioribus equaliter administrat*. The faster it flows, the more benefits it offers. Emphasizing the strength of its current, Bartholomeus pointed not only to the transport qualities of the river (*naves… suo impulsu agitat et impellit*), but also to its role as a source of energy for even the largest mill wheels: *rotas etiam gravissimas celebriter per violentia circumuoluit*. However, he devoted the most space to its purifying, refreshing, cooling and irrigating qualities: a fast-flowing river removes

108 Bartholomeus 1519, lib. XIII, cap. II: *De fluvio.*

109 Loc. cit. Cf. IsidoriEthym. 1911, lib. XIII: *De mundo et partibus*, cap. XXI: *De fluminibus*: "*Fluvius est perennis aquarum decursus, a fluendo perpetim dictus. Proprie autem flumen ipsa aqua, fluvius cursus aquae. Prius autem flumen quam fluvius, id est prior aqua quam decursus…*" Bartholomeus Anglicus tacitly accepted Isidore's latter distinction, which fact can be testified by his using both these terms as synonyms: *flumen sive fluvius* – cf. Bartholomeus 1519, lib. XIII, cap. II.

110 Loc. cit. Cf. also Aristotle:*Meteorology*, book II, 2: "And those rivers are large which flow for a long distance through a lowying country, for by their situation and length they cut off the course of many others and swallow them up. This is why the Istrus [the Danube – note U.S.] and the Nile are the greatest of the rivers which flow into our sea." It is, however, not Aristotle that Bartholomeus Anglicus referred to in the discussed fragment of his encyclopaedia, but to the example given by Pliny the Elder of the Danube and its 60 tributaries and 7 estuaries where it flows into the Black Sea – cf. Plinius/Pliny the Elder, book IV, 12, 79.

all obstacles, carries everything that is clean, purifies the places it flows through, including the water in lakes and fish ponds, nourishing the fish swimming there; it cools everything that is hot, it invigorates everything that is thirsty, and irrigates the neighbouring ground and creates favourable conditions for roots and seeds to grow. By writing that the river rinses dirt and impurities from the body and clothes (*…sordes et immundicias tam corporum quam vestium mundificat…*), Bartholomeus pointed to the importance of rivers for the hygiene of people living nearby. Among the benefits offered by the river to towns and settlements, Bartholomeus enumerated also the defence, transport and supply function of the river; by flowing around towns, the river makes them defensive, at the same time supplying them with food and goods (*sua circumfluentia civitates et alia habitacula muniter fortificat; tam victualia quam mercimonia ad civitates deferentes… locupletat; … loca munitionibus congrua coadaptat…*). This was the first type of rivers that carried "living water" that was always clean and free from contaminants. Alongside the "living water" river, Bartholomeus defined another type of rivers. These were raging torrents (*torrentes*), changing at times, which during heavy rains overflowed their banks, caused floods and destroyed the nearby grounds and roads, carrying stones and chaff.[111]

This description[112] briefly outlines all the most important advantages and disadvantages of rivers that can be useful and friendly, but also dangerous and destructive. This ambivalent nature of rivers had a tremendous importance for the developing settlement, including the vast majority of mediaeval towns located on rivers.[113] However, not always or not to the same extent all the above-mentioned functions of rivers were observed in the space of river towns or in the everyday social and economic life of their inhabitants. This depended mainly on the different location of the towns in relation to the rivers and on the size of the rivers.

II.1 Lowland towns and the river

Undoubtedly it were lowland towns that most strongly felt both the benefits and the problems connected with having a river within its limits. All the characteristics enumerated by Bartholomeus Anglicus can be referred to the Seine and to the role

111 Bartholomeus 1519, lib. XIII, cap. II (also taken from Isidore of Seville).

112 Together with Bartholomeus's opinions about the quality of river water as drinking water, quoted in Part I of the present work.

113 Wacław Ostrowski, one of the most outstanding Polish town planners, wrote: "Nearly all towns are situated on rivers that are big or small, dynamic or slow, »thick« or »thin«" – Ostrowski 1996, p. 183.

it played in the life of mediaeval Paris (fig. 1). The Seine might have been the direct model for the description, considering that Bartholomeus observed this river not long before writing his encyclopaedia, during the time when he lectured at the Sorbonne after having completed his studies at Oxford. The main advantages of the Seine (the fact that it constituted a defence of the Île de la Cité, the place from where water was drawn and in which fish were caught, a large communication, transport and trade artery, the source of energy needed for the neighbouring mills and mills on boats, the place where crafts requiring water could function) decided the spatial layout and functions of Paris three mediaeval settlements, and also the character of the city as an important commercial port.[114] Like in Bartholomeus' description, they also outweighed the disadvantages, i.e. its repeated flooding, even though the floods caused serious disturbance in the functioning of the city, mainly

114 For a review of more recent studies concerning all the above-mentioned issues cf. a collection of articles in: La Seine 2000, passim; about mills in Paris: Berthier 2003, pp. 217–232. In Bartholomeus's homeland, the Thames played the same role for mediaeval London – Keene 2001, pp. 161–168: of a major trade artery and a river full of fish: "fluvius maximus piscosus", as it was characterised in a 12th-century description; and of a source of energy for mills and a place where craftsmen could perform their work requiring water, e.g. dyers or craftsmen dealing with the final stages of cloth production. About the economic significance of other big rivers for towns built on them, cf. e.g. Schönfeld 1978, pp. 110–124 (the Danube as a factor of Regensburg's economic growth, but chiefly as its main transport and trade route thanks to which the town became the centre of transit trade between Eastern and Western Europe, an intermediary between Byzantium and the Champagne fairs in trade of such bulk goods as salt and wine, but also cloth, iron, lead and copper. Also about lower cost of transport of these goods on the Danube than by land). Cf. also Racine 1986, passim (the presentation of the Roman origins of the legal principles concerning the ownership of rivers in the Po Valley and the use of these principles in the towns in the Po Valley); Balestracci 1994, passim (about bishops and communal authorities having the right to water in Italian towns and about the confrontation or forms of cooperation between them in this respect, e.g. concerning the control of ship traffic on rivers); the same problems regarding towns in Lorraine were discussed by Marc Suttor 1992, pp. 104–105. Cf. also a town planner's view on the role of the water supply system together with the Tiber in the shaping of Roman landscape throughout the centuries – Wolski 1989, passim. Among studies on mutual relations between rivers and towns in late Middle Ages in the Polish lands we should specially mention works by Alfred Kaniecki concerning water in Poznań (listed in Bibliography in the present work).

of its municipal and political hub as well as the port, crafts and commercial centre located on the Right Bank (*la Rive Droite*).[115]

Fig. 1: The Seine within the town space of Paris. Fragment of the Paris town plan from 1540 – Plan de Paris (Tapisserie), 1818.

115 Journal Bourgeois 1991, pp. 225, 231–233 and 313. Cf. also, inter alia, Vernet 1952, pp. 47–56, Lafay 1991, p. 69, Le Maresquier-Kesteloot 2000, p. 54 et seq., Chevaillier 2000, p. 65.

The situation was different in the case of Rouen, the second largest French port after Paris. There the Seine flowed next to the town (which did not save it from floods) and served almost exclusively as a major communication and transport artery (fig. 2). It made the town become the centre of great transit trade, which is shown in Louis XI decree issued in Arras in 1477: the *bonne ville et cyté de Rouen* is described as the main and capital city of Normandy, large and vast, strong and densely populated, situated at the mouth of the Seine so conveniently that is could accept even large ships coming from every foreign country with all kinds of goods. The latter could be further transported up the river to Paris and other cities of the Kingdom and of Normandy either on water (on the Seine and its tributaries) or on land.[116]

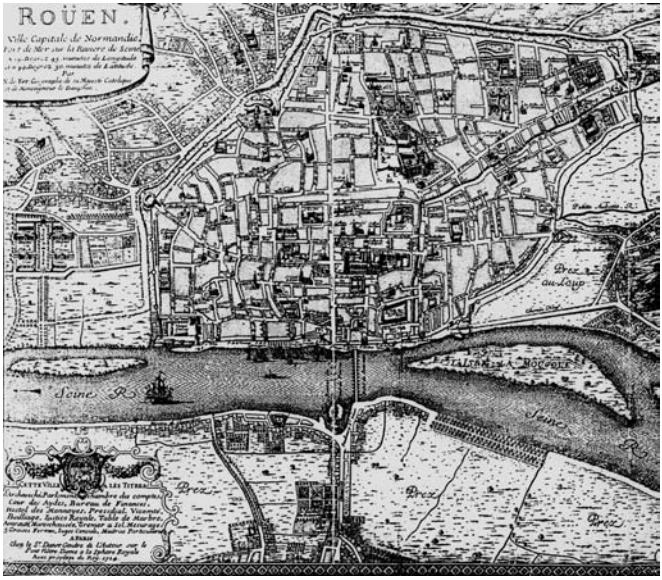

Fig. 2: Rouen on the Seine. Plan from 1724, after: Herval 1947, vol. I, Rouen.

116 "[…] la principale et métropolitaine de nostre dicte pais de Normandie, grande et spacieuse, forte et bien populée, joignant laquelle court la rivière de Sayne que de la mer jusques à icelle ville porte et peult porter grans et bon navyres venans de tous pays et nacions estranges et aussy partir de nostre dicte ville de Rouen amont ladicte rivière et porter à paris et autres nos villes et citez toutes marchandises qui y seront apportez par mer et y en apporter d'autres, de nostre dict royaulme et pais tant par ladicte rivière et autres qui en icelles chient et affluent et mesmement par terres". Quoted from: Delsalle 1982, p. 27.

However, apart from this undeniably important function of the Seine, in the town its water was used at the very most by owners of suburban gardens situated near the river; when at the beginning of the 16th century a water supply system was conducted there, even they wanted to have access to this system.[117] The energy and production functions were fulfilled by three small Rivers: Renelle, Robec and Audette; the former two were tributaries of the Seine, the latter was a tributary of Robec. It was on these rivers that functioned the suburban mills and workshops of the local fullers, dyers and weavers,[118] and also tanners (although tanners' workshops were located in the centre of the town, because there they had access to running water from the River Renelle[119]). The development of these crafts, especially the drapers' craft, was favoured by natural conditions, namely by the boggy terrain of the east suburban and *intra muros* space of Rouen, with a shallow water-bearing stratum and a considerably humid climate.[120] According to research carried out by André Guillerme, the Rouen crafts that needed water did not function only on the above-mentioned three small rivers, but also on adjoining canals created while the marshy grounds were drained.[121] Indeed, it was such an expanded network of natural and artificial watercourses that was easy to arrange and to maintain, especially in the boggy lands like in Rouen, that created sufficient conditions (a permanent access to water) for a full development of such crafts and that enabled centres with such networks to become important hubs of these crafts. It was only on numerous canals – both in the space *extra* and *intra muros* – that specialized workshops dealing with various stages of cloth production could function (e.g. dyeworks or tenters). The *sine qua non* condition for the establishment and the development of the large Western European weaving and cloth centres was their resemblance in terms of spatial layout to Venice,[122] namely with water being an

117 Sowina 2001, p. 33.

118 Cf. a royal document dated 28 September 1199: Declaration des droits sur les moulins de Rouen appartenant au Roi puis à l'Archeveque: *Cirographum de consuetudinibus molendinorum Rothomagi* concerning the obligation to repair any damages caused by the River Robec overflowing its banks, imposed on millers, fullers and dyers whose houses and workshops were situated by the riverside *(…omnes molendinarii …omnes fullones et tinctores super aquam Rodobecci manentes qui domos tenent et habent vasa fullonorum et calderias* …): Recueil Chartres Normandes 1919, pp. 15–17 and chart XII.

119 Le Lieur 1911, p. 11; Sowina 2001, p. 29.

120 Quenedey 1926, p. 101; Histoire de Rouen 1979, pp. 82–83 and 146.

121 Guillerme 1983, illustration on p. 87.

122 About shaping this space through draining marshy grounds also by building canals – cf. extensively and thoroughly Crouzet-Pavan 1992, chapter I: "La ville et

indispensable element of this space. This very comparison was used in the 2nd half of the 15th century by the King Louis XI of France to describe Amiens, the capital of Picardy, during his visit there. He called Amiens "the little Venice".[123] According to A. Guillerme, apart from the two above-mentioned cities, a number of other towns of the region deserved this name, including Troyes, Provins, Beauvais, Châlons-sur-Marne, Senlis, Etampes, Noyon and Caen, all of them being important cloth or linen centres.[124] It is worth mentioning that an analogous landscape was to be found in other large cloth centres not distant from the ones mentioned above, e.g. Mechelen (Malines) in Brabant or Bruges in Flanders.[125] The canals of Bruges (fig. 3a, 3b), a large cloth trade centre, apart from playing the obvious and important role in transport, communication and trade, as was underlined in literature,[126] were used (like in the other above-mentioned cloth centres) by craftsmen who worked in their immediate vicinity (in the Middle Ages Bruges was famous for its elegant thin black cloth[127]).

ses frontières: à la conquête de l'espace," pp. 57–139 and maps on pp. 1097 et seq. (unnumbered), showing residential area being extended at the expense of water and marshes.

123 Guillerme 1983, p. 84.

124 Op. cit., p. 64 et seq. About the development of "river crafts" ("les métiers de la rivière") in these centres in the Middle Ages – cf. op. cit., pp. 106–109. Another important cloth centre of this zone is worth mentioning, namely Douai in Artois, located in the marshy valley of the River Scarpe, one of the Flemish "bonnes villes" (apart from e.g. Ypres, Ghent, Bruges and Lille). The town had to build its water system (including draining canals) which performed defence, transport, energy and production purposes – cf. Lohrmann 1985, pp. 197–201. In-depth studies on water management and ownership relations in the entire valley of the River Scarpe – Deligne 1998, p. 23.

125 It was called "Venice of the North" inter alia by Erasmus of Rotterdam – cf. Vermeersch 1992, p. 20.

126 Cf., inter alia: Historische Stedenatlas 1991, passim, *Bruges et l'Europe* 1992, passim, Blockmans 1992, passim, Fossion 1992, passim, Murray 2005, passim.

127 Blockmans 1992, p. 45. About the leading role of Bruges (apart from Ghent and Ypres) in the early (12th century) use of new weaving techniques – Endrei 1987, p. 74.

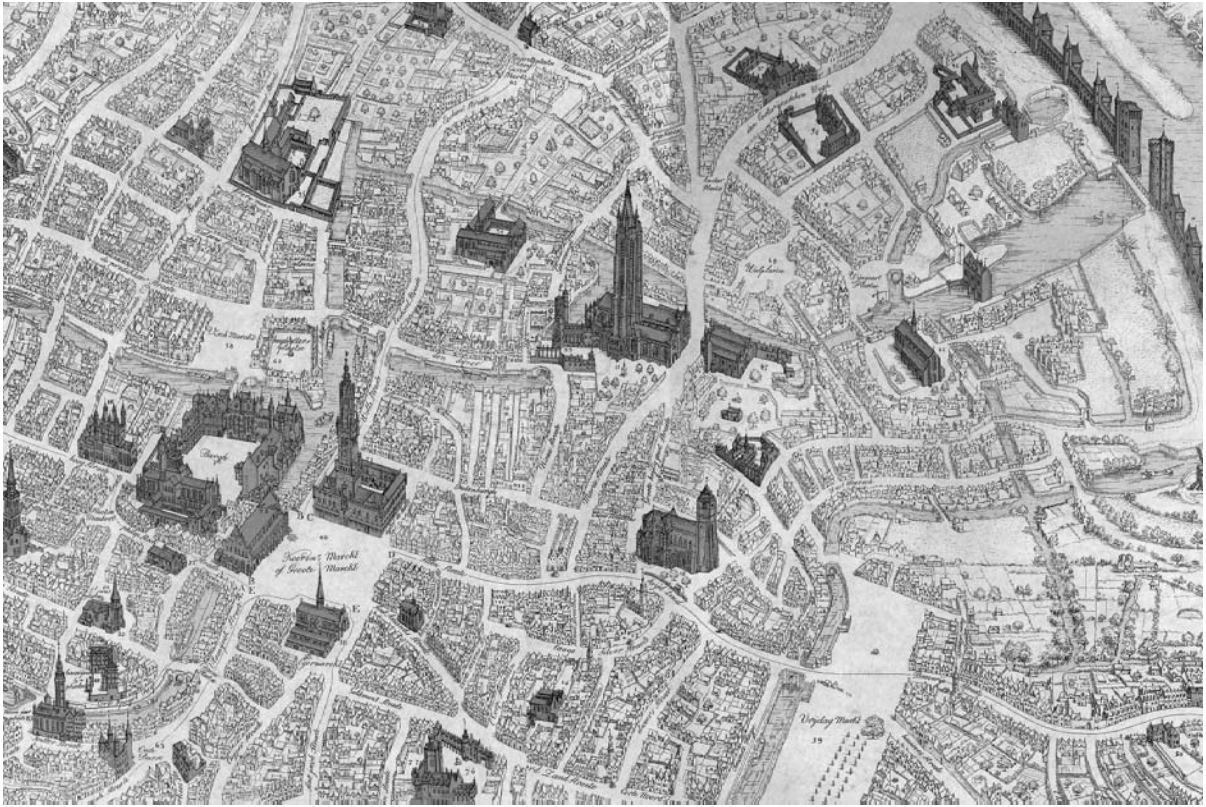

Fig. 3a: Canals in Bruges on a copy of a fragment of the town plan by M. Gheeraerts dating from 1561/1562, after: Brugge 1994.

Fig. 3b: Canals in Bruges on a photograph by Tadeusz Baranowski.

Weavers, invited to Wrocław to practice their craft in the 2nd half of the 12th century, called Walloons in literature, although they could have come from any of the above-mentioned regions in which the drapers' craft developed rapidly,[128] brought not only the production methods[129] and nomenclature (perhaps the echo of the latter can be the etymological connection between the Wrocław "Ketzer(berg)"[130]

128 Zientara 1975a, pp. 174–175; id., 1975b, pp. 349 and 357, where the author presented various conjectures, gathered from literature, and aired the following opinion: "[…] apart from the general statement that the newcomers came from the Romanic parts of the Empire and the neighbouring French lands, we are unable to define their native land in greater detail. The most probable are the lands of the bishopric of Liège, the County of Namur, Flanders and Artois, but it is also possible that they came from the Duchy of Brabant, Hainaut, or even the bishopric of Verdun, the County of Bar, or more precisely: Lorraine. Perhaps studies on the surviving material connected with place names will make it possible to locate the fatherland of the Silesian Walloons more accurately." For a highly detailed study on the above subject cf. also Młynarska-Kaletynowa 1986, pp. 59–66. In the opinion of the author of the present work, source terminology concerning the Wrocław "Walloons" ("Gallici", "platea Gallica") referred to those who came from 12th-century "Great" Flanders in general, hence it might have also concerned Flemish people. Such an understanding is suggested by a sentence from 1301: *locandi predictum districtum iure Theotonico, Gallico, uel quocunque alio* […], which could be translated as a foundation "with German, Flemish or any other law" (the Latin sentence taken from the act of the conferral of villages near castle of Pławiec to Jan Muskata, the Bishop of Kraków, quoted from: Gawlas 1997, p. 398).

129 About the great development of weaving from the 11th century in Flanders in relation to the improvement of the weaving technique, which in turn resulted in an increase in the size of the woven cloth – cf. more: Endrei 1987, pp. 73 et seq. Op. cit. (pp. 77–78) about the expansion of Flemish and Walloon weavers from their overpopulated homeland to European towns, including Hungary (where they established separate districts), Wrocław (a separate "Walloon settlement"), Vienna (the dyers' guild who until the 18th century called themselves "Fleminger") and Italian towns, including Padua, where in 1265 they were exempt from all taxes and customs, and later a decree also abolished import duty on wool, dyes and tools needed for production. The presence of Flemish and German weavers in Padua was confirmed as early as in 1406. In Florence in the first half of the 15th century "panni a moda Doagio" was produced, i.e. the same type of cloth as in Douai.

130 Let us recall that according to M. Goliński's findings (1997, p. 195), place (street) names containing an element similar to the word "Ketzer/Kötzer" were derived from "the so-called spindle (although not the one of a spinning wheel, but the bobbin of that name in the weaving shuttle around which yarn is wound)". Also a fragment of Sukiennicza Street in mediaeval Elbląg, referred to as Ketzerhagen, was associated by

and the earlier Bruges, i.e. Flemish "Catte(voorde)"[131]), but also their habits connected with the place where they worked. It had to be a marshy place in the vicinity of water. Their Wrocław locations fulfilled these conditions: at first the River Oława flowed along the northern and north-eastern boundary of the Walloon settlement near St Maurice's Church (*vicus beati Mauritii*)[132] – *platea Romanorum*, also called *Romana alias ranarum platea*;[133] and later, i.e. from the mid-14th century, they settled in Ketzerberg (Webergasse)[134] on the Czarna Oława River, also with direct and constant access to water.[135]

R. Czaja (1991, p. 131, following A. Semrau's interpretation from 1922) with weavers' spindles found there. To the names used in Elbląg and Wrocław M. Goliński (1997, p. 195), after T. Goerlitz, added the weaver's streets in Gdańsk called Katterhagergasse and Katterhagen. He also put forward a suggestion that the Wrocław pair Hundegasse and Ketzerberg was paralleled by a Kraków pair: Psi Rynek (Dog Market) and Kocia Street (Cat Street). As regards place names that might have been derived from Flemish weavers, we can also take into account "Harrasgasse" mentioned by M. Młynarska-Kaletynowa (1986, p. 59) and M. Goliński (1997, p. 199 – there, however, as an early-modern name), which is unequivocally connected with the town of Arras (Artois).

131 Verschelde 1876, map showing Bruges in 1127, where "Cattevoorde" was marked, which in Middle Dutch meant "Cat's Ford" ("Cat's Passage" – French: "Gué du Chat") – the present author extends her heartfelt thanks to Mr Andries Van den Abeele, heritage conservator and echevin of the town of Bruges, for his linguistic and historical consultation, and to Ms Mania Kozyreff, retired manager of the history section of the Library at the Catholic University in Louvain-la-Neuve, for her agency and warm help. According to A. Van den Abeele, the place called Cattevoorde at the end of the 13th century embraced four streets in Bruges in which tenters stood. Cf. also references to mentions of tenters in Cattevoorde, in: InvBruges, vol. 9, 1883–1885, p. 372 – "licinia de Catvorde" (1288) and "Ramen te Cattevoorde" and p. 383, with the piece of information that it included the following streets: Ezelstrate, Raemstrate, Sledestrate on the watercourse called Hoye (Hoie).

132 Młynarska-Kaletynowa 1986, pp. 59–64.

133 Under these two Latin names on map no. 3: "Wrocław około roku 1300 [Wrocław ca 1300]" (prepared by M. Chorowska), in: Atlas Wrocław 2001. The second name – Frog Street – testifies to a swampy character of the ground. M. Goliński (1999, p. 190) marked Żabia (Frog) Street on the map pertaining to this part of the town as a narrow street diverging behind St Maurice Church at an acute angle from Walońska (Walloon) Street.

134 Goliński 1997, pp. 194–195 and 203; id. 2007, pp. 31–38.

135 Highly favourable natural conditions (marshes between the rivers: Oława and Odra) were also enjoyed by those Walloon weavers who moved from St Maurice settlement in Wrocław and before 1201 settled down in a nearby town called Oława,

The invitation of the so-called "Walloon weavers" to Wrocław in the 12th century formed part of a project of an economic activation of Silesia. Hence, one can assume that the authors of the project[136] were well aware of the fundamental role of this professional group in the development of the places Walloon weavers came from, as the drapers' craft was the basis of the economic power of these centres. However, without the indispensable favourable hydrographic conditions, resembling the ones described above present in all the large centres of drapers' crafts in the north of France or in Flanders, the Wrocław project would have no chances of success. And yet Wrocław natural features and later works done throughout the Middle Ages to adapt the watercourses – mainly digging the moat when the town was first chartered with German law and creating a new moat in the 1290s (at first for defence) 46 m wide and 4.5 m deep with the water taken from the River Oława, which is why the moat was called Czarna (or Miejska) Oława (Black or Urban Oława)[137] – created decidedly favourable conditions for the development of this

where they initiated the local development of this branch of craft – about them in: Zientara 1975b, pp. 357–359, also about the fact that Oława, which belonged to Piotr Włostowic, formed part of the estate of St Vincent Monastery in Ołbin; from 1206 it was owned by Henry I the Bearded.

136 B. Zientara (1975b, p. 366) pointed to Prince Boleslaus I the Tall and to the fact that he might have used the help of merchants from Flanders, Brabant, the County of Namur and the bishopric of Liège, who reached Silesia and – being very mobile – settled in Germany, Bohemia and Hungary; they sometimes invited precisely drapers to come there. In the light of the above, B. Zientara considered a cooperation of Walter of Malonne, from the diocese of Liège, the Bishop of Wrocław in the years 1149–1169, as "possible, but not necessary". M. Młynarska-Kaletynowa (1986, pp. 59–65) argued for the participation of Bishop Walter in this project; she suggested that Walter began to cooperate already with Boleslaus IV the Curly and connected this supposition with the role that Walter as a canon in Płock might have performed in the adoption of the cult of St Maurice in Poland. A temple in the Wrocław Walloon cluster bore the name of this Patron Saint (St Maurice with two of his companions were depicted on the door ordered for the Cathedral in Płock by the local Bishop, Alexander of Malonne, Walter's brother). Marek Słoń (2007, pp. 11–20) argued for the fact that having returned from exile in 1177, Boleslaus I the Tall founded the cluster, but at the same time the researcher pointed out that no sources testify to a connection "between the rule of Walter of Malonne and the establishment of the cluster". According to this scholar St Maurice's Church was built in the 1230s "thanks to the cooperation between Prince Henry I the Bearded and the then Archdeacon Nasław". Cf. also id. 2006, pp. 215 et seq.

137 Młynarska-Kaletynowa 1986, pp. 35–36 and Goliński 2001b, p. 122. About the dimensions of this moat cf. Piekalski 1999, p. 201.

branch of production and also for all other types of crafts requiring water. This was clearly shown in socio-topographical studies conducted by Mateusz Goliński concerning e.g. malsters working between the inner and the outer moat,[138] or several topographically separate clusters of cloth and linen weavers who used water from the moats or from the place where Oława joined the Odra[139] (in the fork of these two rivers – as an island – the New Town was built: the centre of cloth production for the Wrocław agglomeration[140]). The city on the Rivers Oława and Odra (and its branch called Odrzyca)[141] made use of their water to encircle its parts with a network of moats. The city "was reflected in the water" and benefited from it in every way. The situation was aptly shown in an early-modern description of Wrocław done by Bartholomäus/Barthel Stein (Latin: Bartholomeus Stenus) between 1512 and 1515.[142] It presented the city in the shape it acquired in the Middle Ages. The description included information that the author considered as the most important for an agglomeration. It also shows the role of water as an element that organized not only the topography of the town, but also its social and professional space (in this regard B. Stein can be seen as one of the pioneers of social topography). A map of Wrocław of 1562 done by Barthel Weiner (fig. 4) can be perceived as a cartographic complement to B. Stein's description. Marta Młynarska-Kaletynowa noted that both of the sources show the state of the town fortifications after their expansion at the end of the 13th century and at the beginning of the 14th century.[143]

138 Goliński 1997, pp. 140–187 and id. 2001b, p. 122.

139 Goliński 1996, p. 105 and Chorowska/Goliński/2001, p. 8.

140 Chorowska/Goliński 2001, p. 7.

141 Zdzisław Wiśniewski (1995, p. 139) noted that a favourable hydrological situation was one of the most important factors that decided the establishment at that particular place of a centre from the 10th century. About the development of settlements in Wrocław cf. also Piekalski 1999, pp. 86–87, 150 and 162.

142 Stein 1995.

143 Młynarska-Kaletynowa 1986, p. 33.

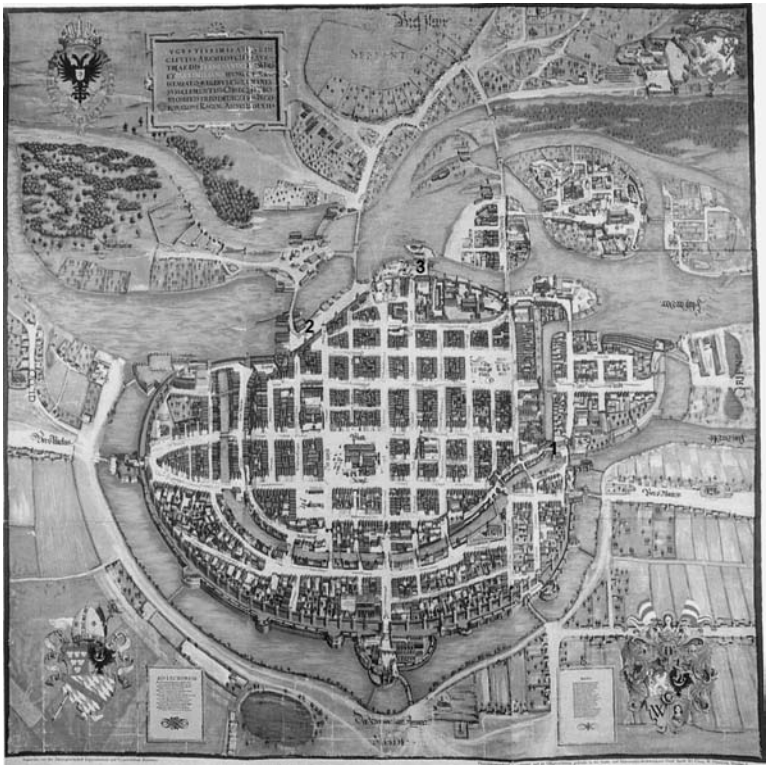

Fig. 4: The earliest plan of Wrocław from 1562 by B. Weiner, after: Goliński 2001b, p. 96. Numbers indicate water-works in Wrocław: 1. The earliest Wrocław water-work raising water from the Oława River for the water supply system on Ketzerberg from the 2nd half of the 14th century; 2. "Wasserrath" – water-work with scoops built in 1386; 3. "Wasserkunst" near the little Isle of St Matthias, built between 1529 and 1539.

Almost like authors of an increasing number of vedute,[144] i.e. cityscapes which became more and more popular at the time, B. Stein picturesquely described the role of the Rivers Odra and Oława in the shaping of the space of the Wrocław agglomeration. He underlined the "friendliness" of the rivers towards the city and at the same time pointed to their defensive qualities for various parts of Wrocław. He also noted that although in the east and in the north the river moved away

144 For Wrocław cf.: "Widok perspektywiczny miasta od południa [Perspective view of the town from the south]", engraving after an unknown model: M. Wogemut and W. Pleydenwurtt, 1493, woodcut; after: Czerner O., 1989, no. 25.

from the town, it still protected it thanks to the fact that the river banks were reinforced with posts, so that the enemy could be held back.[145]

In B. Stein's work rivers and bridges are also present in the *intra muros* street layout. One can encounter a number of sentences like the following: *in aquilonem Odrensis foras mittit ad fluminis pontem*.[146]

Describing the places where "public roads" of the Old Town joined the passages in the town walls, B. Stein mentioned eight town gates and nine wickets and made the supposition that perhaps there was some other door through which tanners could go to the water, like e.g. the one next to the imperial castle.[147] The above excerpts of B. Stein's work testify to the fact that ensuring the best possible communication between the town and the water outside the town walls constitute one of the most important factors organizing the late mediaeval town space,[148] and the professional life of e.g. the above-mentioned tanners, whose need of water was underlined not only by B. Stein, but also – as was already stated – by L.B. Alberti. While analysing the stages of leather processing one can infer that tanners from Wrocław, dwelling in the space *intra muros*, mainly in Nowogarbarska (New Tanners') and Więzienna (Prison) Streets in the Kwartał Rzeźników (Butchers' Quarter),[149] crossed the town walls through the wicket near the imperial castle and made their way to the river at least twice: at first to drench and rinse in the river – i.e. in the soft running water, much warmer than water taken from a well[150] – in the course of cleaning (including scraping) skins freshly taken off animals from

145 Stein 1995, p. 105, 110 and 113.

146 Op. cit., p. 107.

147 Op. cit., p. 24; *Coriarii* in the Latin original – op. cit., p. 108. "Den Gerbern" translated into German (by H. Markgraf) – op. cit., p. 70. Cf. also: Goliński 1997, p. 98 – map of the *intra muros* Grand Quarter with the Tanners' Wicket and Starogarbarska Street (Old Tanners' Street) near the castle.

148 This was also reflected in other towns in place names, e.g.: Brama Wodna [Water Gate] and Wodna [Water] Street in Poznań (Wiesiołowski 1982, p. 161–165 and town maps p. 272 et seq.) and also in a gradual increase of the number of gates and wickets giving onto tracks leading to the river, like e.g. in Brzeg on the River Odra (Ostrowski 1996, p. 182), as well as in the development of a network of small streets called "wodne" [water], as in late mediaeval Sieradz (Sowina 1991b, p. 41).

149 Goliński 1997, pp. 51, 62–63, 376 and id. 1999, p. 16.

150 Turnau 1975, p. 41; Samsonowicz A., 1982, p. 43. The latter researcher noted that in the Middle Ages tanners usually settled very near rivers or lakes, because river and lake water is softer than well water, as it generally contains less carbonate, sulphate and ferrous salts, whose presence determines the water hardness.

blood and dirt (in this case the skins were probably bought from the neighbours – butchers) or hides than had already undergone preservation (drying or salting).[151] Water from the river was also indispensable for a repeated rinsing of hides in the process of their liming (i.e. removing the hair)[152] and greasing (which resulted in suede or chamois leather[153]), when the greased hides were heated and then whitened not only by being exposed to the sun's rays, but also by being soaked and then rinsed in running water.[154] After each of the above actions tanners most probably used the same way to return to their workshops *intra muros*. It was there that the other stages of hide processing must have taken place, judging from the collection of vats dating from the 2nd half of the 15th century, unearthed during excavations at 11 Więzienna Street.[155] Also here water was needed: in the process of treating the hides with lye, tanners placed the hides in holes in the ground or in vats, put the hides in layers, covered each layer with lime and ash, and then poured water over them.[156] This activity was repeated and could take up to two months.[157] In the process of vegetable tanning, most commonly used in Poland, layers of hide covered with tannin, i.e. shredded bark, were poured over with water. Again, this procedure was repeated a few times throughout several months, which time was sufficient to tan soft hides intended to become more delicate products, or even several years, when the tanner wanted to obtain hard leather resistant to abrasion and stretching.[158] Therefore, the permanent access to running water and its sufficient amount in tanners' workshops (I. Turnau calculated that in the entire tanning process 1000 litres of water was used for every hide[159]) were the decisive factors in the organization of the working space of leather craftsmen.[160] This is clearly shown in the miniature *Tanner* from the *Balthasar Behem Codex*. In the foreground we can

151 Turnau 1975, p. 40–43; Samsonowicz A., 1982, p. 45.
152 Turnau 1975, p. 56–57.
153 Op. cit., p. 113; Samsonowicz A., 1982, p. 56–57.
154 Poppe 1978b, p. 137; Samsonowicz A., 1982, p. 69.
155 Goliński 1997, p. 63–64 (and literature).
156 Samsonowicz A., 1982, p. 46.
157 Turnau 1975, p. 45–46.
158 Samsonowicz A., 1982, p. 54–55.
159 Turnau 1975, p. 29, referred to in: Wiesiołowski 1982, p. 224.
160 Which is why it sometimes happened that tanners worked in the very centre of the town, e.g. not only in Rouen, but also in Paris. In the latter city, from the 11th century tanners lived and worked next to the River Seine (in order to have direct access to river water from their plots), in Tanners' Street (rue de la Tannerie) parallel to the river, along a 150-meter stretch from the Grand-Pont [Grand Bridge] (later replaced by the Pont Notre-Dame [Notre Dame Bridge]) to the place de Grève (Chevaillier

see the craftsman scudding the hide in his plot of land, a well and a vat for soaking hides, and in the background, not far away, we can see a river[161] (fig. 5).

Fig. 5: "Tanner" from Balthasar Behem Codex *(ca 1505). In the foreground of the miniature a tanner is scraping a hide in his plot, on which a well and a vat for soaking hides can be seen; not far away there is a river. Collection of the Jagiellonian Library in Kraków. Reproduced after: Miniatury Behem, 2000 (photograph: Janusz Podlecki), with the consent of the Jagiellonian Library.*

2000, p. 65), the main port (Le Maresquier-Kesteloot 2000a, p. 56) and from the mid-14th century the seat of the town authorities.

161 Behem Miniatury, 2000. More on the role of water in the socio-topography of town leather crafts cf. Sowina 2003, p. 250 et seq.

While describing the flow of the Odra in the Wrocław suburbs, B. Stein scrupulously recorded devices that were found there, for the functioning of which water was the source of energy. These were mainly numerous watermills between the Wyspa Katedralna (Cathedral Island), Wyspa Piaskowa (Sand Island) and Nowe Miasto (New Town) which were situated on various branches of the Odra.[162] After the branches met again near the castle and as soon as the river passed under the bridge, it divided into several branches once more and flowed on numerous mill wheels. On the furthest river bank there was a paper mill and on the other side stood a different one which shredded bark for tanners. There was also a building in which cloth was fulled with the use of cogwheels. Below stood a beautiful water grain mill (*pulchra mola frumentacea*).[163] Within the complex of water-powered devices found on the branches of the Odra to the west of the bridge, B. Stein also noted: a sawmill and a grinding mill on the bank of the Kępa Mieszczańska (Burghers' Islet), and a grain mill and a water-work on the town side of the river. About the two former devices B. Stein wrote that there were two wheels installed on the Islet: one powered the saw used to cut thin planks, and the other one rotated the grindstone that ground blunted iron thus sharpening it.[164] In the sawmill huge pieces of wood fished out of the river were cut; B. Stein remarked that they were mainly used by builders to erect public buildings.[165] The wood was fished out of the river with the use of a machine (a crane: *machina tractilis*) mounted on the river bank[166] (fig. 6). There was a place on the Kępa Mieszczańska[167] where linen (*tela*) was bleached in the sun. In the same place was also the town shooting range. Further on along the Odra B. Stein noticedone more mechanical fulling mill (*rota que panno densando dat operam*[168]), and still further – the largest mill (*mola maxima*), in which two twin wheels worked, that stood near the gate which took its

162 Stein 1995, [25], p. 114.
163 Op. cit., [25], p. 115.
164 Loc. cit.
165 Loc. cit. About hauling timber to the River Odra, tying it (presumably into rafts), and later floating it down the river from the estate in Ryczyn in Lower Silesia cf. Młynarska-Kaletynowa 2006, p. 164.
166 Stein 1995, p. 115. The same method of transporting tree trunks and beams and later taking it out of the river onto the riverbank existed in Kraków: e.g. in 1532 Bartłomiej Włoch, a supplier of building materials to the Wawel castle, was paid twice for pulling out 60 tree trunks and later beams from the Vistula River to the riverbank – Rach-Wawel 2003, p. 69. Unfortunately, there exists no mention pertaining to Kraków of a device used to perform this task.
167 Stein 1995, p. 115.
168 Loc. cit.

name from it: Brama Młyńska (Mill Gate). Stein noted that the town drew revenue from all of these devices (*ab his omnibus tributum civitati penditur*).[169] In this group of water-powered town devices B. Stein recorded – as situated before the above-mentioned largest mill, and therefore also on the town side of the river – *rota maxima aquaria, que arte mira totam in urbem per fistulas et ligneos tubos aquam fundit*.[170] It was thus a scoop water-work (*Wasserkunst*), marked as "Wasserrath" on B. Weiner's map dating from 1562,[171] and identified by Klaus Grewe and Mateusz Goliński as created in 1386, modernized first in 1479 or 1497, and later in 1538.[172] B. Stein believed that it was precisely thanks to this huge water wheel that in an admirable way water was distributed in the whole town. It remains unknown whether it meant that in that time another water-work (the one raising water from the Oława River for the water supply system in Ketzerberg) was not used.[173] Excavation works showed that the latter water supply system functioned from the 2nd half of the 14th century, and thus was the earliest installation of that kind in Wrocław confirmed in sources.[174] Its description of 1499 testifies to the fact that it undoubtedly functioned – together with the necessary water-work – in the 2nd half of the 15th century,[175] and excavations provided evidence confirming the functioning of the water supply system, and therefore also the water-work, in the 16th and 17th centuries.[176]

169 Loc. cit. Cf. also a translation into German: op. cit., p. 79: "Alle diese Anlagen bringen der Stadt was ein".

170 Stein 1995, p. 115.

171 Atlas Wrocław 2001, chart 13.

172 Grewe 1991a, p. 65; Goliński 1997, pp. 78–79. Cf. also Buśko 1996, p. 101, where reference to: Długoborski/Gierowski/Maleczyński, *Dzieje Wrocławia do roku 1807*, Wrocław 1958, pp. 184 and 219, footnote 62, about the demolition of this water-work (*Wasserkunst*) in 1479 and its reconstruction in 1538, which would result in an almost 50-year gap in supplying water to the town by this intake. This view is untenable, if only for the fact that B. Stein described this water-work as a functioning device.

173 Goliński 1997, p. 79.

174 Buśko/Piekalski 1993, pp. 170–171; Buśko 1995a, pp. 93–95.

175 Goliński 2001a, passim.

176 Limisiewicz 1998, p. 219, referred to in: Goliński 2001a, p. 114.

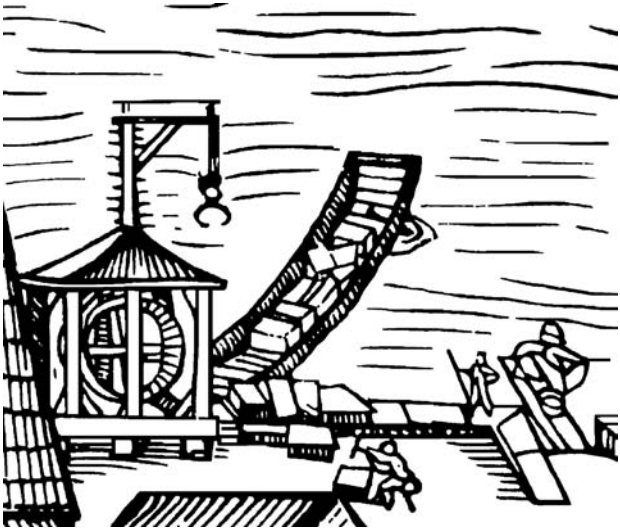

Fig. 6: A device for lifting goods transported on the river. Fragment of Zürich cityscape from 1576, by Jos Murer, after: Goll 1992, p. 268.

The way in which B. Stein presented the Wrocław water-powered devices proves that vertical water wheels were a characteristic element in the space of riverside towns. These wheels were invented in antiquity and described by Vitruvius; their prevalence in the Middle Ages resulted in the fact that the devices in which they were used, namely *molendina*, became the basis of and a major stimulant to the development of mediaeval economy,[177] which in turn brought about greater efficiency

177 It is impossible to list here the whole body of literature that grew from the times of the pioneering article by M. Bloch (1935) to become extensive nowadays. Hence, as far as Western European works are concerned, only selected studies will be mentioned. Their authors presented – always referring to previous literature – the technical, economic and social aspects of the construction and the functioning of watermills. Most of these studies are articles or chapters in editions devoted to various forms of water management, often published after international scientific conferences. From among French works (apart from M. Bloch's article) the following should be mentioned: research referred to in the Foreword of the present study conducted by A. Guillerme (1983, pp. 93–106) and P. Racine (1986, 2003 – where the author mentioned the results of excavations in Barbegal-Arles, published in 1940 by F. Benoît, which revealed a 16-wheel mill from the turn of the 3rd and 4th centuries AD, that proved a breakthrough for the archaeology of mills), and also studies by: Paul Benoit and his disciples (Rouillard 1996; Benoit/Berthier 1998, 2003; Benoit/Rouillard 2000; Bourgès 2003), Mathieu Arnoux

and the development of many branches of craft production. The most numerous water-powered grain mills occupied a prominent place owing to their enormous importance for the sustenance of the inhabitants of mediaeval Europe (fig. 7). It was there that grain was ground to produce flour, and malt (the main ingredient used for making beer) that had been prepared in malthouses was kibbled.[178]

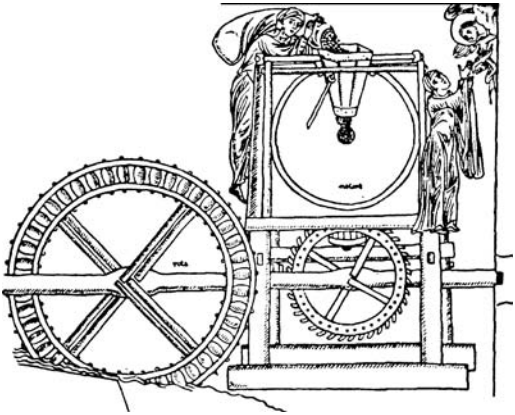

Fig. 7: The functioning of a water grain mill – according to a 12th-century manuscript Hortus Deliciarum *(The Garden of Delights) by Herrad of Landsberg, after: Dembińska 1973, p. 94.*

(2003), André Bazanna (2005); Belgian: Marc Suttor (2003); German: mainly Dietrich Lohrmann (1990, 1996, 2003) and Horst Kranz (1994); Italian: Sante Bortolami (1988), Gian Maria Varanini (1988) and Duccio Balestracci (2003); Spanish: Ricardo Cordoba de la Llave (2002, 2003) and Maria Martínez Martínez (2003). Much to the present author's regret, neither in the above-mentioned works nor in other studies are any traces of the early and rich output of Polish scholars, including mainly Mirosław Frančic's article about the technique of all types of watermills (1954), and works by: Henryk Samsonowicz (1954), Stanisław Trawkowski (1959a) and Zofia Podwińska (1970), or the synthesis about water grain mills in mediaeval Poland by Maria Dembińska (1973). It should be hoped, however, that Grzegorz Myśliwski's article (2003) about the significance of watermills in mediaeval Central Europe will enter international literature, which would at least partly compensate for the above-mentioned absence of Polish studies from international publications. The recent years witnessed the publication of two noteworthy Polish studies about watermills in the State of the Teutonic Order, including Malbork: Długokęcki/Kuczyński/Pospieszna (2004) and Kubicki (2012).

178 Frančić 1954, pp. 81–94; Trawkowski 1959a, pp. 62–86; Podwińska 1970, pp. 373–402; Dembińska 1973 – where older literature was mentioned; Lohrmann 1990, pp. 35–47 (pp. 42 et seq.) and id. 1996, pp. 221–232, where literature was listed. Also, inter alia: Rouillard 1996, passim.

The introduction of fulling mills brought about the mechanization of the process of cloth and linen production, and consequently its considerable acceleration.[179] Water in the fulling mill (fig. 8) was needed not only as a source of energy which powered the fulling wheels that in turn set the fulling stamps or fulling hammers in motion (through a transmission mechanism)[180]; it was also heated in cauldrons and used to pour over the cloth beaten with the stamps.[181] The existence of fulling mills was one of the signs of the town's economic strength or testified to a particular development of the textile industry in the given centre. Good examples of such centres are towns in Flanders, including Bruges,[182] or German towns such as Wismar, Chemnitz or Bremen.[183] The existence or inexistence of separate fulling mills depended on the technical possibilities and on the cost of the installation of devices needed to supply them with water, which is why existing grain mills were sometimes only fitted with fulling wheels; this was the rule in economically weaker centres, including small Polish towns.[184]

179 Poppe 1978a, p. 115. From among studies cf. Clemens/Matheus 1996, pp. 233–234, where the authors wrote (p. 234) that one fulling mill replaced 40 people trampling cloth with their feet.

180 Frančić 1954, p. 94.

181 Reychmanowie 1965, pp. 16 et seq.; Poppe 1978a, pp. 115–117.

182 Ryckaert 1991, p. 177.

183 Clemens/Matheus 1996, p. 234.

184 E.g. in Łowicz in the Mazovia region from among six wheels of a mill on the River Bzura four were used to grind flour, one set the stamp (for fulling?, for groats?) in motion, and the remaining one set the fulling mill and the grinding wheel in motion – Morawski 1986, p. 81. A similar situation occurred in Sieradz, where the largest and the earliest mentioned (1347) mill: the royal malt mill had two flour wheels and one malt wheel; before 1519 a fourth wheel was installed: a fulling wheel – Sowina 1991b, p. 45. Also e.g. in Nowe Miasto Korczyn and in Wiślica (Wyczański 1964, p. 160–161), where mills kibbled malt and millets for groats. In the 17th century in Szadek existed a fulling wheel fitted to a grain mill belonging to the starost– LustWojWlk. 1969, p. 61.

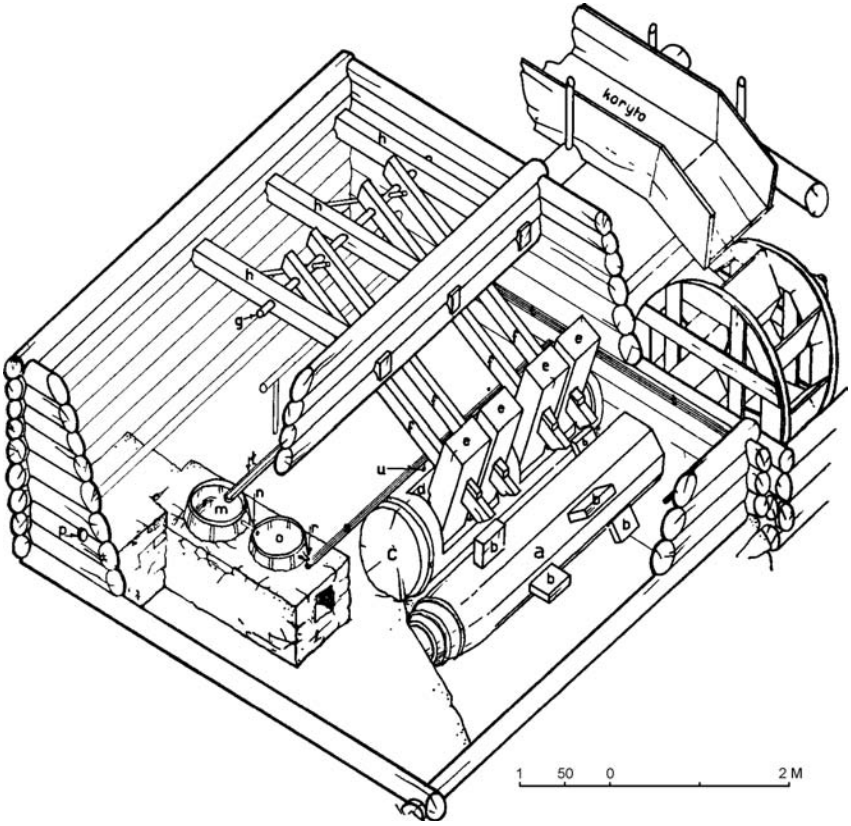

Fig. 8: A fulling mill in Roztoka clearing (Witów). Axonometric projection of the interior, after: Reychmanowie 1965, p. 29.

Fulling watermills were not the only element that indicated the existence of textile crafts in the townscape. The closeness to the river also decided about the location of frames and bleacheries. After the cloth had been fulled, it was stretched on wooden frames and dried. The size of the frames differed from one to even a dozen lengths of cloth, and therefore they took up much space.[185] In the towns of northern France, in the "little Venices", like in the above-mentioned Bruges, frames were set next to the canals,[186] whereas in Chartres and Rouen – next to small rivers

185 Poppe 1978a, pp. 117–118.
186 Guillerme 1983, p. 107.

in the suburbs inhabited by weavers.[187] The bleachery,[188] whose prevalence in the 14th century resulted in a considerable improvement of linen and hemp textile finishing, was always located in a meadow near water. It consisted of vats, pools or canals for soaking linen, cauldrons for heating water, a mangle and the above-mentioned fulling mill. Water was necessary all the time: first for a 24-hour soaking of the newly-woven linen, later for heating it several times in a vat, and finally for pouring over linen stretched out in the sun in a meadow for 2 or 3 weeks. The whole cycle was repeated 3–5 times and it took from 6 up to 15 weeks during the time when the sun shone the strongest, i.e. in summer. This stage of linen processing was described by B. Stein. The landscape "with linen" was characteristic of towns with a well-developed textile craft, e.g. Troyes, Reims,[189] of towns in Little Poland, e.g. Tarnów, Krosno, Biecz or Lublin[190] (fig. 9), and also of Wrocław, as is shown in B. Stein's description. Incidentally, in the latter centre there must have

187 Billot 1987, p. 117; Histoire de Rouen 1979, p. 83.

188 An extensive description of these devices and their functioning in Polish literature: Wyrozumski 1972, pp. 94–99; Poppe 1978a, p. 118.

189 Guillerme 1983, p. 108.

190 E.g. in Tarnów in 1446 the town's bleachery that was being leased to one of the burghers for a perpetual annual rent of 12 marks stood on the River Trosina, in a complex consisting of a "higher mill" and a "large pond", which was to be extended by a fulling mill for fulling linen – BPAU, rkps/MS 3282, no. 6, p. 5v. and Wyrozumski 1972, p. 85. In Krosno before 1450 existed a major bleachery on the so-called leat conducted from the River Wisłok, and later a minor bleachery on the River Lubartówka – Leśniak 1999, p. 56 and pp. 58–59, where also about the work and social standing of bleachers in Krosno. In Biecz, on the strength of royal privileges of 1437 and 1450, a bleachery (*dealbatorium alias blech*) was to be erected "where formerly hop gardens (*horti humulorum*) had been situated, between the town and the burgh", most probably on the leat conducted to the royal mill, since the buildings of the bleachery (including its fulling mill) were to use this leat – MatBiecz, 1914, no. 46, pp. 11–12. About the town's 16th-century profits from the bleachery: ANK, rkps dep./Dep. MS no. 24, pp. 5, 230 and 310 and rkps dep./Dep. MS no. 25, pp. 134v., 153, 264v. et seq.; about cutting off water for this bleachery by the starost Stanisław Boner during the conflict with the town – MatBiecz, 1914, no. 255, year 1554. The bleachery in Lublin was marked as one of 22 most important town buildings and devices represented on an engraving by A. Hogenberg depicting the panorama of Lublin. It stood on a suburban meadow, next to the water, most probably an artificial branch of a vast and deep water reservoir described in the engraving in question as *stagnum spatiosum ac profundum*, in close proximity to the water-work (*Wasserkunst*) that used water from a different leat – Lublin 1997, p. 10.

existed a coordination in time between two mutually exclusive actions, i.e. between stretching out and bleaching linen in bleachfields, and practicing in the shooting range which was located in the same place.

Fig. 9: Lublin water devices: no. 3 – pipe house, no. 4 – bleachery, no. 5 – water tower. After: G. Braun, F. Hogenberg, Civitates orbis terrarum, *Cologne 1572–1618, after: Lublin, 1997, p. 10.*

The prevalence of oak bark mills resulted in the mechanization of shredding oak bark which then was used in tanneries in the process of vegetable tanning of hides. The functioning of bark mills and fulling mills was similar,[191] which was why they were sometimes combined. In that case bark was pounded with stamps of a cloth fulling mill; the fulling mill was either a separate building, or the stamps were installed in a grain mill.[192] It is worth mentioning that apart from bark mills or wheels

191 Frančić 1954, p. 95.

192 Loc. cit.; Poppe 1978b, p. 134; Turnau 1975, pp. 66–67.

also fulling wheels for tanners were installed in grain mills; these fulling wheels set the stamps in motion that fulled the hides, as it was in Kraków.

As was shown in the example of Wrocław, sawmills (in Polish: tartak, pilny młyn[193] or tarty młyn[194]) (fig. 10) were indispensable in large centres, because of a great demand of numerous construction teams for ready timber materials. However, sawmills were found also in smaller centres, especially where wood crafts were developing, namely in towns that could use the local wood or that

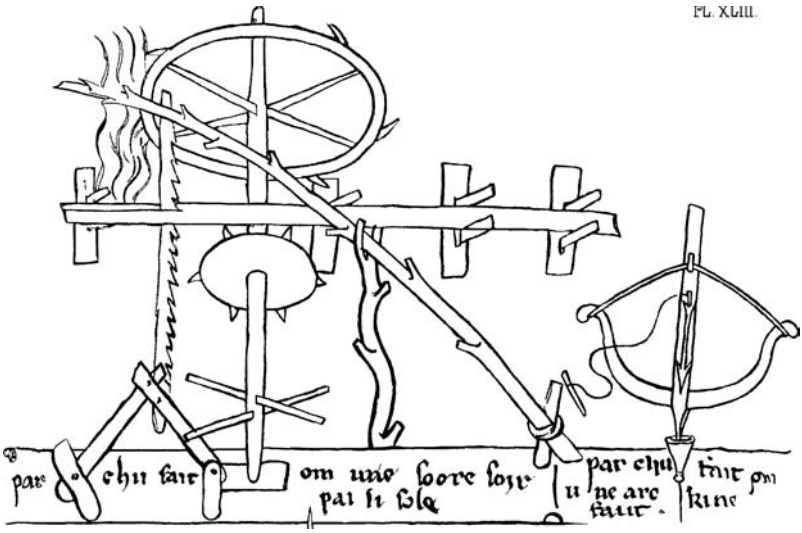

Fig. 10: The operating principles of a sawmill. Drawing from Villard de Honnecourt's sketchbook, France, ca 1235, after: Villard de Honnecourt, 1976, plate XLIII and its description, p. 144.

were transit centres of timber floating. As examples let us cite Sandomierz[195] and Ostrołęka. The latter occupied an important place in timber floating in the Mazowsze region.[196] Setting up sawmills in such centres was to contribute to the economic development of the town, which was the owners' intention. In 1521

193 Thus is written sources, e.g. ANK, IT 47, p. 32 (the 1569 inspection of the Royal domain under the management of the governors of Kraków).

194 MRPS IV/1, 1910, no. 1262, p. 75, year 1511: *molendinum serrae alias pilny mlyn aut tarty in fluvio Czarna sub certo censu pro tenuta Ropciczensi.*

195 Kiryk 1993b, p. 93.

196 Niedziałkowska 1967, pp. 34–35.

King Sigismund I, in order to improve the condition of Śrem and to promote the comfort of its inhabitants, granted the burgomaster and the councillors permission to build a sawmill within the limits of the estate of the Śrem *advocatus*[197] near his watermill in the Ostrów island,[198] underlining that it was a special act of his grace (*de speciali gracia nostra*). In this sawmill timber was to be cut and planks were to be made. The monarch took his decision with the consent of the *generosus* Stanisław Lasocki, the town's leaseholder (*tenutarius*) granting the Śrem authorities the right of ownership to and all the future income from the sawmill.

As regards the Wrocław grinding mill mentioned by B. Stein, it was surprisingly small in relation to the needs of such a large centre. It provided the same services as e.g. the grinding mill in Biecz. The one in Wrocław had only one wheel and one stone, whereas the one in Biecz (at least according to intentions originated up to a century earlier) was to be equipped with two of each kind of the devices. On 20 May 1421 King Ladislaus Jagiellon granted burghers from Biecz the right to build a grinding mill (*lapsatorium*) on the River Ropa flowing around the town, with two wheels and the same number of stones, and to equip it with other instruments needed for grinding, in order to sharpen knives, axes and other tools, obliging them to supply yearly *ratione census* 10 knives suitable for the use in the royal kitchen.[199] As Mirosław Frančić and Benedykt Zientara[200] noted, grinding mills (*molendina cultrificum*) in the Polish lands were used to sharpen, grind and polish metal products that constituted the last stage of work not only of numerous metal craftsmen, mainly knife and cutting tool makers (e.g. shears for cloth cutters), but also of metal vessels or armour producers.

The vision of harmony between a lowland town and its river or rivers (which translated into the centre's well-working economy) that emerges from B. Stein's work, only partly applies to other cities in the Polish lands (e.g. to Poznań[201]):

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197 APP, Śrem I/12: *impensa civili de nouo construere et edificare in Advocatia Srzemensi circa eius Molendinum quod est in Ostrow Molendinum pro Serra/ qua secari seu precidi possint robora/et asseres serrari ac parari.*

198 About the fact that after Śrem had been chartered with German law in 1395, it was located on the island of Ostrów – cf. Dunin-Wąsowicz 1974, p. 95.

199 MatBiecz. 1914, p. 7.

200 Frančić 1954, p. 84 and table II, illustration 4 after p. 94, representing the mechanism of a modern (16th–17th-century) grinding workshop (after: H. Zeisingk: *Theatrum machinarum*, first edition: 1607); Zientara 1954, p. 175.

201 Kaniecki 2004, pp. 181–425.

namely in the part concerning the functioning of Wrocław suburban water devices, mainly watermills. The urban landscape of most other centres lacked a watercourse network as fully developed as the one in Wrocław.

II.2 Upland towns and the river

The 13th-century foundation movement in the Polish lands coincided with an important relocation of mediaeval settlement centres caused by a change in natural conditions. This phenomenon has been most fully described and explained by Teresa Dunin-Wąsowicz.[202] Until the 13th century, settlement centres, inseparably and permanently linked with trade and communication routes on land and water, for which proximity to a river was very important, were created mostly in swampy river valleys, near passages leading across fords and holms of the widest marshes. The 13th-century wave of floods, caused by upsetting the hydrographic conditions following mass clear-cutting of forests near the sources of mountain rivers and connected with the development of settlement in southern Poland, is perceived as the main reason for moving settlement into upland areas, better protected from flooding.[203] Such a location was preferred by numerous towns chartered with German law. It resulted in moving the towns away from the river either in terms of distance or altitude. This, however, produced adverse effects as to supplying these cities in water. As a result, even towns considered to be riverside towns very often had major problems with obtaining water both for individual everyday use and for crafts practised *intra muros*. The situation was particularly difficult when it comes to towns situated on high riverbanks: not only drawing water directly from the river posed big problems, but also the fact that the water-bearing stratum was situated deep under the town made digging wells extremely difficult or even impossible. This fact, however, was completely ignored by Jan Długosz in his *Chorographia*:[204] he only praised rivers and created an idyllic picture of the advantages they offered towns situated on rivers.[205]

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202 Dunin-Wąsowicz 1974, passim; eadem 1995, p. 53.

203 Op. cit., p. 140 and passim. Op. cit., p. 137, where another possible reason for the increase of natural disasters, including floods, namely climatic changes caused by intensified solar activity. Cf. also: Kultura Polski 1997, p. 11.

204 Długosz 1964, pp. 88–93 and 109–114.

205 In this respect *Chorographia* by Jan Długosz reminds one of the above-mentioned encyclopaedic definition of river given by Bartholomeus Anglicus, which is hardly surprising, considering the uniform models used in this kind of descriptions. As regards the models for *Chorographia* by J. Długosz – cf. Piasecka 1970, p. 8–9, where we can read that Długosz made use of Ptolemy's descriptions and maps,

Describing Płock, Długosz noticed that the town was famous not only for being the seat of the bishop and for the castle adjacent to the town, but also for the Vistula River *qui illic undis inflatus alveum suum late spargit*.[206] While referring to the riverside location of Sandomierz, Długosz mentioned in general terms that the town was surrounded by the Vistula River: *Sandomiria, regionis magne Sandomiriensis caput, et que a Vysla fluvio abluitur*.[207] And yet both Płock and Sandomierz, situated on high Vistula riverbanks, had serious problems with obtaining water for everyday needs. To this state of affairs testifies the beginning of the royal privilege of 1585 to re-establish water supply systems in Sandomierz. Such a water supply system was urgently needed, as the town, being situated at a high altitude, suffered from the lack of water and constantly faced peril, because in case of a fire water had to be carried all the way up from the Vistula.[208] Earlier and even more telling sources concerning Płock are worth mentioning. A royal document of 1509 granting the right to establish water supply system in Płock to the initiators and investors of the planned system, including Erazm Ciołek, the Bishop of Płock, contains information about particular problems of the town arising from its location on a high bank of the Vistula River. The excerpt in question testifies to the fact that King Sigismund I understood the situation: he noted that not only the town, but also the castle and the cathedral would benefit from this enterprise, because there was no water in the town, and every day, for common use of all inhabitants, at great expense and with hard effort, water was carried from the Vistula River upwards (*in quaquidem civitate ad(h)uc nihil aque habebatur, sed quotidie ad communem omnium usum magno sumptu magnaque impensa ex fluvio Vysla sursum ferebatur*).[209] The information

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from Solinus's work and from Italian geographical descriptions, and especially of a small work by Boccaccio entitled *De montibus, silvis, fontibus, lacubus, fluminibus, stagnis seu paludibus, de nominibus maris*. Cf. also Tyszkiewicz 2003, pp. 181–183 and Deptuła 2006, passim, where literature concerning *Chorographia* by J. Długosz.

206 Długosz 1964, p. 111.

207 Długosz 1964, p. 112.

208 *Stephanus etc. significamus etc. Quod cum satis cognita nobis esset, quanta difficutate Civitas nostra Sandomiriensis, ut pote loco edito sita ob aque penuriam laboraret periculumque et iam non leve sentiret ex eo, quod si aliquando fortuito, quod absit, incendium in Civitate exoriretur, necessario aqua ex jstula(s.) usque ad illum restringendum* – quoted from: Giedroyć 1908a, p. 138.

209 ZbPłock II 1987, no. 295, p. 43. Op. cit., no. 395, p. 172, where in a privilege of 1534 the King called the establishment of a water supply system the town's first and most important need due to the lack of water.

about people walking down to the river to draw water on a regular basis can also be found in a royal document of 1513, granting Erazm Ciołek a plot by the town walls on the side of the Vistula River for the purpose of establishing a bishop's garden there.[210] This plot, 40 ells long and 30 ells wide (ca 27 x 16.2 m, its surface area equalled ca 437.4 m^2), was situated along the walls of the bishop's manor house in the direction of the Vistula, between the town gate adjacent to the manor and a wicket of the castle bridge. The King, however, made a stipulation that pedestrians crossing the town gate in order to draw water from the Vistula would have the right of free passage across this plot [i.e. without a toll or any obstructions – U.S.]. It was this condition, connected with a constant flow of pedestrians through a limited area that the Bishop had intended as a recreational, quiet garden, surely planted with flowers and herbs, that proved too inconvenient for E. Ciołek. This explains an agreement that the Bishop entered into three years later with the town council. By virtue of this agreement considerable spatial changes were introduced, including moving the town gate (at the expense of E. Ciołek).[211] The plot granted by the King to the Bishop, referred to in the document as *platea*, which fact proves that it was meant to provide transit undoubtedly in connection with reaching the river, was now to be at the sole disposal of the Bishop. In return, E. Ciołek undertook to create such a passage on the other side of the manor, on a strip of land bought from the local gentry and burghers especially for that purpose. In the middle of this passage a new town gate was to be constructed. The reorganization of this part of the town space, mainly resulting from the necessity of ensuring access to the river and to water for the inhabitants of Płock, also included constructing a small bridge over the sewage canal behind the town gate, on the other side of the town walls. This bridge was to enable municipal servants to access the river to draw water. It was to be big (wide?) enough for two or three people to walk through it at the same time. This common enterprise of the Bishop and the King – the owner of the town – is an example (rarely so well documented in Polish sources) of a harmonious cooperation (or at least of such a will or intention) *pro publico bono* of the two most important people exercising power over the town. However, one has to bear in mind that this was an exceptional situation: they had to be aware of the fact that if the problem remained unsolved, the inhabitants of Płock would be denied direct access to water.

210 ZbPłock II, 1987, no. 306, p. 54.

211 Op. cit., no. 315, pp. 63–64.

The inhabitants of Płock did not cease walking down to the river to draw water despite attempts to construct water supply system in the town in the 1st half of the 16th century (which fact will be discussed later). In the mid-1580s, while describing Mazovia, Jędrzej Święcicki noted that the town suffered from the lack of water and that "wells, although dug deep due to the elevation of the town, provide little water through near-dried canals leading from the sources;" for that reason "the people have to draw [water] from the same river for washing, drinking and other purposes; they use ewers and have to carry the heavy load all the way up to the town."[212]

In addition to the above-mentioned direct sources, it is worth noting that crafts practised *intra muros* were clearly underdeveloped,[213] especially those requiring water for their functioning, including tanning or textile crafts. As far as tanning is concerned, it never developed into an independent branch in neither of the towns. Judging from the name of the tanner's workshop in Sandomierz found in 16th-century sources by Feliks Kiryk (*officina sutorum alias garbuz*), it is only logical to agree with the scholar that this workshop was built in the *extra muros* space, by the Vistula River, on the road to a village called Kamień (Stone – a passage was there), and that it was owned by the town, serving all the town's craftsmen connected with the leather industry (*sutores*).[214] This leads to the conclusion that these craftsmen were involved in the total production process of turning animal skins into finished products, which implies the lack of specialization, and therefore the underdevelopment of the crafts in question. Such a conclusion is fully justified, especially in the light of the results of F. Kiryk's research on butchers from Sandomierz. From 1563 they were ordered to sell skins only to shoemakers and other leather workers.[215] A similar situation

212 Święcicki 1974, p. 180. *Thopographia sive Masoviae descriptio auctore Andrea Święcicki* was first published in print in 1634, but it was written ca 1585 – cf. Lalik 1975, p. 494.

213 One of the manifestations of this underdevelopment was e.g. the existence of one collective guild called the Great Guild in which most of Płock crafts were united.

214 Kiryk 1993a, p. 30 and id. 1993b, pp. 101–102. The scholar dated the establishment of the tanners' workshop to the year 1561, whereas the existence of this device had been confirmed in the local written sources in a record of 1548: *domicula alias garbusz sub vallo in piscaria* (APS 6, p. 164), thus under the embankment (or rather escarpment), in the suburb called Rybitwy (Fishermen, i.e. fishing cluster), from where one could enter the town through a wicket (cf. Atlas WojSandomierz 1993, map no. 2).

215 Kiryk 1993b, p. 105.

must have existed in Płock, where shoemakers' and furriers' guilds were active from the 2nd half of the 15th century alongside individual saddlers, harness makers and belt makers, but there are no sources testifying to the independent activity of tanners.[216]

As regards textile crafts, a drapers' guild (whose existence was confirmed in 1407, Sukiennicza/Knapska (Cloth weavers') Street, leading to the Market Square – from the mid-15th century[217]) existed in Płock, where poor quality cloth was produced; later it was either used to make working clothes and clothes for servants, or sold in nearby villages. However, even this cheap production burdened the craftsmen with debts. Probably a small number of cloth merchants were better off;[218] they might have organized the production as well. It is hardly probable that the craftsmen used the river, unless part of the Płock weaving production took place either in suburban burghers' farms (Latin: *predia*) (mentioned by Stella Maria Szacherska as the raw material base, supplying cloth merchants with wool[219]), or in suburban gardens situated on the Vistula River. As to Sandomierz, mainly on the basis of Schoss registers from the years 1557 and 1559 Feliks Kiryk counted 6–7 weavers active in the town,[220] and while mentioning Tkacka (Weavers') Street (calling it Płóciennicza [Linen drapers'] Street), he cited its Latin names found in historical sources: *platea textorum*, *platea Laniatoria*, *platea textorum seu Podolye*.[221] Judging from the second name, it probably referred to cloth weavers (*pannitextorum*, *lanificum*),[222] all the more so because in the 1st half of the 16th century they had their own guild

216 Szacherska 1973, p. 133. According to this scholar, the tanners' craft did not develop in Płock only because of "a mass export of raw hides from Poland and the lack of local material due to limited slaughter in Płock". However, Szacherska's explanation cannot be deemed convincing, because this situation may be considered as a consequence of natural conditions unfavourable for the tanners' craft. As a result, there might have been no demand for untreated hides in this town even before the crisis in the Hanseatic trade (in the 1420s) that brought about, inter alia, an increase in the above-mentioned export of hides.

217 Nowowiejski A.J., 1931, p. 134 and Szacherska S.M., 1973, p. 131.

218 Szacherska 1973, pp. 131–133.

219 Loc. cit.

220 Kiryk 1993b, p. 86.

221 Kiryk 1993a, p. 23.

222 It was not without hesitation that the present author assumed that the name *platea Laniatoria* referred to cloth weavers, because it might have been derived from the word *laniator*, i.e. 'butcher'; in that case, the interchangeable names of this street would mark the presence of these two professional groups in this *platea*.

(*fraternitas pannitextorum*).[223] The elders of that guild formed part of *communitas*, which had a say in decisions concerning important town matters.[224] The location of the street (it reached the Brama Rybacka [Fishermen's Gate]) indicates that weavers' work was organized in such a way as to facilitate the access to the riverside wetlands.

The above-mentioned disadvantages of being a river town shown in the example of Płock and Sandomierz were counterbalanced by advantages offered by big rivers. First of all, in favourable conditions concerning the rulers' policy on customs duty such towns became important river ports. Thanks to this function, the development of the centres and the wealth of its inhabitants were based on river transport and buying and selling goods. It also enabled service crafts connected with the life of the port to flourish. According to S.M. Szacherska's research, sources testify to a considerable activity of Płock merchants from the 1480s: in 1454 King Casimir IV Jagiellon granted them an exemption from a half of the payment of customs duty on the entire territory of the Kingdom.[225] When the merchant and marksmen's fraternity was established in 1489, its members monopolized (as opposed to non-members) not only floating grain and other goods, but also the overall trade connected with the Vistula in Płock (apart from salt trade, which was conducted exclusively by salt merchants).[226] Thanks to a favourable resolution of a years-long dispute over the enforcement of King Jan Olbracht's (John

223 Kiryk 1993b, p. 110.

224 E.g. in 1538 the elders of the cloth weavers' guild (*fraternitas pannitextorum*) took part in the *communitas*, besides the elders of the following guilds: butchers', shoemakers', furriers', and the elders of a collective guild of blacksmiths, rope-makers, locksmiths, wheelwrights, goldsmiths, saddlers and cartwrights – cf. AKS, rkps/MS 84, p. 176. More about the structure of the town authorities in Sandomierz, including the *communitas civium* – cf. Szczygieł 1993a, p. 52 et seq.

225 Szacherska (1973, p. 124) stated, inter alia, that only in 1483 merchants from Płock sold to a merchant from Frombork 300 lasts of rye, i.e. ca 657 tons (we can assume that 1 Gdańsk/Danzig last = 2190 kg – according to Kamler 1981a, pp. 446–447), loaded on 7.5–15 barges (the difference results from the fact that Marcin Kamler (1981c, pp. 363–364) wrote that a barge could carry "up to 40 lasts, but mostly 20 lasts"). We can fully appreciate how large this quantity was when we compare it with the average yearly amount of grain exported by merchants from Sandomierz during a period very favourable for them, i.e. in the years 1546–1576. This average amounted to slightly more than 100 lasts of grain – Kiryk 1993b, p. 131.

226 Szacherska 1973, p. 124.

Albert's) decree of 1498 abolishing the Toruń staple right,[227] namely in the form of two royal judgements of 1527 and 1537 (the first one concerning free navigation on the Vistula River for Płock, Sandomierz and Nieszawa, the other one abolishing the Toruń staple right[228]), also merchants from Płock conducting their business in relation to the river experienced their heyday. Having monopolized the town's trade, they also dominated the town authorities.[229] A study on social topography done by Maciej Trzeciecki showed that merchants occupied central places also in Płock town space, as they owned houses in the Market Square. The scholar pointed out that archaeological finds confirmed the theory about the most wealthy people having inhabited this area, because glass and stoneware vessels were excavated exclusively in the plots of land adjacent to the Market Square.[230]

In the case of Sandomierz (its location being analogous to Płock), one can infer from the oldest preserved Schoss register of 1552[231] that the richest Vistula grain merchants also owned houses in the Market Square, which was typical, like in the huge majority of towns, because the Market Square was perceived as a place of the highest economic importance and of the highest social value. Thanks to research carried out by F. Kiryk, which embraced all early modern archival records from Sandomierz, we know that this state of affairs also existed later. However, bearing in mind that the most important function of both Sandomierz and Płock was that of a port in long-distance trade, one could expect also other socio-topographical arrangements, similar to those identified for Elbląg and Toruń by Roman Czaja and Krzysztof Mikulski. In the first of the two above-mentioned centres, the streets of the highest social value were three streets connecting the centre with the port on the Elbląg River. Until the 1420s, i.e. before the crisis in the Hanseatic trade, these streets were dominated by the most wealthy merchants taking part in this trade. In Toruń, in addition to houses surrounding the Market Square, also brick dwelling houses in the main streets leading towards the Vistula and along the main communication routes were owned and inhabited by the richest merchants engaged in long-distance sea trade via the Vistula River. From the 2nd half of the 15th century, after the Hanseatic trade crisis, these houses were owned by middlemen in leather trade, and later by middlemen in grain trade

227 ZbPłock II, 1987, no. 271, pp. 9–11.
228 Szacherska 1973, p. 125; Samsonowicz H., 1981b, p. 501 and ZbPłock II, 1987, no. 422, pp. 219–221.
229 Szacherska 1973, pp. 125–126.
230 Trzeciecki 2000, pp. 122–123.
231 APS 13, pp. 1–17 and Kiryk 1993a, pp. 17–18.

between the Polish base and Gdańsk,[232] thus also connected with the port on the Vistula.

In the topography of both Elbląg[233] and the Old Town in Toruń, the parallel streets running at right angles to the port formed a "comb layout", typical of port towns.[234] In the case of port towns like Płock or Sandomierz it was the difference in the altitude between the town and the riverbank resulting from the height of the slope that prevented the development of a network of streets running towards the river; instead, passages to the Vistula were created where the natural features of the terrain enabled the descent. This resulted in the division between the town space and the port space. Especially in the town plan of mediaeval Płock (fig.11) there are no traces of an urban planning aimed at connecting the town with the Vistula River. This was caused by the fact that the town was situated on a precipitous slope; Tadeusz Kordala noted that "its relative height exceeds 40 meters in some places, and its inclination reaches 90°".[235] At the base of the slope below the castle hill[236] were the port,[237] the passage,[238] the harbour/harbours[239] and the fishing cluster. However, in the topography of mediaeval

232 Mikulski 1999, pp. 79 and 133. Cf. also: Fehring 1994, p. 192.

233 Czaja 1992, pp. 11–12, 14. The layout of this town was not shaped at once; the full development of the town took about 100 years from the time of its being chartered with Lűbeck law (in 1246) and the western border of the town was moved in the direction of the River Elbląg only in the year 1325. This, however, did not change the "comb layout", quite the opposite: as the streets running towards the River Elbląg were lengthened, the distance between the town and the river became shorter. This was motivated by the growing needs of the big trade that took place precisely between the Rivers Elbląg and Nogat, connecting the town through the Vistula Lagoon with the Baltic sea. About a similar phenomenon in other Hanseatic cities, also earlier, ca 1220 in Lűbeck, cf. Fehring 1994, p. 192.

234 Ostrowski 1996, pp. 180–182.

235 Kordala 1996, p. 86.

236 Żebrowski 1973, p. 65.

237 Trawkowski 1962, p. 736.

238 Kordala 1996, p. 90.

239 The harbour or harbours on the river changed their position, to which fact testifies e.g. the name "stara przystaynya [old harbour]" used in 1534 in sources from Płock (ZbPłock II, 1987, no. 392, p. 165) to describe the location of a garden that was being sold by the Płock *advocatus* to Jan Alansee, the burgomaster of Płock (apothecary of the Polish Queen Bona Sforza), situated within the town limits, on the riverbank. Considering the professional activity and business conducted by the Alansee family, requiring their travelling between Kraków and Płock, it is not impossible that this place still fulfilled the function of a harbour, this time of a private one.

Sandomierz *intra muros* (fig.12) existed a clear street layout that could be called: "from the agricultural hinterland to the port". Two parallel streets: Opatowska (Opatów Street) and Zawichojska (Zawichost Street) that in the space *intra muros* formed part of trade and communication routes,[240] crossed the Market Square, continued as Zamkowa (Castle) Street and Mariacka (St Mary's) Street, then joined together and became one arterial road between the collegiate church and the Castle which descended through the Brama Krakowska (Kraków Gate) down the slope to the riverbank: it was there that the life directly connected with the river was concentrated. This was the part of the Przedmieście Krakowskie on the Vistula river where a port was probably situated, judging from the presence of the majority of granaries.[241] From the east, this area was connected with the Przedmieście Rybaków (Rybitw) (Fishermen's Suburb) that stretched along the Vistula River.[242]

240 Morawski 1993, passim.

241 Kiryk 1993a, p. 27.

242 Kiryk 1993a, pp. 27–28. In 16th-century town books mentions of Fishermen's Suburb (Przedmieście Rybaków – *suburbium piscatorum*), inter alia, in: AKS, rkps/MS 85, folio 378, year 1559 r.; of *piscaria*: APS 6, pp. 159 v. and 164, year 1548; AKS, rkps/MS 91, p. 10v, year 1559. Cf. also: Atlas WojSandomierz 1993, no. 2.

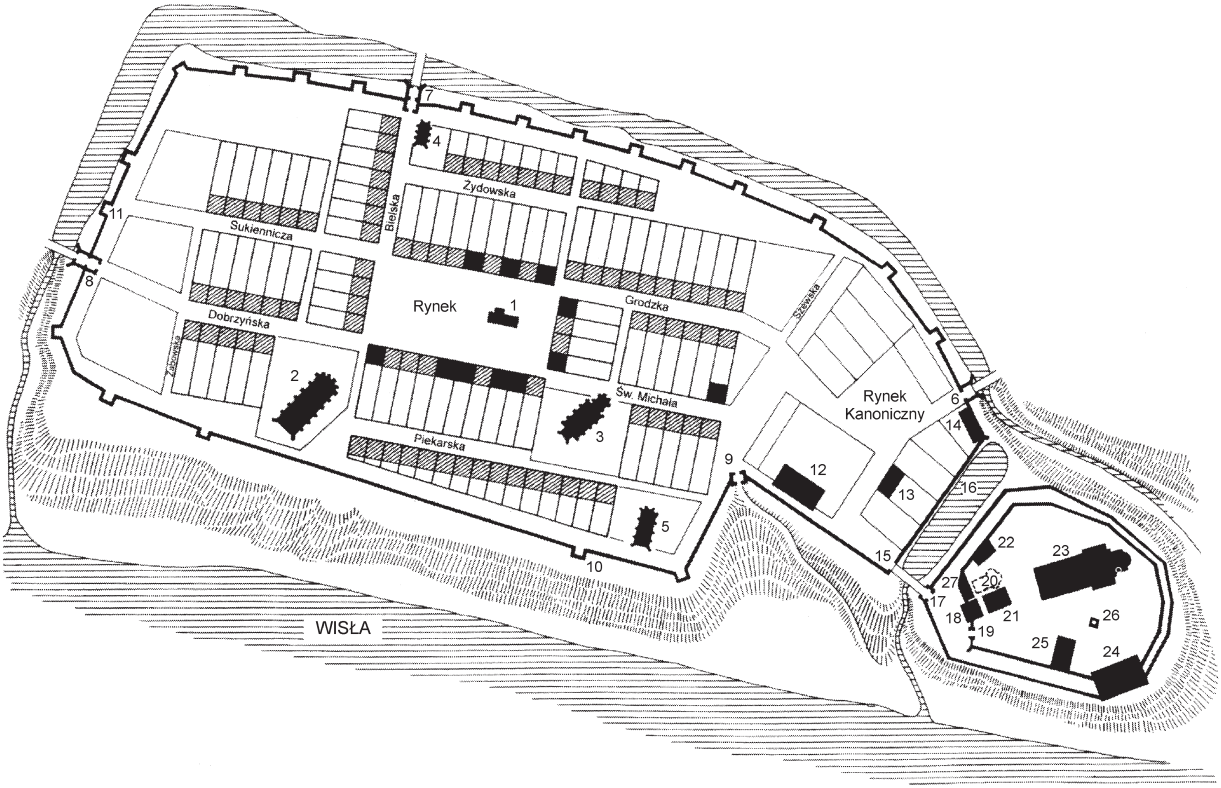

Fig. 11: Reconstruction of a 16th-century town plan of Płock, Polak 2000, p. 53.

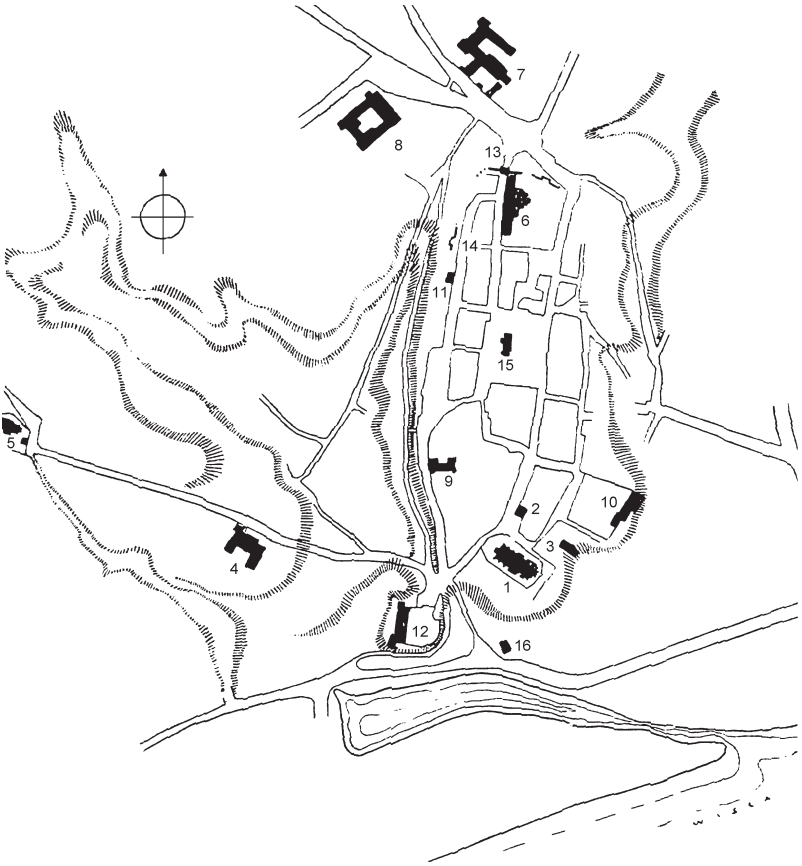

Fig. 12: Town plan of Sandomierz, after: Katalog Zabytków Sztuki w Polsce, *vol. III, no. 11, 1962, p. 52.*

Fishing clusters, like the ones in Płock and Sandomierz, constituted one of the most characteristic elements of the landscape in all river towns;[243] they were a

243 E.g. in Wrocław in the vicinity of the Furta Rybacka [Fishermen's Wicket] closing the end of Więzienna [Prison] Street were plots called "Pod Rybakami [Under Fishermen]" and Rybacka [Fishermen's] Street – Goliński 1999, p. 16. In Old Warsaw a house with a garden "in platea Piscatorum" was cited in 1520 as located "in suburbio in Piscatoria" – KsRadzStWarszawa, 1963, no. 640 (p. 184), 734 (p. 209) and 1351 (p. 400) These expressions used in reference to Warsaw were noted already by Suproniuk 1999, p. 125.

direct consequence of the rulers' wider economic policy aimed at strengthening the centres. Rulers, being the superior lords of waters and riverbanks,[244] conferred the right to use them. This right pertained to fishing,[245] to the above-mentioned river transport, to passages across rivers, as well as to the construction and the use of mills.[246] This right often appeared in foundation charters of the towns among the most important rules concerning the legal and economic organization of the centres. It had a different scope in different centres.

The most frequently encountered pieces of information refer to legal regulations concerning fishing in waters situated within the boundaries of a town or in its immediate vicinity.[247] In an in-depth analysis of the 1286 foundation charter of Sandomierz, Tadeusz Lalik noted that the privilege constituted a manifestation of the political activity of Prince Leszek II the Black, who aimed at "creating the strongest possible burghers' community actively supporting the ruler".[248] One of the most important decisions in this respect was granting the community the right to use the Vistula within one mile up and down the river. This – both for the town and for the *advocatus* – also meant the right to fish within this stretch of the river and gave rise to the establishment of the Rybitwy in Sandomierz.[249] The Rybitwy was a fishing cluster that, like in many other centres, consisted of professional fishermen, who were a link in the economic and tax structure of the town and of the country. A very similar situation existed in Kraków, by virtue of the 1257 foundation privilege: the permission given to the *advocati* to use the Vistula River from Zwierzyniec to the monastery in Mogiła was connected with the right to fish granted to the town and to the *advocati*.[250]

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244 E.g. in a regulation *De libertate in fluviis Regiis* dating from the year 1447 (*Volumina legum*, I, 1859, p. 69) the King was called the owner of all rivers in their beds: *Sane etsi flumina nostra Regni nostri Poloniae […] cum suis alveis Regia nostra sunt […]*. Retaining the ownership rights, the rulers still had control over waters.

245 Topolski 1957, p. 15; Russocki 1981b, p. 178 and id. 1981d, p. 224.

246 In the system of *regalia* they formed part of the water *regale* and the milling *regale* – cf. Russocki 1981b, p. 178.

247 It must be noted, however, that sometimes the right to catch fish was given only to *advocati* and for their private needs, as part of the estate and rights of the *advocatia*, as in the privilege of 1375 for Little Poland's town of Jarosław on San: PrzywilejJarosław, 1995, p. 27. In 1399 King Ladislaus Jagiellon granted the Biecz *advocatus* the right to fish in the River Ropa within the limits of the town of Biecz – cf. MatBiecz, 1914, no. 18, p. 5.

248 Lalik 1993, pp. 100–102.

249 Op. cit., p. 105.

250 Wyrozumski 1992, p. 168.

The scope of the granted right to fish differed depending on the town: from the right of free fishing, limited only by the place of the permitted fishing, to the right hedged around with conditions referring to the way and time of fishing. Apart from the two examples of Sandomierz and Kraków, it is worth mentioning (inter alia) that according to the 1365 foundation charter of Opoczno burghers were permitted free fishing in the Drzewica River and were allowed to dig fish pools;[251] a 1558 royal document confirming the old and granting new privileges for Sieradz included the right to fish for burghers in all rivers and streams within the town limits, without any payments or conditions.[252] One should also bear in mind that at least until the mid-15th century towns which had the right to fish also enjoyed the possibility of building weirs on navigable rivers that seriously hindered river transport and trade. The 1447 regulation *De libertate in fluviis Regiis* imposed the prohibition on building barriers on rivers in order to collect customs duty;[253] for that reason it was known as the regulation that started the process of making rivers navigable. However, it seemingly prohibited the construction of such weirs (yet it enabled net fishing), but at the same time it allowed leaving them in places where they "brought profit" (on condition that a passage

251 Kiryk 1994, p. 91. But also the Opoczno *advocatus* had the right to use this river, to build mills on it (including smithies) and to dig fish pools.

252 AGAD, parchment document no. 3888. It rather concerned fishing for private use, because sources confirm the existence of professional fishermen who were subject to restrictions and charges: in 1568 they were called "rybitwy z miasta [fishermen from the town]" who paid "wkupne do rzeki Warthy [a charge for using the River Warta]" amounting to a yearly average of 4 florins and 13 groschen (AGAD, ASK LVI, vol. III, S. 2, p. 9). There were probably two of them, judging from the mention dating from the following year: "Rÿbaczy doroczni trzei placzą fl. 6 [Three fishermen pay 6 florins yearly]" (AGAD, ASK XLVI, 103d, p. 104v.). The 1628–1632 inspection recorded fishermen who caught fish into the so-called bags, i.e. nets in the shape of a bag stretched on hoops, who paid the fish tax called "rybne" to the castle (12 people, 6 florins in total) – LustrWojWlk., 1969, p. 79. Also in other towns professional fishermen paid for using rivers, e.g. in Kazimierz near Kraków according to an inspection from the year 1569: ANK, IT 47, p. 61. An inspection conducted in Sanok between 1564 and 1565 revealed a difference in the legal status between professional fishermen and burghers catching fish: the former did not have the town's citizenship, which is why they had to pay for fishing, whereas burghers could fish without payment – LustrWojRus., 2001, p. 136.

253 Volumina legum, I, 1859, p. 69 – where the following rivers were listed: Vistula, Dnieper (Niepr), Styr, Narew, Warta, Dunajec, Wisłok, Bug, Brok (Bruki), Wieprz, Tyśmienica, San, Nida and Prosna, with the stipulation that it concerned all other rivers in the Kingdom (*et quaecunque alia in Regno nostro consistentia*).

would be made to allow ships to pass freely, i.e. free of charge).[254] The enigmatic character of this expression made the whole regulation less effective, as it was possible to evade this prohibition (e.g. by way of individual privileges?). This is why the ban was repeated throughout the next century.[255]

Restrictions on the way (and even time) of fishing that applied to towns should be analysed in the light of water ownership. A document of 1445 issued by the Prince of Mazovia and Płock, Ladislaus I, referred to the right of fishermen of the royal town of Płock to fish in the Vistula River only using small nets and rods[256] and explained the reasons of these restrictions. The full right to fish using large and small nets in the Vistula in Płock belonged to the bishopric.[257] This resulted from the fact that this stretch of the river had belonged to the bishopric for a long time and the Prince – as the patron of the Płock Church – reminded the burghers about this and reprimanded them for usurping the right to the Vistula. Apart from the restricted right to fish, they could use the water from the Vistula freely, in such a way, however, as to not to disturb the Bishop and canons.[258] The Prince, being the document issuer, demonstrated his right to the river as the sovereign

254 Volumina legum, vol. I, 1859, p. 69 : *Ubi tamen aliquem obstaculi delectat utilitas, portas cum illo latas faciat, quae transeuntibus liberum praebeant navigium.*

255 The ban was repeated in 1496, 1511, 1532 and 1550 – cf. Olejarczuk 1981, vol. I, p. 282.

256 ZbPłock I, 1975, no. 136, pp. 204–205: *quod piscatores nostre civitatis in predicto fluvio ecclesie parvis tamen retibus, videlicet zabrodna, ucleynicza, wyrsche et hamis wlgariter vąndy piscium, ac eciam cives nostri aque liberum habebunt usufructum absque episcopi et capituli pro tempore existencium impedimento […].*

257 Żebrowski 1973, pp. 89–90 – about a conflict between the town and the Bishop concerning the right to catch fish on the Vistula River. However, Żebrowski did not discuss the document of 1445, whose above-mentioned provisions were upheld in another document, i.e. in a sentence of a court of arbitration of 1490 (ZbPłock I, 1975, p. 347–349); from the latter document we can learn about the size of the fishery on the Vistula River that the burghers were entitled to: to the middle of the river from the shore outside the town to the little rivers called Brzeźnica and Ośnica which marked the town limits.

258 The context of the document indicates that this general expression referred to using water from the Vistula River for economic purposes (for production, e.g. tanning) rather than to drawing it for domestic needs, as the latter did not require permission, unless this was a document in which the Prince reminded everyone about the town's particular problems with water supply connected e.g. with the necessity of ensuring constant access to the Vistula River, as was shown in the example of the enterprise undertaken by Bishop E. Ciołek at the beginning of the 16th century (cf. above).

and kept for himself and his successors the passage, the collection of customs duties and the island opposite the castle.[259]

Let us quote another example of even more restrictive limits set to the way and time of fishing that indicated that water still belonged to the owner of the land on which it flowed. In a fragment of a foundation document of Little Poland's town of Dobczyce of 1362,[260] the King allowed the local burghers – showing them his grace – to fish for their own need "on a hook", i.e. using a rod, in the two rivers flowing around the town, namely in the Raba and the Smarkana rivers. However, they could do it only when the King was out of town. The King suspended the permission when he came to town, with the limitation coming into force as from one day before his arrival. Obviously, the source of such a regulation (also repeated elsewhere[261]) must be sought in the Carolingian *Capitulare de villis*, in its fragment referring to setting up fish ponds,[262] whereas its justification – in the limited quantity of fish in water reservoirs smaller than big rivers. The latter remark constitutes a good excuse to broaden the scope of the present dissertation beyond the role of a big river and its water and to present the impact of a whole watercourse network on the life of Polish towns at the turn of the Middle Ages and the Modern Times.

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259 Not going into detail of customs policy of riverside towns, we should mention that it constituted a manifestation of exercising control over waters. Among profits that towns reaped from close proximity of big rivers were charges (customs and tolls) for transporting people and goods. E.g. Sandomierz had the right to make the following charges: water (*aquaticum*), riverbank (*rippale*) and bridge (*pontale*), which were leased by patricians; also the charge made for the passage on the Vistula River (*navigium*) belonged to the town, but it was leased as well – cf., inter alia: APS 6, p. 16, for the year 1547.

260 AGZ 1872, vol. III, no. 12, pp. 29–31.

261 E.g. a temporary prohibition against fishing in waters belonging to the ruler/manager, during the period of his stay, in order to secure fresh fish to satisfy his needs, issued in 1393 by Witold (Vytautas), the Grand Duke of Lithuania, when he granted a mill and a pond near the town of Łuck to the Dominican friars. Witold made an additional stipulation that during his stay in Łuck fish from that pond be caught only for his needs (*ut dum in Lucko propria constituti fuerimus in persona et tempus seu locus vel hora se obtulerit oportunus tunc in prefata piscina piscandi nobis potestate reservamus*). This was repeated by King Sigismund I the Old – ADKr., Łc. 1., pp. 1 and 16. In 1509 he introduced a similar rule that referred to the Bishop Erazm Ciołek in relation to the ponds that were to be established next to the planned water-work (*Wasserkunst*) in Płock (ZbPłock II, 1987, no. 295, p. 44), which will be elaborated on later (cf. Part III.3. of the present work: "Water supply systems").

262 Capitulare de villis 1968, 65.

II.3 The town watercourse network: the functions of rivers, leats and moats in the spatial development of towns with particular reference to Kraków

This part will concern all natural watercourses or water reservoirs situated in the land belonging to a given town and artificial reservoirs established on their basis. In the majority of mediaeval centres in the Polish lands, in the light of the above-mentioned 13th-century process of moving town settlement away from large rivers, smaller watercourses played a more important role in the town economy than big ones. Even if they were connected with a large river (e.g. as its branches), it was more comfortable to draw water from small watercourses for domestic and production purposes, they also were used to build water systems that enabled the functioning of town production devices that decided about the economic development of the centre. The small river called Brzeźnica in Płock, described in sources as *torrens*, probably because of its fast flow, was not only one of the town limits, but it also was the watercourse on which all watermills working in Płock were situated,[263] including the town water-work (*Wasserkunst*).[264] The royal mill near the castle, and thus near the Vistula River, used a horse mill.[265] This sentence also applies to the castle mill in Sandomierz.[266] Only partially preserved Sandomierz sources allowed researchers to identify two watermills on the small River Koprzywianka.[267] As regards mills on the Vistula River in Sandomierz, F. Kiryk established that "not far from the castle, in the vicinity of meadows near the road to Kraków, existed a second functioning mill powered by the water from the Vistula; in 1525 the King gave it to the town."[268] However, this does not mean it functioned on the very River Vistula thus impairing its navigability. As the author of the present work noted in a 1991 study in which she described mills in Sieradz that were referred to in sources as located *in fluvio Wartha*, four most important mills were actually

263 Żebrowski 1973, p. 88. Cf. also: Szacherska 1973, p. 129. Out of three mills on the River Brzeźnica one belonged to the King, the other one to the provost of the parish church, and the third one to the Dominican friars.

264 ZbPłock II, 1987, no. 393, p. 168.

265 Żebrowski 1973, p. 88 and Szacherska 1973, p. 129. The existence of horse mills in water mills indicates that there were problems connected with supplying them with water, mainly temporary water shortages.

266 Kiryk 1993a, p. 28 and Szczygieł 1993b, p. 80.

267 Szczygieł 1993b, p. 81; Kiryk 1993b, p. 102.

268 Kiryk 1993a, pp. 28–29 and id. 1993b, p. 102.

situated on two leats carrying water from the Warta River.[269] Hence, the watermill on the Vistula in Sandomierz, especially in the early 16th century, could have also been located on a leat carrying water from the Vistula. Unfortunately, probably the scarcity of written sources hindered the recreation of the watercourse network,[270] including artificial watercourses, dug from the Vistula to serve the needs of mills. Such a situation could be probable, considering a mention in a foundation document of streams and small rivers flowing through fields given to the town on which the *advocatus* obtained the right to establish mills and ponds; moreover, the foundation programme included the right of the *advocatus* to establish four mills on the Vistula River with an unlimited number of waterwheels, but situated in designated places.[271] Leaving aside the question of the way in which the Sandomierz *advocatus*' mills were supplied with water, it is worth mentioning that in 1524 one of them (the only?), belonging at that time to the local patrician, Jan Baltazar, was badly damaged. This exposed Baltazar to losses, and therefore town councillors allowed him to build on the Vistula River at his expense two ship mills with two waterwheels (*duo Molendina in navibus cum duabus rothis aquaticis artificialiter constructa*) near the riverbank where an old brickyard stood.[272] If we assume that the mill (mills?) belonging to the *advocatus* worked on the Vistula, the mention quoted above proves a very good example of the evolution from building mills on big rivers to establishing ship mills[273] (fig. 13) being one of the ways of making rivers navigable, which process in the Polish lands was going on at that time.

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269 Sowina 1991b, pp. 45–46 – in written sources from Sieradz these leats were called *flumen brasealis* (because a malt mill and two other mills stood on this leat) and *flumen advocatialis* (as it supplied water to a mill that was owned by the *advocatus*).

270 Atlas WojSandomierz, 1993, no. 2. However, while describing the water conditions of Sandomierz, Andrzej Buko (1993, p. 11) pointed to numerous springs and streams flowing down along ravines from the uplands towards the Vistula River.

271 Dembińska 1973, p. 123; Lalik 1993, p. 105.

272 AKS rkps/MS 84, pp. 105–106.

273 More about placing ship mills mainly on rivers which were important in terms of communication, due to the possibility of moving such mills on the rivers, mooring them to riverbanks or even removing them for the winter; about a ship mill belonging to the Dominican friars from Sandomierz, mentioned in documents dating from the years 1286–1289 as the oldest one known in the Polish lands (KodMp., vol. 1, no 112 and ZDM, part VI, no. 1828, p. 446; cf also. Mazur 1969, pp. 609–610) and about ship mills in Paris on the River Seine – cf. Dembińska 1973, pp. 122–125, where also references to research conducted by M. Frančić (1954, pp. 90–91) and H. Samsonowicz (1954). As far as the earliest, 13th-century mentions of ship mills in the Polish lands are concerned, apart from the Dominican ship mill in Sandomierz, which existed *ab antiquo* (this was

Fig. 13: Ship mill on the Danube in 15th-century Regensburg. A barge with goods can be seen on the river. After: H. Schedel, Liber cronicarum ("Buch der Croniken", "Schedelsche Weltchronik", "Nürnberger Chronik"), Nuremberg 1493, after: Gräf 2006.

noted not only by Dembińska 1973, p. 123, but also by Lalik 1993, p. 105.), we can quote Prince Konrad's privilege of 1263 granting the Głogów *advocatia* to the *advocatus* Fryderyk, on the strength of which among his rights was the permission to build two ship mills with four wheels on the Odra River and to use them free of charge (*Insuper damus ei facultatem construendi super Oderam duo molendina libera super naves cum quattuor rotis*) – quoted from: Czerner/Lasota 1994, p. 64 (after: *Schlesisches Urkundenbuch*, Bd. 3. W. Irgang (ed.). Köln-Wien 1984, no. 462). These ship mills are not shown on a reconstruction of a map "Głogów ca the year 1300", according to M. Kutzner, presented by Jerzy Piekalski (1999, p. 151); the only ship mill marked on that map is the prince's mill. For the sake of comparison, the following works can be mentioned: Kranz 1994, p. 53; Suttor 2003, p. 60 et seq.; Sabján 2005, p. 242–250. The most recent work devoted to ship mills in Europe: Gräf 2006, who presented them according to European rivers on which they were situated and divided them into three construction types. Unfortunately, this work does not refer to the above-mentioned Polish studies and the ship mills in question have not been marked on the map of the Polish lands.

While analysing the way in which mills situated in towns were supplied with water, we can appreciate the fundamental role of all kinds of smaller watercourses in the establishment and the proper functioning of water installations, indispensable for the functioning of the mills themselves. The watercourse network of mediaeval Kraków[274] is a very good example of the role of such smaller watercourses (fig. 14).

Fig. 14: The watercourse network of mediaeval Kraków. Reconstruction: Bąkowski 1902, p. 149.

274 About the water network of early-mediaeval and mediaeval Kraków cf., inter alia: Łuszczkiewicz 1899, pp. 1–28, Bąkowski 1902, pp. 138–172, Mitkowski 1957, pp. 39–65, Radwański 1975, chapters I–III and Wyrozumski 1992, pp. 14–22, with a presentation and a summary of all the earlier concepts. Cf. also Krasnowolski 2004, part I, chapter V, pp. 86–135, especially pp. 92 and 128–135, where he presented the leats of the River Rudawa. The author of the present work does not intend to make a new attempt to reconstruct the entire Kraków water network or the changes in the course of the Vistula's main riverbed caused mainly by floods; she decided to focus (referring to existing opinions) on the role of this network in the life of late-mediaeval Kraków in which the River Rudawa and its branches played the most important function.

As Stanisław Trawkowski[275] noted many years ago, in the foundation charter conferring the right to use the rivers Prądnik and Vistula for economic purposes within the stretch from Zwierzyniec to the limits of the monastery in Mogiła on the town and the *advocati* there were no mentions of the existence of mills on the Vistula, whereas is contained mentions of at least six existing mills on the Prądnik. Trawkowski had no doubts that mills must have existed also on the Rudawa River, not mentioned in the charter. A research study made by Bogusław Krasnowolski suggests a new way to recreate the flow of the River Rudawa, or rather of its leats branching off from it: the "Norbertine", established in 1254 in connection with the construction of a watermill, later called "Granowski", and the "Royal", according to Krasnowolski, dug ca 1286 from Mydlniki in the scope of the programme of fortifying Kraków started by Leszek II the Black in 1285.[276] The latter leat, consistently called Rudawa in written sources, in Krasnowolski's opinion, was built mainly to fill the Kraków moats with water.[277] It became the most important watercourse in the economic life of the town. In late Middle Ages it powered the royal mill that from 1335 was called Bieniasz's Mill, and from 1471 – the Kamienny (Stone) Watermill.[278] According to inspections of 1564 and 1569, the latter mill had 10 overshot wheels: four for malt, three for flour, two for fulling (setting in motion stamps fulling hides) and one setting cloth stamps in motion.[279] Thanks to the leat in question also a nearby "Dębny" oak bark mill could function.[280] It had one waterwheel and shredded oak bark necessary for tanners. Tanners concentrated their activity on this watercourse[281]: this leat and the immediate proximity of the two above-mentioned mills (working also for the tanners' needs) created the best working conditions for them. Like tanners from Paris and as opposed to tanners from Wrocław, tanners from Kraków had direct access to running water from their plots. The same functional and spatial solutions were chosen by tanners from Poznań.[282] In the light of what the author has written in the present study about the role of water in the work of tanners, she is convinced that the establishment of

275 Trawkowski 1959a, no. 1, p. 63.
276 Krasnowolski 2004, part I, pp. 128–135.
277 Op. cit., pp. 132 and 134.
278 Op. cit., p. 131.
279 LustrWojKr., part I, 1962, p. 13, year 1564. ANK, IT 47, p. 47, year 1569.
280 Krasnowolski 2004, part I, p. 128 and 131. Cf. also DokZiemKr., 1971, no. 188, p. 205, year 1438 and ANK, IT 47, p. 48, year 1569.
281 Pieradzka 1931, passim; Wiśniewski 1986a, p. 693 and 698.
282 Wiesiołowski 1982, pp. 271–272.

both the Kraków and the Poznań Garbary (Tanners' District) as separate suburbs should not be looked at as a process of removing crafts that caused nuisance to the inhabitants (tanning was undeniably one of them) away from towns or town centres.[283] It should be treated as one way of tanners' choosing their place in the space of mediaeval towns: it was always connected with permanent and (ideally) direct proximity to running water.[284] As was shown in J. Wiesiołowski's socio-topographical studies of the Poznań Garbary, the situation of the local tanners' workshops was much comfortable than the one of the workshops functioning *intra muros*, because each tanner's plot had access to water and large plots contained all devices needed in the production process (tanning pits,[285] vats etc.) as well as (mostly) the tanners' houses.[286]

In this context, Przemysław Tyszka's pointing to a functional connection between the Garbary in Kraków and Szewska (Shoemakers') Street[287] should be considered as valuable, especially so if we assume that the Latin name of Shoemakers' Street – *platea sutorum* – could have derived from the uni-professional cluster of leather craftsmen (*sutores*) existing in the 14th century, still unspecialized, dealing with the whole production process of transforming hides into a ready product, including tanning (as was the case also later in smaller centres[288]). If this was the case, then the formation of the Kraków Garbary at the end of the

283 This opinion, encountered in the Polish literature referring to the Middle Ages, reminds one rather of L.B. Alberti's instructions from the modern period: "Anything foul or offensive (especially the stinking tanners) should be kept well away in the outskirts" (Alberti, 1988, p. 192). This excerpt from Alberti's treatise was quoted by Jacques Delumeau (1987, p. 230), who associated it with Renaissance hygiene requirements, but failed to notice the role of water for these crafts.

284 Another and by no means less interesting solution was the one adopted in the case of tanners in Toruń. It was for them – and also to create the possibility to build the castle mills – that the riverbed of the river called Struga Toruńska was diverted – Mikulski 1999, p. 37. Hence the concentration of tanners inside the walls of the New Town observed in 1455 and deemed "some sort of a sensation" (op. cit., p. 251), which does not seem correct in the light of the above-mentioned examples from other towns, including mainly Rouen, Paris and Wrocław.

285 About tanning pits with casings resembling a well in the Kraków Garbary – KsWiertelKraków, 1997, no. 69, year 1570, p. 125.

286 Wiesiołowski 1982, pp. 271–272.

287 Tyszka 1999, p. 106.

288 Poppe 1978b, p. 142 (Biecz), KsRadzStWarszawa, 1963, no. 1412, p. 421 (Warszawa), Sowina 1991a, p. 17–18 (Sieradz). Cf. also Sowina 2003, p. 244.

Szewska Street (*platea sutorum*) and beyond as a professionally unified suburb would testify to the increasing specialization in the Kraków leather craft manifested in the separation of tanners' craft in parallel with the maintenance of the spatial connection with the rest of the leather craftsmen (including shoemakers) engaged in further stages of production.

There exists one more premise that such a location of tanners' workshops like in the Kraków Garbary resulted not from their being removed away from the centre due to their being a nuisance to the inhabitants and to the environment, but from their being situated in the best possible place for them: the town waterwork (*Wasserkunst*), i.e. the water intake for the town water supply system, was created ca 1399[289] on the same Royal leat, at a small distance down the leat from where tanners worked.

As far as the rest of this watercourse is concerned, it is unanimously stated in literature that water from this branch of the Rudawa River flowed around the town, filling its moat. However, it is hard to accept the categorical tone of B. Krasnowolski's remark that the 1286 document issued by Prince Leszek II the Black did not concern directly the digging of the leat to the monastery, but it only allowed using it to cater to the needs of the monastery. Krasnowolski based this conclusion on the coincidence of the date of the privilege and the source mentions of 1285 concerning the fortification of the town; he rejected the opinion that the leat carrying water from the River Rudawa from Mydlniki was created for the sole purpose of supplying the monastery with water.[290] However, some fragments of the document point to a greater role of the Dominican friars in the construction of this watercourse ca 8–10 km long.[291] One of these fragments was already analysed by Klemens Bąkowski,[292] who noticed that Prince Leszek II the Black formally conferred on the Dominicans the right to water they had conducted before (*prius*) from the Rudawa and on the strength of this document he allowed them to conduct water for ever to the monastery through the territory of Krowodrza, belonging at that time to the

289 Ligęza 1971, p. 29.

290 Krasnowolski 2004, part I, p. 132. Such a conclusion conflicts with a phenomenon encountered in mediaeval Europe as early as from the 8th century: it were precisely monasteries that made every endeavour to have the most convenient way of obtaining water (cf., inter alia, examples from Flanders from the 13th century – Deligne 1998, pp. 22, 90 et seq.). More on this subject: Part III.3. of the present work: "Water supply systems".

291 KDKK, I, 1874, no. 86, p. 118–119 and copy in: ADKr, LibAnt., p. 144–145v. and Prothocollon, p. 3–3v. and ADKr. 449, no. 1.

292 Bąkowski 1902, p. 159.

Order of the Holy Ghost whose members accepted the regulation (*Nos Lesko… tradimus aquam quam prius de rudawa fluuio in suam eandem duxerant domum*). The further part of the document also indicates that it was a technical undertaking of the mendicants. The Prince stated that his donation to the benefit of the friars was made for God and for the salvation of his soul,[293] and he categorically criticised anybody who would hamper the Dominicans in their action of drawing water, as *Comes* Grzegorz Żegocic, the landlord of Balice near Mydlniki had done. Żegocic betrayed the Prince and for this treason he lost not only his land and property, but also his life. This concerned the events of 1285, namely the armed rebellion of the nobility and the attempt to put Prince Konrad II of Masovia on the Kraków throne.[294] In the discussed document, Prince Leszek II the Black underlined that he had punished Grzegorz making use of his superior right and granted the Dominicans an irrevocable formal permission to perpetually draw water from the Rudawa River from the village of Mydlniki (*unde nos tamque legittimus dux et princeps dominus et heres bonorum omnium predictorum prefatam aquam donamus perpetuo et irrevocabiliter fratribus memoratis ut ipsam sufficientem pro suis necessitatibus et Commodis de dicto fluuio Rudawa de Midlniki ducant et habeant ac possideant semper libere et quiete*). The language of the document served not so much to show the importance of the enterprise, but to underline the strength of the Prince's decision as the rightful, unquestionable ruler of the territory, including the river (the Prince imposed a fine of 100 marks of silver for violating his decision). The Prince's decision sanctioned the state of affairs that had existed since at least the previous year: the Dominicans built the leat at the time when Żegocic (the landlord hostile toward them) was alive. This formal conferral of perpetual rights gave the friars a sense of security in terms of providing water for the monastery, most probably for the mill functioning within its limits (*in utero*);[295] this way the Prince wanted to thank them for their faithful service, including the events of 1285.[296] The Prince showed his gratitude also to the German patriciate of Kraków:

293 Granting water was thus an expression of charity towards neighbours: the highest form of piety done for the sake of one's eternal salvation – cf. Squatriti 1998, p. 12 et seq. and part III.3. of the present work: "Water supply systems".

294 Samsonowicz H., 1984, p. 200; Żmudzki 2000, pp. 401–419.

295 Długosz J., 1864, p. 454: *item notandum, quod per monasterium Sanctae Trinitatis in Cracovia fluebat fluvius Rudawa, et habebat dictus fluvius, notabile in se Molendinum in utero monasterii, et erat Molendinum illud fruiferum, et multa Monasterio afferetis emolumenta.* Quoted also in: ADKr., Protocollon, p. 84.

296 Żmudzki 2000, pp. 275–284 and 440–441.

after having quelled the rebellion of the knights, i.e. in August 1285 at the earliest,[297] he began the project of fortifying Kraków, probably together with the burghers, thanking them this way for their loyalty during the rebellion.[298] Water needed for the moat (that accompanied wooden fortifications) could only be drawn from the existing "Dominican" leat. To the fact that the discussed watercourse originally led to the monastery and catered for its needs testify later documents, namely a sentence of the Court of Arbitration of 1395 headed by Piotr, the Bishop of Kraków,[299] concerning the settlement of a conflict between the Dominicans and the councillors and an agreement between these parties entered into in 1454 with the help of the Bishop Zbigniew Oleśnicki acting as the arbitrator.[300] The above source materials are supplemented with the Dominican description of the conflict reaching 1612.[301] In the sentence of 1395 among several litigations concerning the possibility and the way in which the Dominicans used the space belonging to the town there was a decision referring to directing water "from Bieniasz's mill – from the main intake of Rudawa behind the town walls, up to the monastery, entering the monastery through the gate adjacent to St Mary's Church school, near the newly built public well". The rest of the document leaves no doubts as to the fact that it concerns Leszek's II the Black privilege ensuring the supply of water to the monastery.[302] In the topography of the town at the end of the 14th century the water, having crossed the town walls near the hospital and monastery of the Holy Ghost, was to be led in an underground brick canal along the Holy Cross Street, or "some other way" which would suit both parties to the arbitration. The town councillors were to contribute to the construction of this watercourse, and – apart from the 12 marks they had given to the Dominicans for this purpose[303] – they were to give the friars "two kilnfuls", i.e. 24 thousand bricks (fired in two kilns). The Dominicans did not carry out this solution (perhaps due to technical reasons) and they did

297 Jurek 2001, p. 254.

298 Wyrozumski 1992, pp. 183–184; Żmudzki 2000, pp. 420–422; Rajman 2004, p. 206.

299 KDMK I, 1879, no. 81, pp. 109–111. A copy of this sentence also in the documents of the Dominican Monastery – cf. ADKr., K.1 (LibAnt.), pp. 129v.–130 and Protocollon, p. 87.

300 KDMK I, no. 157, pp. 222–223 and: ADKr., Prothocollon, pp. 5–6.

301 ADKr., Prothocollon, pp. 5–6.

302 KDMK I, 1879, no. 81, p. 110: *Quemquidem aqueductum Prior et Conuentus predicti, qui pro tempore fuerint, habere debebunt cum omnibus eisdem Iuribus, que ipsis per Serenissimum Principem dominum Lestkonem diue memorie olym ducem Cracoviensem, literis suis Priuilegialibus sunt concessa.*

303 This was also recorded in town accounts from the year 1395 – cf. ANK, rkps. MS 1589, p. 18. The money was paid to the friars in Kraków denarii.

not build the canal in question.[304] In 1454 the friars asked for an underground branch that would connect the town water network with the monastery; in return for this connection and for compensation from the town in the amount of 10 marks, according to the sentence of the court of arbitration headed by Zbigniew Oleśnicki, the friars relinquished forever the privilege granted them by Leszek II the Black.[305] In the 17th-century monastic records there is a distinction between "the old water granted by Leszek" and "the new water", drawn from the town water supply system.[306] Leaving the topic of "new water" for further discussion, let us focus on the mentions of "the old water" found in the discussed documents. The author of *Prothocollon*, Arnulf Presinus, master of theology, noted that after the arbitration of Piotr, the Bishop of Kraków, in 1395, "having taken 12 marks from the Kraków councillors, the Fathers Dominicans were to conduct the old water, i.e. the one they had been granted by Leszek, to the monastery; however, they did not conduct the water *ad usum*, although they had taken the 12 marks, and just like 100 years before, they did not have (*sine usu*) the old water to use 59 years later."[307] At the beginning of the book Presinus mentioned that the River Rudawa was taken away from the monastery at some point during the 83 years following the year 1223 in which the Dominicans came to Kraków [*sic*].[308] Therefore, the leat ceased to be used between 1295 and 1306. This is obviously an approximation, but it coincides with the period to which the brick and stone fortifications encircling Kraków are dated.[309] If we base our conclusions on the above-mentioned records, we will find that water from the village of Mydlniki flowed to the monastery only for about 20 years, starting from the construction of the leat before 3 August 1285. It was also only during this period that a mill functioned within the monastery,[310] presumably the first reason for building this watercourse. The construction of the above-mentioned fortifications that encircled the town in its mediaeval shape was connected with extending the city by incorporating lands in the vicinity of the Churches of the Holy Ghost and of the Holy Cross up to the Dominican monastery: these lands

304 This was how this was remembered in the Monastery in the 17th century – cf. ADKr., Prothocollon, p. 6.
305 KDMK I, no. 157, pp. 222–223 and ADKr., Prothocollon, p. 5.
306 ADKr., Prothocollon, pp. 110v–111.
307 Op. cit., p. 110v.
308 Op. cit., p. 3v.
309 Rajman 2004, p. 206.
310 In 1525 the Kraków Dominicans had their mill in the village Prądnik– MRPS IV/1, 1910, no. 4834.

were probably acquired by Wenceslaus II from the Bishop of Kraków Jan Muskata.[311] If we assume that the course of the water flowing to the monastery described in the document of 1395 was the same as the course of the 13th-century leat flowing to the monastery, we can infer that it was this watercourse that flowed where later the Holy Cross Street was, at the same time playing the role of the first town moat. After the town had been extended and the stone wall had been built, the necessity to cross it was a sufficient technical obstacle for the further functioning of the stretch of the Rudawa-leat. The construction of the stone and brick fortifications of Kraków left the Dominicans only with the right to draw water to their monastery; there were no technical possibilities for this part of the leat to function and neither the rulers nor the town authorities showed any signs of cooperation in this respect. From that time on, the stretch of the Rudawa-leat situated *extra muros*, used to the construction of a new moat and to large-scale water-works in the early 14th century, was to serve only the town needs. One hundred years after being cut off from their leat, the friars stood up for their right. Despite its being recognised in 1395, also this time left to their own resources, the Dominicans did not manage to cope with the task, even though it did not envisage the functioning of the mill and all its necessary water installations, but consisted only in providing for the everyday needs of the friars.

As regards the moat surrounding mediaeval Kraków, according to B. Krasnowolski's findings,[312] it consisted of water from the above-mentioned Rudawa-leat, encircling the town from the north and east, and of a watercourse branching off from it near the north-western stretch of the town fortifications, thus forming part of the west and the south line of these fortifications;[313] when these watercourses reached the south-eastern part of the fortifications, they joined and flowed into the Vistula River. This reconstruction that constitutes a repetition of K. Bąkowski's findings[314] to a considerable extent clearly lacks any reference to the results of archaeological research carried out by the team headed by Kazimierz

311 Wyrozumski 1992, p. 185 and after him: Krasnowolski 2004, part I, p. 108.

312 Krasnowolski 2004, part I, p. 131.

313 For that reason in written sources the two watercourses were called "Rudawa", like the one from Mydlniki which supplied water to the monastery. About the moat on the western side of the town – cf. Acta Tomiciana, vol. XV, 1957, no. 301, pp. 414–415, year 1533: *fluvium Rudawa*; about the moat-leat on the northern and eastern side of the town – KDMK, I, 1879, p. 235: *usum aque nostre de Rippa seu fluvio Rudawa, que in fossato retro Ecclesiam Sancti Nicolai extra muros Cracovienses fluit*. Cf. also: Sowina 1996, p. 223.

314 Bąkowski 1902, p. 145.

Radwański, which is why this reconstruction is too general, at least as far as moats of mediaeval Kraków are concerned. The excavations brought fragmentary, but valuable information allowing to specify the look of the stretch of water belonging to the strongest, north-eastern part of the fortifications that in the late 15th century was further strengthened with the Barbican. What was discovered in this 130-meter long stretch, were two parallel moats.[315] These excavations showed that the "line of water" consisted of the main, inner moat (called Stara Fosa/the Old Moat) ca 28 m wide in its widest upper part, and of the outer moat from 14.2 to 17.5 m wide.[316] When we add to the above values 10–12 meters, i.e. the distance between the two moats,[317] we obtain the total width of the "line of water", at least in this part of the Kraków fortifications, equalling from ca 52.2 to 57.5 m (the total width of the two lines of water being from 42.2 to 45.5 m). The moats were 4–5 m deep.[318] It is worth noting that these dimensions were very similar to the Wrocław Czarna Oława, and the total width of the two Kraków moats together with the stretch of land that divided them was even greater than the width of the Oława-moat. The Wrocław and the Kraków "lines of water" differed in structure, which probably resulted from the differences in the technique of building moats. Like over the Wrocław river-moat, also in Kraków bridges were thrown across moats. The above-mentioned excavations revealed that before the Barbican had been constructed there existed a tower closing the elongated neck of the Floriańska gate and a bridge behind it,[319] and therefore over the moat. Underneath the remains of the walls of the neck connecting the Floriańska gate with the Barbican (and therefore dating from before the construction of the Barbican) the archaeologists excavated two subsequently functioning bridges over the so-called Old Moat: the earlier one made of stone and the Gothic one made of brick. The Barbican revealed itself to be one of the most innovative solutions from the area of the art of fortifying towns in Europe of the late 15th century. *Inter alia* two moats were discovered: the narrower, inner moat and the moat of the front of the Barbican 26 meters wide (thus matching the width of the main town moat within the same stretch). The wider moat was lined with limestone and sandstone up to where "high water" could reach and with brick above this level.[320]

315 Radwański 1986, pp. 53–54 and id. 1995, p. 27 (also on the basis of Emil Zaitz's rescue excavations).
316 Radwański 1986, p. 53.
317 Loc. cit.
318 Radwański 1986, p. 53, referred to in: Rajman 2004, p. 206.
319 Radwański 1995, p. 27.
320 Radwański 1986, pp. 34 and 36 and id. 1995, p. 27.

In the neck of the Barbican the team excavated the remains of a bridge with two arches of the culvert, a chamber of the trapdoor of a drawbridge, remnants of water lock devices and walls of the barrier dividing the two moats and culverts inside it.[321] In the light of the excavation findings described above, one can assume that the Kraków moats also played the role of transport routes for heavy or large goods and materials, also transported in great quantities. One can thus speculate that it might have been the Rudawa-moat that in the spring of 1466[322] served to deliver three times threescore, i.e. 180 pieces of timber (*tres capetias roborum*) for the roofing of All Saints Church, including 17 transverse beams, half an ell wide (0.293 m) and 31 ells long (18.17 m) each; 30 joists of the same width and 30 ells long (17.58 m) each, 6 posts 26 ells long (15.24 m) each, as well as the necessary wall plates and beams connecting rafters. The timber was to arrive on the construction site, near the Church, already joined and arranged, which task belonged to the duties of the supplier, who was supposed to deliver the timber at his own expense, under penalty of excommunication and a fine of 24 marks, the equivalent of his whole remuneration.

Although K. Radwański made a chronological connection between the creation of the watercourse he called "the outer moat" and the water system of the Barbican,[323] one cannot exclude the possibility that a two lines of moats existed earlier, at least in some parts of the fortifications. For example the royal privilege of 1401[324] allowing Kraków burghers to dig a new moat from St Nicolaus' Gate to the Grodzka Gate could have concerned the construction of the second waterway

321 Radwański 1986, pp. 39–40 and id. 1995, p. 27.

322 CA Suppl., 2000, no. 61, p. 45. A contract entered into at the end of November 1465 was to be completed by Easter of 1466 (i.e. by 6 April), or by the beginning of the spring timber floating down the Vistula River. The latter date might suggest that the timber in question was transported on water (due to its weight: one beam weighed – converted into metric system – several hundred kilograms). It results from the 16th-century inspections of the Royal domain under the management of the governors of Kraków that even Nieciecza, a lazy branch of the River Rudawa, was used to float timber that had been transported on the Vistula River – LustrWojKr., part I, 1962, p. 7, year 1564 and ANK, IT 47, p. 22.

323 Radwański 1986, p. 55.

324 KDMK, part I, 1879, no. 98, p. 138: *concedimus Nowa fossata erigendi et fodiendi incipiendo ab extra a walwa sancti Nicolai vsque ad walwam sub Castro Cracoviensi, qua itur Kazimiriam, situatam, que fossata aquis et decursibus aquarum iuxta industriam ipsorum sine dispendijs nostris et alienis ipsis licitum erit adimplere et Piscinas pro vtilitate eiusdem Ciuitatis in ipsis facere, Quarum piscaturas pro ipsis et vtilitate eiusdem Ciuitatis Cracouiensis adiungimus perpetuis temporibus duraturas.*

in this area, if we assume that the Rudawa-moat had already flowed also along the eastern limits of the town.[325] A double wreath of watercourses existed in Kraków undoubtedly in 1533, as evidenced by a document issued by King Sigismund I dating from the same year, concerning moats requiring repair that surrounded the town walls: *pro restauratione municioneque ac fortificatione fossatorum, circumcirca muros illius (civitatis)*.[326] The town received the King's permission to build canals near St Nicolaus' Gate, close to the royal watermill Kutlowski, in the most convenient place. These canals were to be placed in such a way as to allow water from the River Rudawa to flow freely (*libere*) to the moat adjacent to the town walls, however, without causing detriment to the mill in question. In the same privilege the town obtained the King's consent also to construct an underground sewer under the River Rudawa *de fossa seu piscina*, located near the Wiślna Gate. Thanks to this sewer this *fossa* (*fossatum*) was to be cleaned and the sewage was to be carried to Zwierzyniec. Owing to terminological differences between *fossa seu piscina* and *fossata murorum circumcirca muros* as well as due to a clear division of instructions referring to them in one document there is no sufficient evidence to identify the *fossa* with the town moat on the western side of the town and therefore to assume that a double wreath of watercourses also existed there at that time. Nevertheless, one cannot reject this possibility, considering that in 1533 *fossa seu piscina* was the water of a branch of the Rudawa called Nieciecza,[327] whose water was directed in 1506 precisely to this part of the town fortifications in the scope of their renovation.[328] Together with the *fossa*/Nieciecza the town acquired all water flowing from it as well as ponds and pools existing in it in the Kraków space *extra muros*, in the town meadows called Błonie in the direction of Zwierzyniec (*fluvium predictum Nyeczecza cum aquis, Gurgitibus ex eo defluentibus, cum piscinis in eo existentibus, in anteurbio Cracoviensi versus ferale per viccum Civilem alias Blonye*), until that time belonging to the royal fish stores[329] and excluded from them from then on.

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325 Rajman 2004, p. 225; Krasnowolski 2004, part I, p. 134.

326 PrawaPrzywilejeKraków 1885, no. 752, pp. 919–920.

327 In written sources the word "Nieciecza" was used to refer to artificial watercourses in which water flowed very slowly or even reservoirs through which water flowed or was "passed". For that reason the following words were used as synonyms of "Nieciecza": *lacus*, *piscina*. *Cf. Bąkowski 1902, p. 147, footnote 5, where, inter alia, source citations: "Nieciecza sive lacus", "piscina vulgariter Nieciecza"*.

328 KDMK I, no. 232, pp. 336–337.

329 *Custodia piscium* was a complex of pools in this area (on Nieciecze, i.e. several lazy branches of the River Rudawa) used for storing fish which were to be sold in a fish market in Kraków – Kutrzeba 1900a, p. 51 and Pieradzka 1931, pp. 56–59.

The privilege of 1401 was granted in relation to the strengthening and repairing town moats that constituted an element of fortifications. However, as transpires from the document, the new moat was equally meant to become the watercourse on which town fish ponds and pools would be established and in which fish would be bred and caught for the benefit of the town. Hence, there emerged a new and equally important role of moats, namely as reservoirs in which fish were bred. In the Kraków agglomeration this statement can be referred also to the moat of the town of Kazimierz. According to a document of 1422, King Ladislaus Jagiellon,[330] concerned about the improvement of the centre's condition, gave his consent to the creation of a moat that would encircle the town, so that Kazimierz – strengthened in that way – could defend itself more efficiently, be less afraid of being attacked by enemies, ignore their threats and insults, and be able to stop them. The height, width, depth and size of the moat were to be the most convenient and suit the needs of the town in terms of its fortification and technical possibilities (the scope of the works and later: the necessary works to keep the moat in good condition). Archaeological research revealed the dimensions to be 11.5–13 m in width and ca 3.5 m in depth.[331] Despite the dramatic tone about the need to build the moat as a defensive measure against the attacking enemy, in the remaining part of the document the King underlined that at the same time he granted the burghers and the inhabitants of Kazimierz a perpetual and unlimited right to stock the moats with fish and to breed and catch any kind of fish in these watercourses. The royal privilege of 1430[332] granted the burghers of Kazimierz the right to freely catch and make use of fish only in the part of the moat that was called Nieciecza and flowed along the town walls from the weir behind St Stanislaus Church up to the Vistula; in return, burghers were to repair the town walls and the stretch of the moat in question.

A slightly different combination of the functions presented above was revealed in King Ladislaus Jagiellon's document of 1422 concerning the reclamation of swampy suburban lands along the western line of Kraków fortification.[333] "As Our town of Kraków occupies the most important place among other centres in terms of the greatness of things and the number of inhabitants, willing to improve its

330 ANK, dok. perg./parchment document no. 175; KDMK, part I, 1879, no. 119, pp. 173.

331 Radwański 1995, p. 28.

332 KDMK, I, 1879, no. 127, p. 188.

333 These fortifications used the escarpments and the faults in the edge of the middle terrace, beyond which lay highly watered and swampy grounds of the flood terrace – Radwański 1986, p. 6.

conditions and to contribute to the reinforcement of its fortifications so that this capital city and the lady of towns of Our Kingdom could effectively defend itself against enemy attacks, out of Our inborn benevolence We give the councillors and the town for its better fortification and also for a better protection of the dwellings inside the town the space (*spacium loci*) called Żabocruk situated between Our new fish pond (*piscina*) and the River Rudawa, the town wall below the canon's houses[334] and Our garden colloquially called Swijerzinecz."[335] It transpires from the further part of the privilege that it concerned a perpetual granting of full rights of ownership to this piece of land, including all benefits and profits as well as the water flowing there. The town councillors and citizens of the town were to become the owners of the causeways they would build in future and of one or many fish ponds they would establish there. Only they would be entitled to fish in these ponds. The king forbade his officials or anyone else to destroy the above-mentioned causeways maintained by the burghers. The King made the stipulation that during his stay in Kraków the burghers would give him fish from these ponds. This document presented the situation existing in 1422 along the town's western border, outside its walls. It showed that this part of the space *extra muros*, belonging to not to the town, but to the King (and thus forming part of the Royal domain under the management of the governors of Kraków), was at that time in the state of being reclaimed and underwent considerable changes not only in terms of topography, but also in terms of ownership. In the immediate vicinity of Żabocruk/Żabikruk existed a royal garden called Zwierzyniec (Latin: *Ferale*) and recently a fish pond was established, also belonging to the King. Now it was time to reclaim the swamps of Żabikruk (most probably its name signified the loud croaking of frogs) by creating one or several fish ponds (*piscinamque vnam uel plures*) at the back of the canons' houses, on the outer side of the town wall and on the right bank of the Rudawa River flowing along this wall. Not far away, the Rudawa flowed right next to two canons' houses situated at the shortest distance from the Wawel Castle, including Jan Długosz's house behind which it turned to the east.[336] The swampy terrain of Żabi Kruk adjoining the river had a

334 The canons' plots must have sloped considerably towards the edge of the terrace, as the town wall discovered in the walls of their outbuildings (Radwański 1986, p. 65) was described as running "below" them. This surely made it easier for the water that was carried away to flow down through a network of neighbours' canals, existing within the limits of the Kraków canons' plots – cf. Sowina 1996, p. 221.

335 The original Latin text of the document – KDMK, I, 1879, no. pp. 172–173.

336 Długosz 1863, p. 185. Archaeological and geological boreholes next to the southern side of Długosz's corner house (Radwański 1986, p. 70) showed that having turned

naturally defensive character. This quality was to be strengthened by establishing there one or several fish ponds, another water obstacle besides the river. Here, it is worthy of notice that the reinforcement of the defense system of Kraków and Kazimierz (i.e. the second part of the late mediaeval agglomeration of Kraków), in that same year (1422), took place, no doubt, because of the serious threat of the raids of the Bohemian Hussites into southern Poland.

In 1533, i.e. 111 years later, the Kraków councillors issued a document which can serve as the point of departure to trace the complicated ownership relations of this place after 1422. It revealed that the town authorities did not seize the opportunity to reclaim the stretch of land in question and to benefit from it. On 7 March 1533,[337] following a conflict with Karol Koczer/Kuczer, a town councillor, concerning "the place (*locum*) called Żabikruk, situated outside the Wiślna Gate between the River Rudawa and the town wall, at the back of the canons' houses, that had been given to the town by King Ladislaus," the town council had to relinquish all rights to this piece of land in Koczer's favour. Koczer produced one document issued by King Casimir IV Jagiellon in which the monarch gave his consent to the town's giving up this piece of land to Mikołaj Krejdlar/Kreydlar and another document in which the town council on behalf of the whole Kraków community gave this land to Kasper/Kaspar Beer/Ber, a town councillor and a royal moneyer/*Münzmeister*.[338] Karol Koczer based his claim on the fact that he took over the hereditary rights to this land from Kasper Beer. Research carried out by scholars from Kraków showed that Koczer was Beer's son-in-law:[339] it can thus be assumed that Koczer obtained these rights as a result of his marriage to Katarzyna Beer (Żabi Kruk must have been her dowry).

Let us take a closer look at the documents presented by K. Koczer. In the first one dated 29 June 1468 King Casimir Jagiellon stated the reasons of his decision and defined the conditions under which Mikołaj Krejdlar and his heirs became the owners of Żabi Kruk.[340] The monarch referred to the privilege of 1422 and stated that the town councillors gave this land to Mikołaj so that at his own expense he could dig a pond (*piscina*) there, which task Mikołaj had just accomplished. The

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east, the Rudawa River flowed in close proximity to this house which originally had been a royal bath, very well placed – on the river.

337 PrawaPrzywilejeKraków 1885, no. 751, pp. 918–919.

338 Biographical entries about Kasper Ber (Beer, Behr, Beher, Bar), who died in 1543 r. – Pieradzka 1935, pp. 443–444 and Noga 2003, p. 296.

339 Biographical entries about Karol Kuczer, who died in 1538 r. – Pańków 1971, p. 74 and Noga 2003, p. 322.

340 KDMK, III, 1882, no. 466, pp. 612–614.

King confirmed this donation, stressing Krejdlar's special services rendered to the King and to the Crown of the Kingdom of Poland. The King wanted to show Krejdlar even greater generosity and granted Mikołaj and his heirs the right to fence and to strengthen the edges of the pond with posts and to build one or several bridges over the Rudawa River (depending on the needs) in the direction of the Vistula and in Zwierzyniec. The monarch also allowed Krejdlar to build and repair all the necessary causeways surrounding the pond and to plant them with orchards [in order to strengthen the causeways – author's note]. Water was to be carried to the new pond through canals (*per canalia*) from the Kraków town pond and from the Rudawa. In return for all these favours, waters carried away from the town through the gate [Wiślna – author's note] and otherwise (*alibi*) to the Rudawa could flow in the channel through the *predium* that town councillors had given to Krejdlar, as had been done before, from time immemorial. There was also another condition of a different nature: in return for the councillors' generous gift, Mikołaj pledged, also on behalf of his heirs, that the pond would never cease to be a part of the town lands, and would always be owned by a Kraków burgher. If any of Mikołaj's successors renounced the municipal right (*ius civile*), within one year and one day (according to the Magdeburg law) they would be obliged to sell the estate, but only to a Kraków burgher.

The discussed document of 1468 contains various information and encourages to draw at least several conclusions based also on other source material. In comparison with the text of 1422 it reveals that until June 1468 (i.e. during 46 years) the town built only one pond in Żabi Kruk and that it owned a *predium* there, namely farmland with buildings on it (manor farm). The town gave this property to Mikołaj Krejdlar before 29 June 1468; at that time he had already "organized" the pond (*fecit, effodit et paravit*). The document issued for Krejdlar's benefit does not impose the requirement to give fish from the pond built by Mikołaj to the King. It is known from the inspection of the Royal domain under the management of the governors of Kraków of 1569[341] that this obligation to the King (in the document of 1422 concerning all fish ponds that were to be built there) was eventually restricted only to the above-mentioned pond belonging to the town.

Mikołaj Krejdlar was entrusted with the further development of this land, including mainly earthworks (the construction of the pond and the bridge/bridges), because both the town authorities and the King wanted to reward him for his services also in this domain. For Krejdlar this was the next step in accumulating

341 ANK, IT 47, p. 31.

his fortune. According to Jan Ptaśnik's research, Krejdlar came to Kraków from Wrocław. In 1453 he was admitted to citizenship of Kraków. He was married to Jerzy Szwarc's (the burgomaster of Kraków)[342] daughter and thus Krejdlar became the owner of a garden with ponds in the suburbs behind St Nicolaus' Church that had belonged to Szwarc. In 1458 Krejdlar received the King's permission to draw water from the River Prądnik to these ponds (in 1440 Jerzy Szwarc obtained an analogous permission concerning the same ponds).[343] It was only the following year, i.e. 1459, that Mikołaj Krejdlar was mentioned in written records as a town councillor and a leaseholder of the Olkusz lead mines, and from 1462 also as a leaseholder of the Kraków toll (*theoloneum*).[344] Krejdlar's first economic activity in Kraków (documented in sources) was connected with ponds and fish. This, together with Mikołaj's investment of 1468 in Żabi Kruk described above, shows that this economic area must have played an important role in Krejdlar's business activities (apart from the royal lead mines and the Kraków *theoloneum*). He strove to profit from the specific character of Żabi Kruk (where water was the crucial factor in deciding about the way in which the terrain was to be developed), which is why he purchased the Wiślna bath in the following year.[345] Probably willing to enlarge them he bought in 1470 for 8 marks a house on the moat behind the Gniezno Archbishop's house, near the above-mentioned bath.[346] It is characteristic that although he entered into this transaction with another burgher, he concluded it before the court of the Kraków burgh, which means that the lands in the vicinity of the Kraków moat belonged to the King. As regards Mikołaj Krejdlar's properties in this area, he also owned a house there (that he had bought in 1467) between the Wiślna Gate and the back of the bath. The whole area (important in terms of investments) was unified and developed by Mikołaj Krejdlar; 3 years after his death

342 CA I, 1917, no. 331, p. 99, year 1438 –dominus Georgius Swarcz protunc proconsul and op. cit., no. 1028, pp. 308–309 and the editor's (Jan Ptaśnik's) footnotes pp. 309–314 (where, inter alia, a biographical entry about Jerzy Szwarc, who died at the beginning of 1451). According to Z. Noga (2003, p. 227), the ennoblement of Jerzy Szwarc dating from the year 1442 was the earliest known act of this type among Kraków burghers.

343 MRPS III, Supp., 1908, no. 169; AGAD, MK 21, pp. 106–106v. In 1504, also on the strength of a royal privilege, this permission was transferred to Erazm Ciołek (from 1503 – the Bishop of Płock).

344 Ptaśnik 1914, pp. 23–24 and CA I, 1917, no. 1028, footnote 12 (also by J. Ptaśnik), where apart from the above-mentioned functions that Krejdlar performed, also about him as a Kraków burgrave and about his ennoblement. Cf also: Pieradzka 1970, pp. 292–293 and Starzyński 2010, p. 282.

345 KDMK, III, 1882, no. 467 bb., p. 615 (4 August 1469).

346 KDMK, III, 1882, no. 467 cc., p. 615 (10 August 1470).

in 1477 the land was inherited by his son, Erazm. Such a conclusion can be drawn from Jan Ptaśnik's findings. Among estates that Erazm inherited from his father the scholar enumerated 3 parts of a house in the Market Square called Karniowski's house (later known as the Palace under the Rams) and "a vast garden with houses, a mill, ponds etc. behind the Wiślna bath between the town walls and the Rudawa River".[347]

The second piece of evidence confirming Karol Koczer's rights to the land in question that he presented in 1533 was the document issued by the Kraków town council on the strength of which the council gave the land to Kasper Beer. However, there existed specific conditions on which the land was given to Beer, but they were not stated in the document of 1533.[348] They were enumerated in a document issued by the town councillors at the beginning of May 1506.[349] In reference to the fact that in the 15th century the land had been given to Mikołaj Krejdlar in return for the "organization" of a pond and garden and to some other conditions specified at that time (e.g. the stipulation that the land could only be sold to a Kraków burgher) in 1506 the town authorities decided that Kasper Beer and his successors who would inherit the garden would have to pay a yearly rent of 5 marks (half due at Easter, half on Michaelmas Day). Water would be conducted to the pond – like in 1468 – through one channel without any fees, this time only from the town moat (*eynen freyen Wasserflosz haben aws der Stadtgraben*), and therefore it is possible that – just like it had been done before – the water would be conducted from the Rudawa flowing into the town moat.

Judging from the royal document of 17 November 1504 and from its being entered in the Crown Register,[350] Kasper might have taken over the land before this date, because at that time he was referred to as the owner of the pond situated there. He stated that although he had long (*ex antiquo*) possessed the right of "free" carrying water away from his pond in Zwierzyniec (*ex sua piscina in ferali*) through a channel (*per canale*), along the outer side of the town walls, opposite the canonry houses, to the royal ponds located there (*ibidem in ferali*), he asked the monarch for a new, special privilege in order to avoid any trouble connected with the course of this channel. King Alexander Jagiellon acceded to Kasper's plea and underlined that he granted this privilege in view of Kasper's

347 Ptaśnik 1914, p. 23.

348 PrawaPrzywilejeKraków 1885, no. 751, p. 919.

349 KDMK, III, 1882, no. 490, pp. 645–647.

350 Op. cit., no. 489, pp. 644–645 (printed text of the document); MRPS III, 1908, no. 1867 (summary); AGAD, MK, 21, p. 87 (manuscript of the text).

loyal service, and especially because in Kasper's house the royal coin was minted. The privilege extended also to Kasper's successors.

Thus, it is hard to tell when exactly and how the pond became Kasper's property. Jan Ptaśnik's studies revealed that the merchant Erazm Krejdlar/Kreidler as a royal courtier and a middleman of the Lithuanian Camera supplied the royal court with goods he bought *inter alia* from Kasper Beer (Bar).[351] Perhaps taking over the pond by Kasper resulted from the business he did with Erazm. Therefore, the Kraków council's *resignatio* of 1506 only formally sanctioned the state of affairs already existing.

The 1533 document does not mention either the pond or the garden. The description of the place (*locum Zabikruk nuncupatum*) that constituted the object of the conflict contained a general enumeration of Koczer's *edificia omnia* from the Wiślna bath (*balneum Wisle*) that also belonged to him, to the Rudawa River, and down to the royal pond, to the canons' houses and to the Baszta Poselska (Deputies' Tower). It was also stated that Karol Koczer and his successors were to pay the town 5 marks of annual rent, as before. In Kraków revenue books of 1542 this piece of land was entered as *Hortus circa balneum Vislae* for which the late Karol Kuczer's heirs still paid the rent "according to the record of the donation dated 7 March 1533."[352]

As regards using moats for the functioning of watermills, Kraków records show that mill water devices existed not directly on the moat, but on a leat branching off from it, and thus on another artificial watercourse. Let us take a look at the process of conducting water from the Rudawa-moat to a town fulling mill built in 1458. The King granted the town councillors and the Kraków community permission to use water from the Rudawa: *damus et largimur Usum Aque nostre de Rippa seu fluuio Rudawa, que in fossato retro Ecclesiam Sancti Nicolai extra muros Cracovienses fluit super Molendina(s) nostra ibidem situata*.[353] The town was allowed by the King a considerable measure of freedom in choosing the most convenient location of the fulling mill and in deciding about its functions: it could be used both to work every kind of cloth and to whiten all types of linen and fustian, and thus it could form part of a bleachery complex, like the fulling mill belonging to the abovementioned bleachery in Biecz. There was, however, one restriction. If using water by the fulling mill should have a detrimental effect on the royal mills, water drawn

351 Ptaśnik 1914, pp. 23–24.

352 KDMK, II–IV, 1882, p. 746. No data concerning this pond also in the 1564 inspection of the Royal domain under the management of the governors of Kraków – LustrWojKr., part I, 1962, pp. 3–19.

353 KDMK, I, 1879, pp. 234–235.

from the Rudawa-moat by the above-mentioned Kraków councillors to the benefit of the town, should always be led back to the Rudawa-moat and returned for the needs of the royal mills.

The construction of the town fulling mill entailed digging a separate leat. Also royal mills which were given priority in using water from the Rudawa-moat might have had their own leats. Perhaps the current of the Rudawa-moat was not strong enough for their wheels, or simply they were not to obstruct the functioning of the moat.

The King's regulations referring to the use of waters in the Kraków space *extra muros* show that it was the King, not the town, who had control over this space and over economic activities taking place there; they also show the considerable extent of this control. This situation resulted from the fact that a part of this space together with watercourses flowing there belonged to the King as the territory of the Royal domain of Kraków. This state of affairs was peculiar to Kraków and differed from the situation found in other centres chartered with German law. What is striking from the perspective of the present studies is that in the whole period in question (i.e. at least until the 1530s) it was strongly underlined that the town moat belonged to the King.[354] For that reason using the town moat required the King's consent. This can be explained by a particularly strong identification of the moat with the royal River Rudawa, even though water flowed to the town moat not directly from the river, but through its artificial branch. However, the King attached special importance to having control over the whole body of water connected with the Rudawa River, namely over all its channels and branches. This undoubtedly resulted from the economic role of water from this river, indispensable mainly for the functioning of mill devices not only belonging to the mills owned by the Royal domain under the management of the governors of Kraków, but also to those which on the strength of royal privileges worked for the benefit of the town or individual burghers and brought profit (namely rent) to the Royal domain under the management of the governors of Kraków.[355] The noticeably dominant economic interests of the King being the owner of the waters acted as a strongly

354 In other late-mediaeval royal towns moats usually belonged to these centres, e.g. in 1471 Poznań town councillors recorded in their court book a sale and purchase transaction concerning a mill functioning on their moat in front of the Brama Wielka (Great Gate): *molendinum […] in fossato nostro ante portam Summi situm cum omni iure, dominio et proprietate atque emolimentis proventibusque omnibus*. The seller was a woman – a Poznań burgher, and the buyer – a local councillor – ARadzPozn., II, no. 1186, p. 14.

355 Cf. a list of these mills in 1564, in: LustrWojKr., part I, 1962, pp. 9 et seq.

limiting factor in the town's enterprises that – like the above-mentioned fulling mill – could contribute to the economic development of the city.

The ownership of waters in Kraków was divided between the two main parties having power over the town, namely between the town authorities and the King. In Kraków mediaeval written sources there is a clear division between "royal waters" and "town waters". A record of 1424 can serve as an example. Mikołaj, and "old" master fountain-builder (*antiquus aqueductor, d'alde rormeister*), entered (before the town council) into the following agreement with Stanisław Czanstoff, a royal fisherman. On the strength of the entry in the town books and having paid a deposit of 2 marks, Mikołaj committed himself to paying 1 mark for fishing in the royal waters (*in aquis domini nostri Regis*); Stanisław was to pay the same amount of money to the town councillors if he fished in the town waters (*in aquis Civitatis*).[356]

The above-mentioned documents show that the King reduced the area that belonged to him together with waters already flowing there and with watercourses that were to be built there in future. This tendency, observed in other centres within the scope of town foundation programmes, in Kraków appeared late and was limited because of the fact that the principal residence of the King and the Royal domain were located there. New owners enjoyed full rights of using the waters just like in other centres, including the right of perpetual hereditary possession (*iure hereditario, in perpetuum, in ewum*). Thus, without the King's interference, they could rent, give or sell them. This can be testified by a record of 1420, found in Kraków echevin books, referring to the town councillors' renting *aquas et Rivulos Civitatis Cracoviensis ultra sepultura Judeorum in pascuis Civitatis existentis*, i.e. waters and streams of the town of Kraków near the Jewish cemetery on the town pastures. The waters flowing through this terrain were to be rented to two Kraków burghers for a year for 2 marks due in 2 semi-annual instalments. After a year they were to return *dictas aquas et piscaturas Civitatis Cracoviensis* undamaged to the town and its councillors.[357] Hence, the agreement mainly referred to the town fish ponds. This contract can be compared with a rental agreement entered into in Poznań in 1491: Poznań councillors rented "water in Luboń", i.e. a village belonging to the town on the Warta River, to Maciej, an inhabitant of that village, "for fishing" for a year from the first Ember Days following St Lucy's Day (i.e. in winter, from 14 December) to the ones next year.

356 ANK, CC 428, p. 211.
357 ANK, SC 5, p. 3.

Maciej was to pay 120 groschen due (quarterly) in 4 instalments on each Ember Days (30 groschen each).[358]

Water was not only rented, but it was also sold. In 1442 Marcin Polski, a Kraków burgher and royal tailor, bought "forever" for 20 marks the branch of the River Rudawa leading to his mill.[359] Marcin purchased it from a member of the gentry, Piotr of Chełm, the Castellan of Połaniec. The content of the document reveals that it concerned sharing a leat that had been built before from the River Rudawa to Piotr's mill. Piotr allowed Marcin to build a weir on the leat, probably to increase the efficiency of the mill (by intensifying the course of the leat and thus the rotation of the wheels). Apart from paying 20 marks, the tailor was to sew clothes for Piotr and his wife until the end of their lives. It seems that this was a good deal for Marcin, especially if we consider that 4 years before he had invested big money in buying at an interval of 2 months the right to use and derive income from a half of "Granowski" mill and a half of the "Dębny" oak bark mill (*quercini alias dampny*).[360] He paid a total of 370 marks (40 and 330 respectively). He could not afford any obstacles in supplying either of the mills in water. Probably such problems occurred in 1442, since he had to buy water from another leat.

Records of selling water for the needs of devices requiring water can be found also in other centres, e.g. in mentions of the payment for water led to the bleacheries in Sącz and in Krosno. In the former case, in 1564 during an inspection of royal properties in Sącz, "the town councillors were asked about the bleachery. They testified that the bleachery was located in the lands belonging to the town, but that it belonged to individual citizens; the burghers paid 4 marks for the water they conducted to the bleachery themselves".[361] In the latter case, in 1593 in Krosno 6 zlotys and 12 groschen was paid for leading water from a leat to a bleachery.[362]

The above examples reveal an important issue connected with water perceived in terms of possession as the object of transactions.[363] In town written sources it was revealed it concerned artificial watercourses or reservoirs sold separately, as

358 ARadzPozn., II, 1931, no. 1549, p. 232: *Arendavimus aquam in Lubom a dictis quattuortemporibus sancte Lucie usque ad unius anni decursum Mathie de Lubom pro captione piscium, de qua solvere et dare debet omni anno duas sexagenas ad quodlibet quatuortempus per mediam sexagenam procuratoribus civitatis.*

359 DokZiemKr., 1971, no. 192, pp. 209–210. Cf. also Sikora 1989, pp. 44–45.

360 Op. cit., no. 187, pp. 203–204 (6 February 1438) and no. 188, pp. 204–205 (21 April 1438).

361 LustrWojKr., part I, 1962, p. 155.

362 Leśniak 1999, p. 58.

363 Sowina 2006a, pp. 37–49.

shown above. When waters were just an element of the transaction, they were only enumerated (like in the case of privileges granted by the sovereign), which fact alone also testified to their importance. This happened when the transaction concerned either devices connected with watercourses (mostly mills) or entire lands on which the watercourses were situated. For example, in 1510 the burgomaster of the Old Warsaw together with the town council (acting as the administrators [*provisores*] of the of the Holy Ghost Hospital) granted hereditary ownership of a small mill outside of town (*molendinum parvum sub civitate Warschoviensi*) that belonged to the hospital to the miller Stanisław, together with all benefits drawn from it, including "the waters and the fish" and a lan (*laneus*) of field belonging to the mill.[364] In 1517 the burgomaster and some councillors of the Old Warsaw, acting as the *vitrici* of the Warsaw Collegiate Church, in order to increase the utility of a garden on the Vistula River that was intended *pro fabrica* of this church, gave the garden to a prince's miller for an annual rent paid to the Collegiate Church in the amount of 130 groschen. Together with the garden and the benefits that could be drawn from it they also gave "streams and flowing waters" situated in the garden in a sufficient abundance to serve to build fish ponds and a mill (*cum rivulis, aquis et eorum decursibus, in eisdemque aquis piscinas et molendinum erigendum construendum sive edificandum*).[365] In the years 1532–1535 the Kraków echevin records described the manor farm belonging to the Betman-Boner family (due to the division of the property between family members), situated in a cluster of other patrician manor farms, and enumerated its "waters, streams and brooks, ditches/canals, ponds and pools" and their "fields, meadows, buildings, bushes and thickets, manses/lans and pastures".[366]

Besides the above-mentioned production and power devices that required water from rivers one should undoubtedly mention public baths, mainly because in the economic programmes of the foundation of towns they (as well as mills) occupied an important place and were a source of income for the *advocatus* or for the community.[367] Devices connected with public baths constantly required

364 KsRadzStWarszawa 1963, no. 890, p. 256: *cum… omnibus utilitatibus, fructibus, <aquis, piscibus et aliis> proventibus ex ipso molendino provenientibus.*

365 KsRadzStWarszawa 1963, no. 1216, pp. 357–358.

366 ANK, SC 11, p. 336, year 1532 and p. 515, year 1535.

367 To date, the subject has been elaborated in the following monographs: Dąbkowski 1913, passim and Lachs 1919, passim. These two works were used, inter alia, in: Jelicz 1966, pp. 72–75, Tyszkiewicz 1977, pp. 190–192, Rutkowska-Płachcińska 1978c, pp. 347–357, Jasiński 1982, p. 92, Kaniecki 2004, p. 585. Cf. also Słoń/Sowina 2010, pp. 563–580. Research shows that in the Polish lands they were steam baths in which

large amounts of water, which is why in literature there prevails an opinion that baths were situated on watercourses.[368] An analysis of both written sources and monographs of Polish towns shows that in many cases baths were topographically close to various watercourses. However, repeated general observations mentioning that late mediaeval baths used "running water from a nearby river"[369] do not explain how the water was supplied to the buildings of the baths. In most cases it is not known (probably due to the lack of source material concerning the water supply of public baths) whether water was carried by servants working there or whether it flowed through conduits, like in the Toruń bath in Baths Close in the Port Suburb, to which water was supplied through conduits from the town moat.[370] It must be added that water could be drawn from the town moat to the baths also if they were situated in the space *intra muros*. This was the case when the Poznań town council in 1497 allowed the burgomaster, Piotr Adam, to draw water to his bath situated in Woźna (Beadles') Street (*platea Bedellica*) from the stretch of the moat between the Brama Wielka (Great Gate) and the Brama Wodna (Water Gate).[371] Despite the fact that this allowed the burgomaster to construct a straight conduit that did not turn in any place, ca 120–150 meters long, along the Woźna Street, it had to cross the town wall in a chosen, i.e. the most convenient place (*unum cannale faciendum de fossata civitatis nostre prefate inter Summi et Aquaticam portam fluentem per murum civitatis, ubi sibi placuerit, usque ad balneum suum in platea Bedellica*). This enterprise was more difficult

large amounts of steam were produced by pouring water over heated rocks. After a steam bath (and being whipped with birch twigs), people poured cold water over themselves. People also bathed in wooden bathtubs (e.g. in 1558 1 mark and 4 groschen were spent on the needs of the Wawel castle, namely on: "larchwood for a tub for bathing" – RachWielkorzBoner, 1974, p. 175) in stone bathtubs – Rutkowska-Płachcińska 1978c, p. 350, and in metal bronze and tin bathtubs – Tyszkiewicz 1977, p. 191, who also pointed to the germicidal properties of metal containers that had a positive impact on maintaining hygiene. Also in a bath of the Abbey of the Canons Regular in Wrocław (situated on the River Odrzyca, a branch of the River Odra) bathtubs were used – Słoń 2000, pp. 93–94.

368 Cf., inter alia, Gouédo-Thomas 1995, p. 137, where on the basis of literature the author presented a general opinion that supplying mediaeval French baths with water was not a problem, as they were situated on rivers, from where water was drawn.

369 Tyszkiewicz 1977, p. 191.

370 Tandecki 2001, p. 167; however, contrary to T. Jasiński's opinion (1982, p. 92), this was not a water supply system, which was correctly pointed out by R. Kola and L. Kotlewski (2003, p. 25).

371 ARadzPozn., II, 1931, no. 1694, pp. 348–349.

to build and later to preserve in good condition (not only the conduit, but also the town walls with a hole going through them, which raised the overall cost of the upkeep of the bath) than the one in Toruń. It was also exceptional, because the permission was granted to the burgomaster whose special services for Poznań were underlined. The decision was taken against a dramatic background of the bath: as evidence indicates, at that time the means of supplying water to the bath that had been used before, came to an end: first from a dug well belonging to the bath,[372] and later (on the basis of a perpetual agreement) from a well connected with a nearby malthouse, but belonging to somebody else.[373]

The location of baths on a watercourse was optimal also because of the possibility of carrying used water away from the baths. Nevertheless, baths were not dependent on watercourses to such an extent as were devices connected with mills. Water could be supplied to baths also from dug wells[374] or from a water supply system.[375] In late Middle Ages, alongside the establishment and the development of water supply systems, baths were situated not necessarily on rivers, sometimes even far away from them, including the space *intra muros* with no watercourses. This applied not only to public baths, but also to private baths[376] which became more and more numerous, especially in large centres. The author of the present study would connect the royal privilege of 1401 for Kraków to build a bath "in the most convenient place for the town"[377] with the construction (from 1399) of a water-work (*Wasserkunst*)/water supply system rather than with decisions pertaining to town moats, found in the same privilege. As far as supplying water from dug wells to baths is concerned, in Kraków at least 2 public baths recorded in written

372 Stadtbuch von Posen, 1892, p. 45*, footnote 7.

373 ARadzPozn., II, 1931, no. 1286, p. 65 (year 1477).

374 E.g. in Środa a town in Greater Poland in the 16th century one of the public wells stood next to a bath (*puteum circa balneum*). It was probably from this well that an open trough carrying water was conducted to the bath – APP, Środa, I/73, p. 47.

375 Like this even in smaller centres, e.g. in 16th-century Sieradz (AGAD, dokument pergaminowy/parchment document no. 3888: […]*cannalibus ad balneum […] proprio sumptu a proximiore tractu cannalium nostrorum alias od blischschego czugu rur absque ullo censu, liberam facultatem damus*. The Płock water supply system built from the year 1534 was to supply water to, inter alia, a dried-up dug well belonging to a local bath – ZbPłock II, 1987, no. 393, p. 167.

376 Cf. e.g. a permission issued in 1537 for Jerzy Gutteter and his wife Regina to build a bath in their house in the Market Square in Lviv and to conduct water through pipes to this bath – MRPS IV/3, 1915, no. 18815, p. 71 (summary); AGAD, MK, 54, p. 239 (text).

377 KDMK, I, 1879, no. 98, p. 138.

sources from 1358: the Rogacka bath and the Jewish bath, both had other sources of water than the vicinity of a watercourse. At first it was their own wells the upkeep of which was financed by the town.[378] In the case of the Rogacka bath located *intra muros* no written sources were found (as opposed to the above-mentioned Poznań bath belonging to the burgomaster) about building a conduit from a nearby moat which would also (like in Poznań) require making a hole in the town walls. It is not out of the question that in 1404 the Rogacka bath in Kraków used the town water supply network which ran in its vicinity.

II.4 Water in suburban gardens situated on rivers

While describing the ways of using river water by towns and their inhabitants and how owners of the waters controlled this process it is necessary to elaborate in greater detail on the importance of river water for gardens as well as for fish ponds and pools very often found there, primarily owing to their role in the economic situation of their owners and of the towns.

The phrase "water in gardens" can be associated with a decorative fountain in the middle of the Garden of Eden or *hortus conclusus*, inextricably linked with the Blessed Virgin Mary, because it symbolizes her womb in which the life of Jesus, the human Son of God, began. In both cases the fountain of "living waters" symbolises eternal life that God offered to humans. Biblical representations of the Garden of Eden as the place of eternal happiness, and thus as the place of abundance, became the model for earthly gardens, the ones meant for pleasure. In these gardens everything was to serve pleasure: plants, namely aromatic herbs and flowers, trees heavy with delicious fruit and providing shade, animals like rabbits, hares, roe deer, boar gambolling amongst the greenery and fish swimming in ponds. A description just like the one above was given in the early 14th century by Pietro de Crescenzi. He specified that the ones that were to derive pleasure from the gardens were kings and lords.[379] Thus, Crescenzi wrote about court gardens. It was this excerpt from Crescenzi's work that Franco Cardini pointed to in his description

378 ANK, rkps/MS 1589, p. 147 (year 1397): 4 marks and 8 scots in total were paid *pro fonte stube balnearis retro cornutos* […] in that year, out of which sum the most was paid for oak timber for a well and as payment to its digger (*fossor*). In 1400 the town spent as much as 25 marks and 1 groschen on a well belonging to the Rogacka bath – ANK, rkps/MS 1590, p. 56 and KsRachKraków II, 1878, p. 325. About a well next to the Żydowska (Jewish) bath outside St Anne's Gate – ANK, 1589, p. 324 (year 1399): *primo super fossione fontis* – 0.5 mark.

379 Crescenzi 1548, p. 489.

of 12th–14th-century gardens belonging to Florentine patricians.[380] At this opportunity Cardini recalled an opinion known from literature that the Biblical image of the Garden of Eden – Paradise (together with Babylonian-Persian, Greek and Roman influences[381]) had an effect on the way that the image of the Paradise Garden in the early-mediaeval Islam from Spain to Sicily was shaped.[382] These images, adopted by the Norman conquerors of Sicily, found their perfect realization in the form of the royal gardens of King Roger II of Sicily and King Frederick II of Sicily in Palermo, described in detail by Henri Bresc.[383] The quintessence of mediaeval images of a garden as a place of pleasure, they represented the symbiosis of two great cultures: Islamic and Christian. In the layout of these gardens water played a major role as an element not only indispensable for plants, but also decorative, shaping the landscape of these gardens to a considerable extent. Natural and artificial springs from which water squirted (i.e. water was supplied by a specially built water supply system) as well as water reservoirs: fountains, cisterns, pools, wells, ponds and streams combined into a whole water system. It was not only the most perfect example of mediaeval water technique used in gardens, but generally it also performed an important role in spreading technical knowledge concerning water supply.[384]

Bearing in mind the royal gardens in Palermo (that became the symbol of and the model for the Paradise Gardens) and court or patrician gardens described by Crescenzi (fig. 15) and Boccaccio, as well as their early 16th-century counterparts in the form of the royal gardens adjacent to the Wawel Castle, we shall focus on supplying water to suburban gardens, namely pieces of farmland (fig. 16) playing an essential role mainly in the economic situation of their owners by providing them

380 Cardini 1994, p. 268; cf. also: Calò Mariani 1992, pp. 343–372. About the treatise and illustrations in Crescenzi's Italian and French manuscripts – Mane 1985, passim. In Italian belles lettres among descriptions of patrician gardens – inter alia: Boccaccio 1985 (Giornata quarta, Novella sesta): about a garden belonging to a patrician from Brescia which was a place of his daughter's trysts among roses, near a fountain spouting fresh water.

381 About the motif of the "Fountain of Life" in Greek, Hellenistic and Roman literature, including Pliny the Elder – cf. Cardini 1992, pp. 545–547. In Polish literature – Prymas 2001, p. 131.

382 Cardini 1994, p. 263.

383 Bresc 1972, pp. 55–127; id. 1994, pp. 239–258; Cardini 1994, p. 263. About Emperor Frederick II Hohenstaufen's fascination with Muslim culture which manifested itself, inter alia, in his patronage over the dissemination of scientific achievements of the Islamic world in mediaeval Europe – cf. (in Polish literature) Hauziński 1984, passim.

384 Bresc 1972, passim.

with food or components used for craft. The functioning of such gardens (together with other lands used for farming) in the period under research was confirmed for many European towns,[385] including mediaeval Rome[386] and mediaeval and early 16th-century Paris.[387]

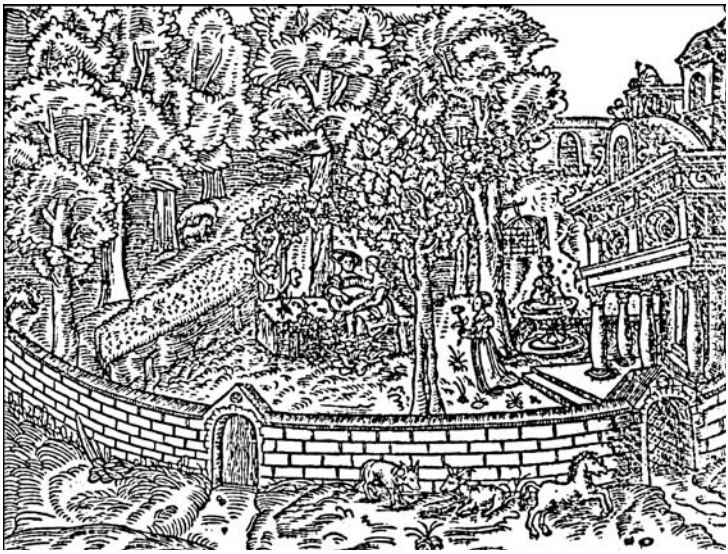

Fig. 15: A court or patrician garden – a place of repose and pleasure, mid-16th century, after: Crescenzi-Trzycieski 1549, pp. 646–647.

385 Cf. Braudel 1967, vol. I, pp. 372–373, with examples of mediaeval towns: Ulm, Augsburg and Nuremberg; in this scholar's opinion, this phenomenon – unfortunately defined too broadly, for the entire pre-industrial period, i.e. until the 18th century – was a fact occurring worldwide, not only in Europe, but also in Islamic towns and in such countries as China and India.

386 Hubert 1990, p. 153: *domus cum orto post se* – in 10th–13th-century Rome vegetable gardens adjacent to houses on plots inside the town.

387 Delumeau 1987, p. 238 – underlining the lack of a sharp difference between "the rural and the urban world", he referred to Pierre Lavedan's findings that Paris in the times of Francis I, i.e. in the first half of the 16th century, in many respects was a rural agglomeration, which thesis was to be confirmed by the fact that farmers and viticulturists lived within the town walls and that fields and meadows were situated in close proximity to the town. For an earlier period cf., inter alia: Roux 1969, pp. 1203–1204 – about gardens adjacent to houses in the university quarter in Paris, also in 1295 on the River Bièvre (the garden was separated from this river by a wall due to its flooding – cf. also: BHVParis, Egout Bièvre).

Fig. 16: Garden as agricultural farmland, mid-16th century, after: Crescenzi-Trzycieski 1549, pp. 197–198 and 488–489.

In the economic life of towns in the Polish lands farmland played a important role not only in the Middle Ages, but also in early modern times.[388] In small centres farmland was sometimes the main source of burghers' wealth.[389] Apart from gardens adjacent to houses: vegetable gardens on plots *intra muros*[390] (in the late Middle Ages they were found almost only in small towns), the possessor of a plot of land *intra muros* also had at least an *ager* (consisting of three stretches of field) and a garden (*hortus*, *ortus*) *extra muros*, on the lands granted to the town at the occasion of its foundation, both in small and large centres.[391] The *ager* was worked according to the three-field crop rotation system; each of the three stretches of field was situated in a different large field (three such large fields made up the total of the arable land of a town or a village), whereas the suburban

388 Bogucka/Samsonowicz 1986, pp. 161 and 448–450; Tyszkiewicz 2003, p. 118.

389 Sowina 1991b, pp. 59, 64, 75, 175.

390 About the place of gardens in the structure of the mediaeval town plot in the light of archaeological research cf. Piekalski 1999, pp. 236–237.

391 Sowina 1991b, p. 156 et seq.

ortus (*hortus*) was a separate and fenced unit, as its Latin name suggests.[392] As opposed to the stretches of fields which were generally sown with crop, the *ortus* was mainly a garden in which various plants were grown (*ortus cum omnibus fructibus*[393]): vegetables, herbs, plants that served as components for textile production (flax and hemp to produce linen and ropes), hops[394] (already indispensable for beer production), fruit trees etc.[395] Only rarely did records from Polish towns specify that the *ortus* was in fact a meadow (*locum prati aut orti*[396]) or an orchard (*hortus seu pomerium* in Kazimierz near Kraków[397]). Often there were barns – threshing floors (*ortum cum allodio*) in the *orti*.[398]

Socio-topographical studies revealed that in the space *extra muros* besides gardens which belonged to the burghers who owned plots *intra muros* there were also *orti* adjacent to suburban houses (*domus cum orto adiacente*[399]). In the latter case the houses and the *orti* were called either *ortulaniae*[400] (crofts), i.e. small farms, or – if they were larger and more prosperous – *predia* (*ortum seu predium suum, predium – cum orto adherente*), namely manor farms consisting of a farming and breeding complex of land and buildings, sometimes of a considerable value;[401] in larger centres *predia* often included residences for the burghers or the gentry.[402] Gardens that belonged to these estates might have been not only vegetable gardens, but also separate places performing the function of a haven of rest and pleasure

392 Rutkowska-Płachcińska 1957, p. 418.

393 AGAD, SCA I, p. 31, year 1437 and Sowina 1991b, pp. 159 and 179.

394 E.g. a hop garden within the limits of a patrician manor farm in Nowy Sącz in 1542 – ANK, AD 53, p. 140.

395 Cf. Capitulare de villis 1968, cap. LXX, where plants which should be grown in a perfect garden were listed.

396 Sowina 1991b, p. 186.

397 ANK, IT. 48, p. 222, year 1595.

398 Sowina 1991b, p. 195.

399 Op. cit., p. 159.

400 This was the name used in Little Poland's towns, e.g. in Proszowice – ANK, IT 230a, p. 21, year 1424: *ortum alias wzagroda*; ANK, Proszowice 1, p. 487, year 1487: *ortulania alias zagroda*, op. cit., pp. 524 and 531–532. They formed a compact fenced area, which fact can be confirmed by another source term from this book (p. 203, year 1479 and p. 231, year 1480): *circumseptura alias zagroda*; Proszowice 2, p. 289, year 1533: *hortulania*. *Hortulaniae* were also present in Bochnia, cf., inter alia: ANK, ASB 10, p. 200: *pro orto seu ortulania*, and in Biecz – MatBiecz 1914, no. 172, p. 57, where rent in the amount of 24 groschen *ab una hortulania* in the suburb was paid to the provost of the local hospital.

401 Sowina 1991b, p. 159.

402 Wiesiołowski 1982, p. 205.

described by Crescenzi (A. Trzycieski, the Polish translator of Crescenzi's work, called such gardens cloister garths (*viridaria*),[403] thus identifying them with gardens inside monasteries).

The necessary condition for the existence of all kinds of gardens was supplying the soil and the plants with a sufficient amount of water. Pietro de Crescenzi described it in a systematic way proper to treatises. At the beginning of Book VI devoted to gardens he noted that mellow soil that is more moist than dry is the best for gardening.[404] A few dozen pages before he divided arable land into 9 categories according to the quality of the soil. He listed moist land for a garden in the second place, right after land for vineyards.[405] Such land was undoubtedly found on watercourses. According to Crescenzi, a garden needed springs or running water that, if necessary, could be directed between patches, or a pond (or a pool) nearby, or at least a well from which water could be drawn to water plants or to cool them by the moisture derived from water.[406] If none of these options were possible, it was necessary to dig holes in the garden, also between patches, in which water could collect, also "to cool down the herbs".[407] As a confirmation of the pertinence of these instructions, Crescenzi referred to Palladius, who wrote (referring to Columella): *Hortus, qui caelo clementi subiacet et fontano umore percurritur, prope est, ut liber sit et nullam serendi disciplinam requirat*.[408] Still referring to Palladius, Crescenzi summed up that the best garden would be situated on a hillside, so that water could flow down freely. A suitable amount of water, i.e. not too much and not too little, was important to maintain proper functioning of a garden. Hence, not only a shortage of water, but also its surplus could ruin every garden. For that reason Crescenzi advised digging in November in very damp gardens draining furrows through which the excessive dampness would flow away, which would prepare the soil for the spring sowing.[409] These were the drains and furrows about

403 Crescenzi-Trzycieski 1549, book VII, pp. 488–489.

404 Crescenzi 1548, lib. VI, p. 187 : *De hortis et de natura et utilitate herbarum, quę feruntur in eis*; Crescenzi-Trzycieski 1549, pp. 198–199.

405 He referred to works by Varro and Cato the Elder – cf. Crescenzi 1548, lib. II, cap. XXV, p. 68 and Crescenzi-Trzycieski 1549, p. 140.

406 Crescenzi 1548, lib. VI, p. 199.

407 Crescenzi 1548, lib. VI, p. 187; Crescenzi-Trzycieski 1549, p. 199.

408 Palladius 1898, liber I, 6, 10.

409 Crescenzi 1548, lib. VI, p. 199.

which he had read in Palladius' work.[410] Crescenzi also pointed to the same role of ditches encircling gardens. These ditches performed the function of fences.[411]

An analysis of written sources referring to late mediaeval and early 16th century towns in the Polish lands shows that information concerning water devices functioning in gardens was unequal in terms of quantity and content.

The only example showing the importance of a proper functioning of the canal-fences between neighbouring plots that was found in the course of the present research refers to an acute and long-term conflict between members of one family, namely the family of a patrician from Sandomierz, Jan Serni, highly successful grain merchant conducting business on the Vistula River and leaseholder of the Bochnia salt mines. The conflict between Jan and his nephew, Bartłomiej Serni, who was a town councillor, continued for at least 20 years (1549–1569), until Jan's death. Bartłomiej claimed that it was his uncle's fault that the canal silted up to such an extent that the excess of water flooded Bartłomiej's gardens. This conflict, handled also by the King, set Jan at variance not only with Bartłomiej, but also with other members of the family: Jan sold his house and farmland to a cousin, who in turn sold it to Bartłomiej. Jan considered this as highly disloyal.[412] This example clearly shows the necessity of the proper functioning of such installations in the space connected with gardens.

Wells were another type of garden water installations cited in the abovementioned treatises and equally rarely mentioned in written sources concerning towns. Wells were easy to dig in riverside gardens, where the water-bearing stratum was found not deep beneath the ground. They were mentioned in records only if their existence was worth emphasizing for some reason. For example, among very many source mentions of suburban gardens in Old Warsaw in the town councillors' book from the years 1447–1527 there is only one piece of information about a well in a small garden. However, considering that on the same plot of land there was also a malthouse (*braseatorium*),[413] it is difficult to tell whether the malthouse was not the reason for the existence of this well. Such a situation was typical in other towns. A different piece of information dating from 1498 concerning the small town of Poniec in Greater Poland mentions a well (*fons*) as an element of a manor farm (*predium*). As a result of the

410 Palladius, 1898, lib. VI, 3. The need of the existence of such ditches was also pointed out by Anzelm Gostomski in the year 1588 (Gostomski 1951, p. 56).

411 Crescenzi 1548, p. 143.

412 APS, rkps/MS 6, pp. 195–195v., AKS, rkps/MS 86, pp. 53v–54 and AKS, rkps/MS 91, pp. 124–126, 155v–156.

413 KsRadzStWarszawa 1963, no. 975, p. 284.

division of the estate between family members, a half of the well together with a half of the field on which it was situated and which belonged to the manor farm, and together with a garden, 1/3 of a field and a meadow were given by a local town councillor and his brother to their brother-in-law.[414] The third mention relevant to the present research refers to Kraków, i.e. a much bigger town with incomparably richer archives. It dates from 1568 and concerns the division of a garden in which a well was situated. Like in Poniec, both the well and the garden belonged to a suburban estate which consisted also of a house, a stable near the garden and an arbour in the garden.[415] Town wells (*fontes*), i.e. public wells, situated in the vicinity of gardens and thus perhaps supplying water to these gardens, were also rarely mentioned in written sources. To include just a few examples of such wells, one mentioned in 1482 was situated in Warsaw in Długa Street,[416] one was called the „Red Well" (*Rubeus fons*) and was near the gardens and vineyards in Winiary in Poznań,[417] and one in the suburb of Czchów, a small town in Little Poland, in the vicinity of which (*circa puteum*) in 1552 was a manor farm (*predium*) belonging to a family of the local burghers.[418]

In most cases written sources mention the suburban "green areas" simply as being located on watercourses, namely near rivers (big or small), leats and town moats branching off from rivers, or – although less frequently – lakes,[419] therefore mainly in wetlands, including lowlands and floodplains.[420] The latter provided natural irrigation and fertilization of the gardens by "friendly" spring floods, but also constituted a serious threat in the case of floods-cataclysms.

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414 APP, Poniec I/17, p. 30.

415 KsWiertelKraków, 1997, p. 25.

416 KsRadzStWarszawa, 1963, no. 189 and 190, p. 64. Mention of a garden near a (public) well – op. cit., no. 609, p. 176, year 1502.

417 ARadzPoznań, I, 1925, no. 1165, p. 444.

418 ANK, AD 514, p. 255.

419 E.g. a garden on a lake in Greater Poland's small town of Wolsztyn – APP, Wolsztyn 1649, p. 22 (year 1545): *ortum ad lacum aut penes lacum*.

420 This concerns gardens located on vast flat grassland, mostly near watercourses, in numerous Polish towns, like in Proszowice and Sieradz, source examples of which were quoted above. Cf. also Chmielewski 1962, pp. 79–82. Additionally, what seems worth noting are "hortillonnages" in Picardy, including Amiens, i.e. farming garden plots set up on marshland, criss-crossed by a network of canals performing three functions: that of communication and transport, water supply and drainage. These lands survived in their mediaeval shape to the present day.

As far as gardens situated on a big river are concerned, we can quote the above-mentioned cluster of gardens on the Vistula River escarpment[421] in the suburb of Warsaw's New Town that belonged *inter alia* to the Warsaw Old Town patricians,[422] gardens on the Vistula in Płock,[423] or vineyards and orchards located in Toruń on the Vistula terrace in Przedbramie Jakubskie (a suburb outside St Jacob's Gate).[424] It is worth mentioning that Marcin Kromer, a Polish chronicler, went into raptures about the fertility of the gardens in these towns and in other centres on the Vistula River: in Kraków, Sandomierz and Gdańsk. He wrote that "the excellent quality and the variety of pears, apples, plums, peaches, cherries and nuts grown there can effectively compete with fruit from Hungary and Italy." He added: "Polish soil is suitable for growing chestnuts, mulberry, cotton, figs, almonds, watermelons, melons, herbs and various kinds of flowers, including all that forms the charm of Italian gardens and the elegance of Italian palace parks, provided that the plants are cultivated with greater care and protected from the cold."[425] These words were written by a man who not only knew his country very well, but also was highly educated: he was a doctor of both laws, studied in Padua and Bologna, he held high state and Church posts: as a secretary to King Sigismund II Augustus, as a canon in Frombork (after Nicolaus Copernicus) and as a bishop of Warmia.[426] Kromer probably read Pietro de Crescenzi's treatise (perhaps in the original version) and having direct contact with the King's court, he saw the royal gardens on the Wawel Hill[427] and in its vicinity, including the above-mentioned royal garden in Zwierzyniec. While describing Kraków, he noted the qualities of its suburbs: "Its suburbs are vast and populous, with gardens and orchards full of various fruit trees, with fish ponds, farmlands, and charming for their mildness

421 KsRadzStWarszawa, 1963, no. 1816, p. 551: *ortum in porta inter Pąchirek ex una et gradum descendendo ad Wislam partibus ab altera iacentem.*

422 KsRadzStWarszawa, 1963, no. 1216, p. 357. Mentions of other gardens located on the Vistula River in Warsaw – KsRadzStWarszawa, 1963, cf. the following entries in the index: "ortus" (p. 797) and "Wisła" (p. 759).

423 ZbPłock II, 1987, no. 433, pp. 229–230 – a royal permission to build a brickyard in a garden called Grabówka on the Vistula, in which a pond had already existed. About a cluster of gardens in the neighbourhood – op. cit., no. 495, p. 295.

424 Mikulski 1999, pp. 395–396.

425 Kromer 1977, p. 28.

426 Op. cit., p. VI et seq. (VIII, XXXIV–XXXV).

427 On the Wawel Hill a garden layout was established near the eastern side of the Renaissance royal palace – cf. Ciołek 1953, p. 65; Pianowski/Firlet 2002, pp. 11–15, who dated this enterprise to ca 1540, and loc. cit.: bibliography; also Stępień 2002, pp. 49–50. Cf. also: Firlet/Pianowski 2008, passim.

of climate."[428] These gardens were so fertile not only thanks to the Vistula River, but also to the above-mentioned small rivers, mainly Rudawa and Prądnik. Clusters of Kraków suburban gardens, well documented in written sources, were situated on these rivers, e.g. along the roads to Łobzów and Czarna Wieś[429] and beyond St Nicolaus' Gate.[430]

The fact that gardens were established on smaller rivers or artificial watercourses was documented in written sources for many other towns, including Kalisz,[431] Sieradz,[432] Proszowice,[433] Ciężkowice[434] and Bochnia. A socio-topographical study of Bochnia based on records from the town's oldest preserved echevin book reveals a landscape full of gardens just outside the Brama Piotrkowicka (Piotrkowice Gate), i.e. to the east of the town. Gardens and *hortulaniae* belonging to burghers, suburbanites, and the Dominican friars extended from the north to

428 Kromer 1977, p. 50.

429 Pieradzka 1931, passim.

430 From among many examples in Kraków town councillors' and echevin books, cf., inter alia: ANK, SC, 5, p. 102, year 1425: *dominicus ortulanus horreum suum magnum situm ante valvam sancti Nicolai penes ortum domini Nicolai Vastgort nostri Advocati usus plateam super fundo sive terra domini quondam Georgy morsteyn cum pervio alias durchfort et cum omnibus iuribus domino Georgio Swarcz libere resignavit et promisi*t; ANK, SC 6, p. 42, year 1432: *ortum et domum ante valvam p. Nicolai retro fossatum*. Cf. also: ANK, ALonhCrac., p. 486, year 1572.

431 APP, Kalisz I/53, p. 250, year 1540: *domus et hortus… in suburbio Calisiensi penes domum Marcowa et penes torrentem versus religiosos fratres Bernardinos*; APP, Kalisz I/54, p. 304, year 1543: *Item hortum alterum cum edificÿs situm penes fluvium transeuntem ab ultimo ponte.*

432 AGAD, CastrSirInscr., 12, p. 495, year 1534: *domum suam unacum horto in suburbio Siradiensi penes fluui … Nec non cum obstaculo alias zÿazem*; AGAD SCA I, p. 31, year 1437: *ortum cum omnibus fructibus…in parwo porzecze;* SCA I, p. 34v., year 1434: *ortus in Krasawa*; SCA I, p. 153, year 1448: *ortus circa Crassawa*; SCA I, p. 160, year 1448: *ortus circa fluvium alias na Porzeczu;* near the town moat: SCA I, p. 91, year 1443: *ortus post fossam cum allodio*; SCA I, p. 290v., year 1453: *ortus* … post fossatam; a garden on a leat (identified as a leat as a result of socio-topographical studies): SCA III, p. 72, year 1515: *ortus in porzecze ex parte fluvÿ ad molendinum grądzka fluentis.* Cf also Sowina U., 1991b, p. 44–47, 160–166, 179 et seq.

433 ANK, Proszowice 1, p. 129, year 1478: *ortum Crzemyenczowsky iacentem penes Canal ex una et penes ortum Crasavi*; p. 249, year 1481 – *zagroda penes civilem fossatam*; p. 250 – *domus iuxta fossatam et ortum marek*; ANK, Proszowice 2,: p. 122, year 1520: *ortulaniam…que iacet penes fluvium Srzenya ex una parte et Bophorium Civile alias Blonye*.

434 ANK, Ciężkowice, rkps/MS 413, p. 32 (year 1551) and p. 127 (year 1579).

the south along the small River Babica, also called a torrent (*torrens*), and from the west to the east on both sides of Piotrkowicka Street that ran to the east of the town,[435] up to the estate of the Bochnia *advocatia*.[436] According to the Bochnia records, there was one more small river flowing in the area between gardens called *floszka*.[437] Owing to the fragmentary character of the records it is difficult to definitely establish whether this cluster of gardens and *hortulaniae* was connected with lands (bearing the same name) situated in the vicinity of the bath. The bath,[438] however, built most probably also on the Babica River, could be located more to the south, in the direction of the Brama Sądecka (Sącz Gate). Gardens, in the records referred to as the ones situated "behind the bath" (*retro balneum*), constituted a distinct cluster.[439] In 1497, Świętosław, a water carrier,[440] bought a house *in platea retro balneum*, but closer to the Dolny Rynek (Lower Market Square), perhaps in order to draw water from the nearby River Babica, whose current was rapid (*torrens*), and therefore its water was unpolluted (except for the times of floods). It is known that on that river were devices requiring good-quality drinking water, e.g. breweries belonging to Bochnia burghers.[441] Suburban gardens situated on rivers near Bochnia existed also in Zawada,[442] i.e. in the vicinity of the River Babica, and on the River Solawa (*zolawa*) near Góra Salomona (Solomon's Mountain).[443] They also existed in the neighbourhood of the building of the Bochnia salt mine,[444] whose exact location has not been found. Bochnia was therefore surrounded by gardens and farmlands at least from the north, the east

435 ANK, (The Bochnia branch), ASB 10, p. 173, year 1492: *ortulania in pl. Piotrcovicensi inter Grzescam et inter Babycza fluvium*.

436 ANK, (The Bochnia branch), ASB, 10, p. 42, year 1487.

437 ANK, (The Bochnia branch), ASB 10, p. 107, year 1489. Owing to the lack of other information concerning this river (also in the town's monograph), it is difficult to establish whether it was a polonized (and thus distorted) diminutive of the German word "Fluß", which could refer to the small River Babica (considering the neighbouring *advocatia*), or perhaps rather to a small (natural or artificial) watercourse that was not mentioned elsewhere.

438 Warcholik 1958, pp. 641–642.

439 ANK, (The Bochnia branch), ASB 10, pp. 217 and 228, year 1493; pp. 245 and 247, year 1494.

440 ANK, (The Bochnia branch), ASB 10, p. 309.

441 ANK, (The Bochnia branch), ASB 10, p. 256: *domus cum braxatorio penes torrentem Babycza*.

442 ANK, (The Bochnia branch), ASB 10, p. 164, year 1492.

443 ANK, (The Bochnia branch), ASB 10, p. 103, year 1489.

444 ANK, (The Bochnia branch), ASB 10, p. 261, year 1492.

and the south, which was possible thanks to the above-mentioned small rivers. It is worth mentioning that the lively trade in real estate and the ownership structure of the lands that provided the town with food show that these lands performed an equally important economic role as in other small and medium craft and farming towns of the Crown of the Kingdom of Poland. When we compare mentions from Bochnia 15th-century records and the results of research pertaining to this town[445] with findings concerning towns that were the objects of socio-topographical studies, we can discover a slightly different image of late 15th-century Bochnia than the one presented until now. It can be seen not as a centre of rich burghers who acquired their wealth from salt mining,[446] but as a cluster of people making their living on providing services for the salt mine (profits from the salt mine flowed outside the town). These people worked in such occupations, including crafts,[447] the majority of which (also present in every other town lacking a specific function) placed them lower down the professional and social ladder, which fact decided their meagre means and considerably influenced the economic weakness of the town. Another characteristic feature of weak towns also present in Bochnia was the above-mentioned wide "farming zone" belonging mainly to burghers and suburban crofters. This zone did not consist of suburban manor farms, as these belonged to rich burghers; it consisted of gardens and crofts that provided their owners with food which they could also sell on the local market (thus also acting as service providers).[448] If we look at the situation from this perspective, it will seem only natural that not much later, during the 1564 inspection, when the circumstances changed due to a mining crisis, Bochnia was called "a poor town" which at that time asked for a tax reduction on butchers' stalls.[449]

The existence of fish ponds and pools in suburban gardens should undoubtedly be connected with the fact that since the late Middle Ages fishing economy constituted a very important element of Polish economy,[450] including town economy.

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445 Kiryk 1980, pp. 80–86; id. 1985, pp. 211–223.

446 Kiryk 1985, pp. 215–217.

447 A comprehensive list of these crafts in: Kiryk 1985, p. 215.

448 According to F. Kiryk (1985, p. 215), the fact that "a considerable part of the burgher society made their living from farming" was to testify to the wealth of the inhabitants (besides mining).

449 LustrWojKr., 1962, p. 65.

450 At that time also Bohemia was a country with a flourishing fishing economy – cf., inter alia: CIMRBoh., 1960 and 1961, passim: numerous mentions of fish ponds in Bohemia.

In 1442 in the Kraków region a *piscina cum piscibus* cost 40 marks,[451] and a yearly rent for another one amounted to 1 mark,[452] whereas a fish pond that was big brought a profit of ca a dozen marks.[453] In the 16th century, as carp breeding became widespread, the fishing economy of Bohemia, including Silesia, and of the western part of Little Poland, including the Kraków region, was at the highest European level.[454] According to data from the 1564 inspection of the Crown properties, the income from the fishing economy of Little Poland's Crown manor farms amounted to 12.2% of the total income from these manor farms.[455] This found its reflection in 15th- and 16th-century town records pertaining to Little Poland (and thus also to Kraków) in which we find numerous mentions of ponds and pools: with fish (*piscina cum piscibus*), in gardens (*ortum cum piscina*) and in manor farms-*predia*. For example, in 1449 in Little Poland's town of Chrzanów among properties put up for sale were three quarters of a garden *cum piscina*;[456] in 1503 in Nowy Sącz the *vice-starost nobilis dominus* Wierzbięta became the owner of a suburban manor farm together with fields, ponds and pastures forming part of the estate from time immemorial;[457] in 1547 in Sandomierz a part of a manor farm (*predium*) with a strip of garden, an orchard and an adjacent fish pond was leased;[458] in 1572 town councillors of Ciężkowice transferred into private hands a pond (*piscina*) situated among suburban gardens, despite its importance in the

451 KsWójtKraków, 1995, no. 1510, p. 113 – purchased in two installments 20 marks each. About the prices of *piscinae* cf. also Rachkról., 1993, p. 168, where a purchase of a *piscina* for 60 marks was recorded in the royal accounts at the royal estate income collection point in Nowy Sącz for the year 1412.

452 KsWójtKraków, 1995, no. 1618, p. 127 – 14 June 1442.

453 Górczak 1999, p. 92.

454 Russocki 1981c, p. 223. Extensively about this cf. Hoffmann R., 2000, pp. 390 et seq.

455 Russocki 1981c, p. 223. Nevertheless, we have to take into account that this data may have been merely an inspection estimate of production possibilities, as was pointed out by Andrzej Wyczański (1964, p. 97), who commented on the revenues from the pond economy of the Korczyn starosty in the light of the 1564 inspection.

456 ANK, (Wawel), rkps dep./Dep. MS 36, p. 52, year 1449; there was also a suburban pond cluster in Chrzanów, which can be evidenced by a mention from the beginning of the 15th century of the fact that a man called Brudz of Ciężkowice bought a field situated *post piscinas* in the early 15th century – cf. op. cit., p. 7.

457 ANK, AD 49, p. 636.

458 APS MS 6, pp. 144v–145.

town water supply system.[459] The Kraków suburban gardens also abounded with ponds and pools.[460]

In 1598 the Kraków municipal officials called *quartalienses* described water devices in an abandoned garden belonging to the Jesuits, and before that to Hieronim Bużeński, a member of the gentry, salt miner and royal tax collector.[461] The garden was situated in Nowa Wieś, a Kraków suburb on the road to Łobzów. It included four pools, two huge, two small, all destroyed, because all blocked, silted up, overgrown, and without water. There was no water in any of the sluices, *Mönchs,* or troughs, but only empty holes in need of general repair. The description of the bad state of repair gives us an idea of how fish ponds and pools functioned at that time.

In the mid-13th century Bartholomeus Anglicus formulated the encyclopaedic entry *De piscina*[462] in the following way. A pond is water collected to nourish fish; however, through antiphrasis, this word is more frequently used to refer to a water reservoir without fish,[463] as Isidore teaches. In order for a pond to be built properly, the ground must be solid, the water that shall be let in must be pure, and the inflow of water must be continuous. Where the ground is muddy or marshy, tasty fish cannot be bred; neither can they be bred where water does not flow, because stagnating water that is not moving becomes easily putrefied. For that reason, to freshen water in a pond, fresh (pure) water should flow into it through channels and pipes, whereas banks and causeways that form the sides of the pond prevent the inflowing water from flowing out. From such ponds small streams are conducted to irrigate gardens; herbs and trees planted near ponds become lavishly green and bear abundant fruit: *Piscina est aqua ad nutriendum pisces collecta; quis*

459 ANK, (Wawel), rkps dep./Dep. MS 414, p. 92.

460 An archival research of the Kraków town books revealed the existence of *piscinae* in the main clusters of suburban gardens, e.g. outside Brama św. Mikołaja (St Nicolaus Gate) – cf., inter alia: Wyrozumska 2003, no. 35, pp. 23–24 (year 1441), after: ASC 6, p. 227 and KsWójtKraków, 1995, no. 1682, p. 135; gardens also in Garbary, along Czarna Street, in which, inter alia, a fish pond belonging to the Lang patrician family was situated – cf. CA, Suppl. 1993, no. 75, p. 130. More about the topography of gardens, ponds and rivers in the district of Garbary – Pieradzka K., 1931, passim.

461 KsWiertelKraków, 2000, pp. 13–14.

462 Bartholomeus 1519, lib. XIII, cap. XIIII, De piscina.

463 E.g. from the Muslim times in the gardens of Palermo *piscinae* were present together with cisterns, irrigation containers (pools) – cf. Bresc 1994, p. 244, with the following quotation from a 12th-century mention of a donation of a garden: *"ut faciant ibi piscinam ad rigandas inibi futuras erbas et domesticas arbores"*. What is worth noting is its striking similarity to the description provided by Bartholomeus Anglicus.

per antifrasum aquarum collectio non habens pisces piscina sepius nominetur ut dicit Isidorus ad bonitatem aut piscine erigitur fundi soliditas aque influentis puritas et influentie continuitas: ubi enim fundum est limosus et paludosus pisces saporosi nullatenus nutriuntur: ubi etiam recens aqua non fluit: aque stantes et non mote defacili corrumpuntur: et ideo ad piscine renouatione(m) per canales et fistulas aque dulces et recentes inducunt vallibus et ageribus ne influentes aque effluant piscinarum termini minuunt. De piscinis etiam riuuli ad ortorum irrigatione deducuntur herbe et arbores iuxta piscinas site magis virentes et fructifere inueniunt. The term 'pond' (and not 'pool') was used for the translation of this entry, since – judging from Olbrycht Strumieński's instructional treatise "O sprawie, sypaniu, wymierzaniu i rybieniu stawów, także o przekopach, o ważeniu i prowadzeniu wody [On setting up, building, measuring and stocking ponds with fish, and on ditches, weighing and conducting water]", first published in print in 1573, but which repeated much earlier knowledge of the subject – Bartholomeus described a pond, i.e. an artificial water reservoir, whose basic function was breeding fish. According e.g. to O. Strumieński, the difference between a pond and a pool (*piscina*) was that pools were used to keep fish in when water was drained from ponds. An inherent element of the system of devices used to breed fish, pools were mainly used to keep fish in them. They could be either water reservoirs dug in the ground and inseparably connected with ponds, or other water reservoirs (even wooden vats and pools placed in cellars). The former type is found e.g. in accounts of the Kraków *viceprocuratio* of 1393–1395: *Pro piscibus recentibus emptis et destinatis in Sadzawca per Wislam versus Nepolomice V marc. XVIII sc., pro transfretatione predictorum piscium in Szadzawka lignea ibidem per Wislam racione precii III sc.*[464] In this case *piscinae* were even used for river transport of fish on the Vistula from Kraków to Niepołomice. Fish pools situated in cellars existed e.g. in monasteries, like in the case of the Kraków Dominican monastery.[465]

The similarity of the function of ponds and pools and of their construction (aimed at providing equivalent conditions for the fish) was undoubtedly the reason for using one term in mediaeval and early 16th century written sources pertaining to Polish lands to describe the two types of reservoirs, namely *piscina* (plural: *piscinae*). Sometimes even the context does not show whether the reservoir in question was a pond or a pool. From 13th-century source records quoted by Maria Dembińska we can infer that the word *piscina* was used interchangeably

464 Rachkról., 1993, p. 25.

465 Oral information received from Fr Adam Franciszek Studziński OP from Kraków, for which the author expresses her heartfelt gratitude.

with the word *stagnum* to refer to fish ponds which were also called *magnae piscinae*.[466] The latter term suggests that the word *piscinae* was also used to refer to small ponds, like the ones noted (in Polish: "stawki") in 16th-century inspections.[467] Surely larger were the 15th- and 16th-century fish ponds described above, e.g. the *piscinae* in the Kraków Żabikruk situated outside the town walls and the royal *piscinae* in Zwierzyniec.[468] However, according to O. Strumieński, in a well-organised farm there were fish ponds and fish pools, the latter in such an amount so that fish from periodically drained ponds could be kept there. This is why the word *piscinae* did not necessarily refer to several smaller or larger ponds: it could refer to one pond (or small pond) and at least one pool. On the other hand, ponds called *stagni* and *vivaria*[469] were rarely mentioned. For example, in excerpts from Kraków echevin books of 1532–1535 among watercourses and reservoirs forming part of the Betman-Boner manor farm *stagni* and *piscinae* were listed separately.[470] A royal document of 1535[471] contains information about the existing and planned ponds: *vivaria* in Zwierzyniec (which will be elaborated on later). In accounts of Środa in Greater Poland of 1546 there is a mention of a profit made on the sale of fish from the town pond: *pro piscibus ex stagno recepimus sex fertones*.[472]

The analysis of O. Strumieński's text shows that reservoirs for breeding and keeping fish were built in accordance with all recommendations written down in the 13th century by Bartholomeus Anglicus. Both ponds and pools should be built on a watertight ground[473] that is not muddy or swampy;[474] they should be

466 Dembińska 1973, pp. 106–107.

467 LustrWojKr., part I, 1962, pp. 16–17.

468 Apart from the above-mentioned examples dating from the 15th and 16th centuries, cf. also 14th-century mentions of royal *piscinae* in Kraków – Rachkról., 1993, pp. 44, 54, 109.

469 In the Carolingian *Capitulare de villis* (1968), edited in the early 9th century, fish ponds, referred to as *vivaria*, were listed as a very important element of the royal property, e.g. cap. XXI: *Vivarios in curtes nostras*; cap. LXV: *Ut pisces de wiwariis nostris*. Likewise, in the 12th century in Sicily a fish pond was called "Bivarium" – cf. Bresc 1994, p. 241.

470 ANK, SC 11, p. 336, year 1532 and p. 515, year 1535.

471 MRPS, IV/2, 1912, no. 17199, p. 468 (summary) and AGAD, MK 50, pp. 416–419 (text).

472 APP, Środa, I/73, p. 132v.

473 Strumieński 1605, pp. 83–84.

474 Op. cit., p. 82.

encircled by causeways;[475] they should not be filled with still water (that can easily go bad), but with clean running water,[476] or with water changed at the right time, drained at intervals, which can be learned from Strumieński's detailed description. Another conclusion that can be drawn from his advice is that the bigger and the deeper the pond and the pool, the better for the fish. Moreover, a good pond should be 4 or 5 ells deep, and the depth of a pool should equal 3 ells.[477]

As regards constructions conducting water to ponds and pools, Bartholomeus mentioned *canales et fistulas* (which should be understood as canals and pipes) that supplied fresh water, whereas Strumieński wrote about canals (troughs?) and ditches made in the ground conducting water from a river to a pond[478] or to a pool,[479] or from a pond to a pool.[480] As regards installations conducting water away from both above-mentioned types of the reservoirs, Bartholomeus Anglicus mentioned artificial *rivulae* (rivulets, i.e. small streams), whose main role was to irrigate gardens. Strumieński, however, wrote about wooden troughs: they were conduits made from tree trunks cut in half lengthwise with both parts scooped out inside, so that each formed a sort of a long trough; then one part was placed in wet ground (in a dug-out ditch)[481] and covered with the other part acting as a lid.[482] Inherent elements of water installations of ponds and pool, these conduits were used to periodically carry water away from these reservoirs to the river.

Olbrycht Strumieński perceived these troughs to be technically the best way to periodically carry water away from ponds.

If there were more than one line of troughs, the rows should be spaced about 2 ells apart[483] (i.e. ca 1.17 meters).

Another indispensable element used when water was conducted away from reservoirs in which fish were kept were special nets woven from wicker that prevented fish from escaping from the pond.[484]

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475 Op. cit., about causeways of ponds and pools – in numerous places, inter alia: p. 17, but mainly pp. 18–52: "O budowaniu grobley".
476 Op. cit., pp. 15–16.
477 Op. cit., p. 17.
478 Op. cit., p. 16.
479 Op. cit., p. 55.
480 Op. cit., p. 85.
481 Op. cit., p. 84.
482 Op. cit., pp. 36–38 and 40.
483 Op. cit., p. 35.
484 Op. cit., p. 40–41.

As to the installations conducting water away from ponds and pools described by Strumieński, including those situated in suburban gardens, Strumieński advised to place the troughs deeper than the bottom of the pond[485] (ponds should be 4 or 5 ells deep,[486] i.e. ca 2.34–2.93 meters). In the case of pools, Strumieński counselled digging troughs leading to them at the same depth as the pools, i.e. 3 ells[487] (ca 1.76 meters). The troughs were to be placed 3 ells into the pond and 2 ells outside the causeway.[488] As underwater and underground installations, the troughs could not serve to irrigate gardens. Only when the troughs ended, ca 1.17 meters away from the causeway, and their role was taken over by a ditch of the same depth and width,[489] it was that ditch that performed the same function in the garden as the *rivuli* described by Bartholomeus Anglicus.

Carrying water (e.g. in ewers or buckets) from the river to the garden, digging a shallow well in the garden near the river or a ditch on a slope so that rainwater could slowly trickle down into the garden, or collecting rainwater in containers in order to use it for watering plants: neither of these required special cooperation with neighbours (apart from maintaining good neighbourly relations) or made the functioning of the garden conditional on external factors. The case was different, however, when it concerned meeting the above-mentioned technical requirements pertaining to the establishment of fish ponds and pools in the gardens and to their functioning: this required cooperation with neighbours and relied on external factors, so as not to alter the spatial organization of the land on which the reservoirs were situated. Conducting water to the ponds and pools from a nearby watercourse that was owned by somebody else required the permission of the owner of the watercourse, like in the case of carrying water to mills described above. The homogeneity of these situations is revealed in source records pertaining to Kraków, including the inspection of 1564 of the property of the Royal domain under the management of the governors of Kraków. The inspectors' report about the functioning of mills forming part of the Royal domain of Kraków boiled down to the description of the "granted water" and to the conclusion that the inspected "troughs and pipes on the rivers Rudawka and Promnik [Prądnik], built on the basis of royal privileges granting water to people known by name, of various estates, who have manor houses and gardens near Kraków, for their ponds, pools and mills, do considerable harm to the mills belonging to the Royal domain.

485 Op. cit., p. 36.
486 Op. cit., p. 17.
487 Loc. cit.
488 Op. cit., p. 36.
489 Op. cit., p. 40.

Firstly, the water granted and conducted from the river in the direction of ponds and pools does not flow back to the river by the Royal mills, and thus these mills receive an insufficient amount of water (…). Secondly, other mills, standing on the 2 rivers above the royal mills, when in winter they let the granted water on the ice, a block of ice forms which breaks the banks and breaches the dams, which is why guards and repairers must often be called in at great expense."[490] The first description given after these words comprised the objects that were granted water "from Rudawka," enumerated in order from the powder mill up to Mydlniki, i.e. in the opposite direction than the course of the small river-leat, divided into two stretches. From the first stretch – between the powder mill and the "Kamienny" ("Stone") mill – water was conducted to 10 properties; from the second stretch – from the "Kamienny" mill to Mydlniki – to 9 properties. It was stated that the most of these properties used the water for fish ponds and pools situated within their limits. In most cases water was supplied through a single trough. In one case apart from a trough there was also a pipe mentioned. In one case there was only a pipe mentioned. Most of the troughs in the first stretch measured one span in width and in height, referred to as "an equal span", i.e. probably a third of an ell (ca 20 × 20 cm); only rarely the width of a trough equalled "a great span", i.e. probably three quarters of a foot (ca 22 cm).[491] The dimensions of the conduits (and therefore the amount of water that had been granted!) of the second stretch also measured one span, only the measurement was given in different units: "hand" and "small pace",[492] which referred to the troughs ("trough a small pace wide") and to the only pipe in this stretch ("a small pace round").[493] The largest conduit, and thus taking the most water, was a chest "wider than an ell and over a half of an ell high, which takes great water to its owner's plot".[494] Apart from this water that "had been granted", royal mills working on the waters of the River Rudawka were

490 LustrWojKrak., part I, 1962, pp. 14–17.

491 Kamler 1981, p. 69, where the author stated that 1/3 of an ell equalled ca 19.8 cm, and ¾ of a foot equalled ca 22.3 cm; according to the Constitution from the year 1764 the Old-Polish foot equalled 29.(7) cm. The present author took as the basis for her calculations the Kraków foot, used earlier, which equalled 29–29.3 cm; cf. also Krasnowolski 2004, part I, pp. 137 et seq.

492 SłPolXVI, vol. XI, 1978, p. 196; SłStaropol, vol. VI, 1970–73, pp. 125–126. "Kroczek" [a small pace] was also a word used to describe a young carp ca 20 cm long.

493 LustrWojKr., part I, 1962, p. 15.

494 Op. cit., p. 16.

poorer in water that was "stopped" by a water-powered forge (*hamer*) in Mydlniki and by a private fulling mill belonging to Erazm Aychler.[495]

As for drawing water for private use from the River Prądnik, the second description, namely the *List of troughs and pipes*,[496] comprised 22 properties situated along the River Prądnik, also enumerated in the opposite direction to its course, starting with the royal mill "behind St Nicolaus' Church" in the direction of the "Piaseczny" mill and the mill in Rakowice, and further toward the villages of Prądnik and Zielonki. From the River Prądnik less water that "had been granted" flowed through conduits than from the River Rudawka. This is evidenced by a smaller total number of covered two-piece troughs, channels of the same capacity as the troughs (the size in both cases was one span – most probably like in the instance of the River Rudawka – "in width and in height"[497]) and 2 drilled pipes (one of them is known to have had the width of a finger 429[498]). However, the water level in the River Prądnik decreased more noticeably than in the River Rudawka because of the "lease and the stopping of water" by using it for the functioning of as much as 11 private grain mills and 2 grinding mills, one of which stood near a pond collecting water thanks to a huge weir taking water away from the river (additionally, the water disappeared in brooks in meadows). In addition to these actions, detrimental to the royal mills on the River Prądnik, also weir shutters were built in one case and in another case water was conducted to meadows and small ponds "through a large ditch".[499]

The way of using water from the two rivers that performed the most important economic functions not only for the Royal domain, but also for Kraków, as described by the inspectors in 1564, on the one hand reflects the limited possibilities of both of the watercourses, and on the other hand shows the lack of control and

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495 Loc. cit.

496 Op. cit., pp. 16–17.

497 Two troughs conducted to the town bleachery near the mill behind St Nicolaus' Church were an exception: so much water flowed through them that – as was noted by the inspectors – it set a fulling wheel in motion – op. cit., p. 16. Perhaps it was a wheel of a fulling mill built in 1458 on the leat of the Rudawa-moat, now (i.e. in 1564) set in motion by water conducted from the River Prądnik flowing nearby. This perceptible change in time in the way water was supplied may have been the reason for the error contained in literature (Wyrozumski 1992, p. 364) that from the very beginning the fulling mill was powered by water from the River Prądnik, and not from the River Rudawa.

498 MRPS IV/2, 1912, no. 15252, p. 362; AGAD, MK, Acta Petri Tomicki, 43, 40–41; ANK, GrabowskiStaroż., p. 790.

499 LustrWojKr., part I, 1962, p. 17.

the lack of skill in managing them in the period known as the Renaissance heyday of the town. This meant that the governors managing the Royal domain, including the royal water resources, did not adhere to rules formulated in preserved earlier royal decisions, e.g. in a decision stating that granting water from a royal river was an exceptional privilege. We can find only a trace of this rule in 1564: this privilege was enjoyed mostly by the representatives of the Kraków patriciate as well as by the Kraków: Bishop, Castellan and *supparius salis* and also by the Dominicans and the parsons of St Anne's Church and St Mary's Church. A close reading of the earlier royal privileges granting water reveals the sovereign's consistency in describing these privileges as acts of his exceptional grace shown only to important people. As has been mentioned above, Jerzy Szwarc (the councillor and burgomaster of Kraków) obtained in 1440 the King's confirmation of his right to perpetually use water from the royal River Prądnik for the functioning of *piscinae* in a garden that had long been owned by Szwarc, located in a cluster of gardens behind St Nicolaus' Church Water was conducted to them from the river through separate conduits. The privilege to use water did not apply to the property, namely to these garden fish reservoirs, but it concerned Szwarc personally (and his natural heirs), since – as has also been mentioned before – in 1458 the Monarch issued another privilege for the same property, this time for the benefit of Mikołaj Krejdlar, and in the early 16th century one more: for the new and young Bishop of Płock Erazm Ciołek. This is known from the royal document of 20 December 1504 in which King Alexander Jagiellon, acceding to Ciołek's requests, confirmed the above-mentioned privileges (of 1440 and 1458) *super liberum aquae fluxum de fluvio Prandnik per canalia duo ad piscinas in horto existentes*.[500] The King also allowed the construction of a third conduit that would – apart from the two existing canals – conduct water from the river. And thus also the Bishop Ciołek as the next owner of the garden and of the *piscinae* located there had to make an effort to obtain the King's personal privilege granting him the right to draw water from the royal river. Besides, these *piscinae* were not the only fish reservoirs that Erazm Ciołek owned in the Kraków suburbs. Earlier, on 13 June 1502, the King granted him the right to conduct water from the River Rudawka to ponds/pools (*ad piscinas*) in a garden that belonged to Ciołek, situated near the Church of the Visitation of the Blessed Virgin Mary in Piasek,[501] i.e. in Garbary. Bearing in mind that two months earlier E. Ciołek (referred to in the above-mentioned document of 1502 as the provost of Vilnius and secretary

500 MRPS III, 1908, no. 1929, p. 124; AGAD, MK 21, pp. 106–106v.
501 MRPS, III, 1908, no. 548, p. 36; AGAD, MK 20, p. 9.

to the King) had become the Kraków canon,[502] one can presume that the garden was situated within the Kraków canons' custody.[503] The water was to be conducted through an underground canal, which was a much more complicated enterprise in terms of technical requirements than conducting it through an open ditch. The necessity of building an underground canal might have resulted from the fact that between Ciołek's garden and the Rudawka River were plots of land belonging to other people.

Technical conditions of the royal privileges of 1502 and 1504 granting water that was necessary for the proper functioning of fish reservoirs in Erazm Ciołek's gardens indicate that he was especially favourably treated by the King. This would be consistent with what is known about the career of the young entrepreneurial Erazm. In 1494 as a twenty-year-old he was drafted in by Alexander Jagiellon, the Grand Duke of Lithuania, to Vilnius and became his secretary. For nearly a year (from the beginning of 1501 to the beginning of 1502) as the Duke's emissary in Rome he was sent on a difficult diplomatic mission which he successfully accomplished.[504] Having returned from that mission he became a canon in Kraków – and the owner of the garden with the above-mentioned fish reservoirs for which water from the River Rudawka was needed. The conferral of the waters from the River Prądnik in 1504 (including the "third, additional" canal as an expression of King Alexander's special grace) was preceded by E. Ciołek's nomination to the Bishopric of Płock in 1503 (also thanks to the King's support 437[505]) and by his taking part (as the Bishop-senator) in the general Seym in Piotrków in 1504, important for the interests of the royal domain and the treasury.[506] The privilege granting E. Ciołek the additional water from the River Prądnik (which was the effect of his efforts) was issued right before Christmas of 1504, i.e. in winter, when it was difficult to dig in the ground. But the Bishop, who was about to leave for Rome in a couple of days on a second diplomatic mission,[507] received the permission on the

502 Łempicki 1938, p. 78.

503 About gardens of the Kraków canons' custody in Garbary – cf. Pieradzka 1931, pp. 49–50.

504 For the details of the mission – cf. Łempicki 1938, p. 78; Bardach 1978, p. 318.

505 Łempicki 1938, p. 78.

506 Bardach 1978, p. 323.

507 Łempicki 1938, p. 78 – about the details of that mission to Pope Julius II, including the efforts to confirm the Second Peace of Toruń/Thorn of 1466 between Poland and the State of the Teutonic Order, and to demand the fulfilment of the outstanding homage which was to be performed by the Grand Master of the Teutonic Order before

strength of which the works stipulated in the document could start in spring, even during his absence, which in fact lasted until autumn of 1505.

Granting water from the royal rivers Rudawa and Prądnik for gardens situated in their vicinity had a distinct economic aspect to it, as it concerned garden fish pond and pools. A reading of the royal privileges granting the right to conduct water to these reservoirs reveals that their importance in the beneficiaries' wealth structure must have been profound. On 28 June 1505 King Alexander allowed a nobleman called Mikołaj Cikowski to buy from another nobleman, Marcin Borzymowski, the plot (*area seu locum*) that formed part of the royal properties in Zwierzyniec and – *ex speciali gratia* – to build anew a pond (*piscina*) there.[508] This plot was situated next to royal ponds. Due to the fact that water from the royal ponds could prove insufficient for the new pond, the King allowed the construction of yet another canal to conduct water from the river Rudawka *ductilibus canalibus alias rinamy* along the causeway of the royal ponds and under a road leading from the Brama Grodzka (Burgh Gate) to Zwierzyniec (*Ferale*). On 29 August 1525 Jan Bethman, Jan Zeyfrid's son, a Kraków patrician, obtained the right to conduct water from the River Prądnik to his fish ponds from the bridge over the River Prądnik in the village of the same name, between the mill belonging to the Dominicans and the paper mill belonging to Jan Haller, another patrician. Water was to be drawn for ever through pipes (*cannas*) measuring "a half of a quarter of an ell and two digits" (*ad medietatem quartae partis cubiti et duorum digitorum*).[509] If we assume that these values made up the total cross section of the inside of the pipes, their inside diameter equalled 11.025 cm (7.325 cm + 3.7 cm),[510] and therefore not much more than a half of the cross section encountered in most conduits listed in the 1564 inspection that measured one span. The royal privilege of 1527 for the Kraków burgomaster Jan Morsztyn concerned conducting water from the River Prądnik to the *piscinae* (a pond or ponds with a pool or pools) situated within the limits of his manor farm in Piasek. Since some of the reservoirs had been supplied with water from this river for a long time, now the "additional water" was to flow through pipes one digit-inch wide (*aliam aquam ad spissitudinem unius digitti ex eundem fluvio Prandnik*

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the Polish King. Loc. cit. – about the Roman achievements of Ciołek, the erudite, including winning the favour with Pope Julius II for the Polish national interest.

508 MRPS III, 1908, no. 2291, p. 151; MK, 21, 233.

509 MRPS IV/1, 1910, no. 4834; AGAD, MK, 38, 543–544.

510 Assuming that 1 ell equalled 0.586 m (the Kraków foot equalled 0.293 m) and that 1 finger (*digitus*) as the smallest unit of length equalled 1.85 cm – Frontinus 1961, p. 90, footnote 163 and SłŁacŚr, III, column 551: transversum (latum) digitum.

recipere, et ad hoc ipsum praedium suum Pyassek per fistulas seu canales ducere). The King underlined that he issued the privilege as a reward for Morsztyn's services.[511] On 31 October 1532 Piotr Wedelicjusz, a royal physician and a Kraków councillor, and his wife obtained a privilege to conduct water from the River Prądnik to ponds and pools in a manor farm in the village Prądnik.[512] Making the wife a co-beneficiary of the privilege was very unusual in comparison with other similar privileges. However, it resulted from the fact that (as we learn from her last will) she was the owner of this manor farm as the rich widow of Jan Lang.[513] Hence Piotr, according to the principles of the Magdeburg law, only exercised the administration of this manor farm. Nevertheless, there was no mention in the royal privilege of this important formal and legal difference. On the other hand, it applied also to the couple's heirs, namely those who would inherit the manor farm together with the ponds. According to the law, this could concern their common children or the children of Piotr's wife born from her first marriage, or Piotr's heirs. No children were born from their marriage, which is why Piotr could legally keep a half of her fortune.[514] On the strength of the last will of Piotr's wife the manor farm formed part of the half of her estate that she bequeathed to Piotr, but in a form that was probably more palatable to the Lang family, i.e. in the form of a 1000-florin bequest on the manor farm: the Langs could pay Piotr the money (this solution, however, did not prevent the Langs from protesting against the bequest). The Langs did not pay Piotr until the end of his life. An inventory drawn up on 26 March 1544, after Piotr's death, contains a list of documents concerning the manor farm, including an agreement on the strength of which Piotr leased the manor farm in question.[515] The royal privilege issued for the benefit of Piotr and his wife concerned the same amount of water and the same (diameter of the) auger as **did the privilege for the town to draw water** from the Rudawa River to the town water supply system. It was to be conducted from the river Prądnik near a small bridge over this river, along the road to Słomniki, and nobody was allowed to obstruct the construction. It was

511 MRPS IV/2, 1912, no. 15252, p. 362 (MK, Acta Petri Tomicki, 43, 40); APKr., GrabowskiStaroż., p. 790.

512 MRPS IV/2, 1912, no. 16591, p. 429 and MK 48, pp. 268–269.

513 Testamentum Honestae Dominae Catherinae, Spectabilis ac Egregii Domini Doctoris Petri Wedelicÿ de Oborniki consortis Conditum in Domo Testatricis ex opposito templi p. Mariae in Circulo feria quinta post Egidÿ Anno Domini MDXXXIX – ANK, LT 772, pp. 270–275.

514 Sowina 2006b, p. 176.

515 CA II/2, 1937, p. 432.

underlined in the privilege that this solution was more convenient than the way in which earlier (on the strength of a decision issued by a commission headed by the Kraków *viceprocurator* Melchior) water was to be conducted to this manor farm, namely next to the meadow belonging to the Dominicans through a wooden conduit through the causeway belonging to the manor farm. These unquestionably favourable conditions of the royal privilege should be interpreted as an additional reward for Piotr for taking medical care of the King, especially in the light of the fact that six months earlier, on 3 May, the King established Piotr's annual salary at 20 marks paid in 4 quarterly instalments of 5 marks each from the Royal Saltworks in Wieliczka.[516]

On the feast of the Nativity of Mary, namely on 8 September 1535, King Sigismund, conscious of the services that Piotr Kmita of Wiśnicz, the then castellan of Sandomierz, the King's marshal, the starost of Kraków, Spisz, Przemyśl and Koło, had rendered to the King and to the Kingdom, gave him a strip of the royal land in Zwierzyniec (*partem loci et aree in ferale quod Swyerzenyecz dicitur*) extending along the River Rudawa.[517] This piece of land was 155 ells long measured from the river and 150 ells wide measured from the ponds belonging to the Kraków Bishop on one side to a house near the ponds belonging to Mikołaj Mniszek, the starost of Łuków, on the other side. On this plot, whose total surface area amounted to ca 8000 m^2, Piotr Kmita was to dig and build ponds (*vivaria*) and all other buildings (*edificia*) that he should consider useful for himself. The King also granted Kmita the right to draw water from the River Rudawa in a sufficient amount to fill these ponds and to keep fish in them, and the other way round: to drain water from all of the ponds at once or from each of them at a time in a completely unrestricted manner.

The privilege for Piotr Kmita is a document of particular value, because it provides information that cannot be found elsewhere. First of all, as has been mentioned above, the word *vivaria* was used to describe ponds instead of the less precise *piscinae*. Hence, we know from the beginning that the privilege referred to "establishing" more than one pond, most probably more than two ponds, considering the mention of the possibility of draining water from all of the ponds simultaneously and from each of them separately (*de ipsis vivariis simul omnibus vel singulis dum placeret et expediret aquam dimittendi*). The next advantage of the document in question is that it stated the exact location of the plot (and of the neighbouring

516 AGAD, MK 47, pp. 432v.–433.

517 MRPS, IV/2, 1912, no. 17199, p. 468; AGAD, MK 50, pp. 416–419. A biographical entry about P. Kmita – Kowalska 1967–1968, pp. 97–100.

plots) on which the ponds were to be built. Even more valuable pieces of information, due to their uniqueness, are the dimensions of the land that enabled the author of the present work to define the surface area that was needed for the establishment of at least three ponds together with the indispensable causeways surrounding them and probably with pools accompanying the ponds (according to the rules pertaining to their construction). The fact that the whole stretch of land in question was intended for breeding fish proves that this privilege, undoubtedly advantageous to Piotr Kmita and his heirs, was of a purely economic character, and not recreational. For recreational purposes Piotr Kmita used a garden at Wiśnicz Castle that he owned near Kraków.[518]

The unlimited freedom that the King gave Piotr Kmita and his heirs in respect of draining water from the ponds most probably resulted from the fact that water from the ponds could be released directly into the River Rudawa, separated from the ponds only by a causeway. If water was released into another pond, there had to be a correlation in time between periodical draining of one pond and filling (with the same water considered as fresh) another, neighbouring pond, according to principles prevalent at the time, presented above in O. Strumieński's treatise.[519]

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518 Kowalska 1967–1968, p. 99.

519 As maintained by Stanisław Russocki (1981b, p. 223), since in mediaeval Poland ponds for rearing juvenile fish were unknown, it took ca 3–4 years from the time the pond was stocked with fish until it was drained. According to O. Strumieński's instructions from 1573 (p. 96), this process was to be repeated every 2 years. The fact that his instructions were being followed was reflected in an inspection of the property of the Szadek starosty which took place in the years 1628–1632 – LustrWojWielk., 1969, p. 61. However, according to A. Wyczański's research (1964, pp. 94–97), in the 16th century within the limits of the Korczyn starosty rearing ponds were drained at different intervals (depending on the year), sometimes every 4 years. Comparative data from mediaeval France, gathered by G. de Gislain (1984, passim, especially pp. 90 and 93), show the same phenomenon, but with a predominance of the 2-year period advised by O. Strumieński. French ponds implementing this system remained filled with water and stocked with fish during 2 years, whereas in the third year they were drained, adult fish were sold, and for a period of ca 7–8 months they were kept dry, which enabled the assessment of their state. The latter period could be lengthened if breeding fish was to be changed into farming (conducted in the pond). If this period lasted 2 years, the plants grown in the first year were willows, and those planted in the second year were winter cereals. If it was only a 1-year period, willows and spring cereals were grown. In some demesnes this was the only way in which e.g. oat was grown (these rules became well established in the late 15th century and remained unchanged until the French Revolution). It sometimes happened that the pond stocked with fish was owned by one person, and the drained pond treated as a

This was how the neighbourly system of the functioning of numerous Kraków suburban fish reservoirs was shaped. Such a system must have functioned e.g. between Kasper Beer's pond that was being drained in 1504 or Mikołaj Cikowski's pond that was being filled in 1505 and the royal ponds in Zwierzyniec to which (respectively) water was released when they were filled and restocked with fish and from which water was emptied at the time of draining (the latter correlation was also envisaged in the case of Mikołaj Krejdlar's pond being built in Żabikruk in the 1460s). The system had to be organized in such a way as to function efficiently and permanently (for more than one generation) in a limited space that was varied in terms of ownership. What is more, its functioning was not to disturb the rhythm of life and work of this space, including its hydrographic conditions. Water was to be used effectively and sparingly (because it was always scarce), and it was not to be wasted, which, unfortunately, was sometimes the case, if we believe the inspectors' complaints.

Any perturbations caused damages in the neighbourhood, which entailed the necessity of settling the matter in court in order to remove their ill effects and prevent them in future. On 15 November 1443 Grzegorz, the parson of St Nicolaus' Church situated behind the Kraków town walls, testified before the consistory court in his own name and on behalf of his Church and undertook to repair all the damages and conduits (*canalia*) through which water from a pool (small

pasture or a field belonged to another person. The harvest was rich, because a layer which remained in recently drained ponds was a good natural fertilizer, especially for cereals. A large-scale destruction of ponds brought about by the Hundred Years' War resulted in their transformation into the above-mentioned farmland, which in turn lead to a decrease in fish production on the one hand, and to an increase in meat production on the other. Written sources from the Polish lands referring to drained ponds are scantier, which is why in works pertaining to fish economy we merely find general information about removing reed from periodically drained ponds (it was used as a building material) and about their being "ploughed and sown" (Topolski 1957, pp. 187 and 189). Very rarely do sources provide us with information concerning the duration of the drain period; it is known e.g. that one of the ponds near Zator and one near Wadowice were dry for a year: the first one "for drying", and the other one "for betterment" – LustrWojKr., part I, 1962, p. 226. Hence, in both of these cases farming was out of the question. Only dry, emptied ponds were sometimes commented on, in that it was economically more profitable to change them into meadows than to bear the costs of maintaining ponds stocked with fish – Wyczański 1964, p. 95. Consequently, we can perceive the great destruction of the pond economy during the Swedish Deluge in the 17th century from the same perspective as the destruction of French ponds after the Hundred Years' War.

pond? – *piscinula*) in his garden flowed away across the "major road" (*per viam et stratam magnam*) at the back of the garden southwards, through a garden belonging to another priest called Teodoryk, and finally filled the latter's pond (pool?). Grzegorz had been granted permission by town councillors (as the probable owners of the road) and Teodoryk (as a beneficiary) to build the underground conduits (placed under the road) following such a track. However, a canal had burst and water flowing through it had partly destroyed the road and had caused some damage to Teodoryk's property.[520]

The technical solution used to conduct water from Kasper Beer's pond to the royal ponds shows a different way of supplying water to some royal fish reservoirs than using water from the nearest river.[521] It also shows that royal ponds played a part in the economic life of suburban garden and fish farms of Kraków. An indispensable and also decorative element of the royal gardens in Zwierzyniec,[522] fish ponds and pools performed mainly an important economic function in the structure of the Kraków royal domain,[523] mostly due to a high profitability of the fishing economy of the period.[524] The latter factor determined the fact that the same kind

520 CA Supp., 1993, no. 244, p. 113. Very similar situations occurred also in other centres, e.g. in 1466 in Poznań, when the town councillors, after an on-scene inspection, i.e. having examined two neighbouring suburban gardens, prohibited the owner of one of the gardens from conducting water away from a pond (pool?) situated there through the garden of his neighbour due to the damage it caused. At the same time they ordered that the water be conducted some other way, but they failed to define which way – ARadzPozn., vol. I, 1925, no. 1066, pp. 400–401.

521 It results from the examples quoted above that the general expression used by K. Bąkowski that royal fish ponds, just like other fish reservoirs, were mainly "fed by waters from the Rudawa River", cannot be deemed satisfactory – Bąkowski 1902, p. 170.

522 It is known from accounts for the upkeep of the royal gardens in Kraków that there were animals, various aromatic herbs (a scene as if from Crescenzi's treatise) and also vegetables for the royal kitchen – cf. e.g.: RachBoner 1955, passim. The existence of an animal garden – *hortum ferarum* – was confirmed in the 14th century, e.g. in the years 1393–1393 – cf. Rachkról, 1993, p. 11. Cf. also Trawkowski 1959b, p. 88. More about garden layouts, especially Renaissance – Ciołek 1953, passim.

523 For the sake of comparison let us note H. Bresc's findings (1994, passim) concerning the same (i.e. mainly economic) role that mediaeval gardens in Sicily played in the structure of the royal property, including ponds and pools functioning in these gardens.

524 Bogucka 1989, p. 234, about the economical Queen Bona Sforza who herself supervised the periodical draining of ponds and their sale in her estates in the eastern borderlands of Poland.

of reservoirs established or already existing in the suburbs of Kraków were owned by lay landlords and members of the clergy who were connected with the royal court and with the Wawel Cathedral, as well as by Kraków patricians who rendered special serviced to the King.[525] At the same time, all of them were dependent on the King's grace reflected in the privileges granting the right to use water essential for the functioning of pools and ponds and necessary to reap profits from the reservoirs. On the one hand, the King rewarded people for their services by enabling them to earn profits. On the other hand, he kept them dependent on his will, as there always existed the unexpressed but obvious danger of losing the profits together with losing the King's favours (by being cut off from the royal water). This shows the extent to which granting the right to water was one of the attributes of power.

525 Thanks to research conducted by Jan Ptaśnik (1905, p. 69) it is known that e.g. in a manor farm belonging to Seweryn Boner, situated outside the Brama Mikołajska (St. Nicolaus' Gate), on the road to Grzegórzki, in the mid-16th century there were 5 fish ponds, including one "large, one smaller and 3 considerable", a bath and a grand garden with a place for strolls called "the labyrinth" and a pool in the centre; a wooden bridge lead to [an island] in the middle of the pool on which a wooden tower was built.

Part III. Water for towns

III.1 Rainwater cisterns

Although in the treatises quoted above rainwater was called "the best" for drinking and cooking, it was recommended that containers for rainwater (Latin: *cisternae*) should be built in places where no water was to be found: *cum aqua deest*, as Pietro de Crescenzi put it, referring to Palladius, and as Andrzej Trzycieski translated it into Polish in 1549: "gdzie woda nie może być" [where water cannot be].[526] Recommendations to use rainwater only as a last resort perhaps resulted from the fact that it was difficult to store (as "the lightest") so as to preserve its high quality, namely that of water suitable for drinking. Let us recollect that the earliest this very piece of advice was given was by Aristotle: [the town] "must possess if possible a plentiful natural supply of pools and springs, but failing this, a mode has been invented of supplying water by means of constructing an abundance of large reservoirs for rainwater, so that a supply may never fail the citizens when they are debarred from their territory by war."[527] Indeed, rainwater cisterns played an important role only in places suffering from a scarcity of water – either temporarily or permanently – or even from the lack of other sources of drinking water.

Two types of cisterns were built: tank cisterns and filter cisterns (fig. 17). At the beginning of the 14th century the latter – more complicated in terms of construction – were described by Pietro de Crescenzi: *Cum aqua deest, cisterna, secundum Palladium, fiat, magnitudie qua dominus delectatur, et quae sufficit ad aquam omnium conduci possit aqua tectorum, testaceum pauimentum superfusione leuiget(ur). Hoc pauimentum omni cura terendum est ad nitorem et lardo pingui cocto assidue perfricandum, ne deducto humore riuus in aqua parte fundatur, et ita post diuturnam siccitatem aque praebeatur hospicium, in eius medio formetur puteus, deinde circa eum omnis concavitas repleatur in fundo de grossis lapidibus fluminum, in medio et de minutis et de sabulo in supremo.*[528] These cisterns had a clay bottom; they were filled with gravel and sand that filtered the rainwater and surrounded the container (*puteus*) holding water that had already been filtered and from which water could be drawn. This description refers to the ancient

526 Crescenzi 1548, lib. II, cap. X, De Cisternis faciendis, p. 17; Polish translation: Crescenzi-Trzycieski 1549, p. 32.

527 Aristotle, *Politics*, book 7, section 1330b. Web.

528 Crescenzi 1548, lib. II, cap. X, De Cisternis faciendis, p. 17.

model of these constructions, mentioned by Palladius,[529] and before that by Vitruvius[530] and Pliny the Elder.[531] In the mid-15th century this model was once more presented in detail by L.B. Alberti,[532] and one hundred years later it was rendered into Polish by Andrzej Trzycieski.[533]

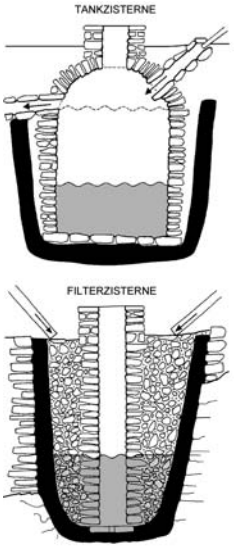

Fig. 17: Rainwater cisterns in mediaeval upland burghs, castles, monasteries and towns. Left: tank cistern; right: filter cistern, after: Grewe K., 1991a, p. 54.

529 Palladius 1898, lib. I, 16–17. Polish translation: Palladius 1999, lib. I, 16–17, pp. 17–18.

530 Vitruvius VIII, 6: 14 and 15. Web: *14. Sin autem loca dura erunt aut nimium venae penitus fuerint, tunc signinis operibus ex tectis aut superioribus locis excipiendae sunt copiae. In signinis autem operibus haec sunt facienda. Uti harena primum purissima asperrimaque paretur, caementum de silice frangatur ne gravius quam librarium, calce quam vehementissima mortario mixta, ita ut quinque partes harenae ad duas respondeant. Eorum fossa ad libramentum altitudinis, quod est futurum, calcetur vectibus ligneis ferratis. 15. Parietibus calcatis, in medio quod erit terrenum, exinaniatur ad libramentum infimum parietum. Hoc exaequato solum calcetur ad crassitudinem, quae constituta fuerit….*

531 Plinius 1897, lib. 36, 52, 173: *cisternas harenae purae asperae V partibus, calcis quam vehementissime II construi, fragmentis silicis non excedentibus libras; ita ferratis calcari solum parietesque similiter. utilius geminas esse, ut in priore vitia considant atque per colum in proximam transeat pura aqua*.

532 Alberti 1988, pp 342–343. Polish translation: Alberti, 1960, pp. 285–286.

533 Crescenzi-Trzycieski 1549, pp. 32–33.

When it comes to European towns, it happened that rainwater cisterns were nearly the only source of water supply for a town. The best known example illustrating this point is of course Venice. The problem of drinking water was one of the most difficult issues which the authorities of *Serenissima* had to deal with.[534] The city was situated on a lagoon, i.e. on saline sea waters, and therefore no wells could be dug, and the first water supply system was constructed in the 1860s.[535] Hence, transporting river water on barges or collecting rainwater were the only two ways of supplying water to Venice. The famous cisterns: Venetian wells (*pozzi alla veneziana*) (fig. 18) played the most important role. Judging from information concerning their construction obtained on the basis of archaeological research,[536] they were the same constructions as the ones presented above, known in antiquity, described by the above-mentioned: Vitruvius, Pliny the Elder, Palladius, Crescenzi and Alberti. After all, Venetian "pozzi" were cisterns, situated ca 3–4 meters below the level of the highest tide. The walls and the bottom were lined with clay. In the centre, on a stone slab, was a ceramic pipe („canna", *il condotto in mattoni*). The remaining part was filled with sand used for filtering and covered with the paving of the street, the square or the backyard (in the case of private wells). In the covering were two or four (depending on the size of the cistern) openings with holes through which rainwater came in either directly or from roofs via gutters (fig. 19).[537] Filtered though sand, water soaked into the central pipe in which it accumulated and filled the casing of the well (in most cases well casings were highly decorative).

534 Braudel 1967, vol. I, p. 169.

535 Oral information about Venetian water supply system acquired in 1998 from Professor Giorgio Gianighian, Ca'Foscari University of Venice.

536 Crouzet-Pavan 1997, footnote 212, quoting earlier literature, including: Gustavo Boldrin, Giovanni Dolcetti, *I pozzi di Venezia*, 1015–1906, Venezia 1910 and Massimo Costantini, *L'acqua di Venezia*, Venezia 1984. Cf. also: Braudel 1967, vol. I, p. 170 and id., 1992, vol. I, pp. 193–194.

537 Alberti 1988, p. 32. Conducting water through gutters to public cisterns in towns is well illustrated in: Crescenzi-Trzycieski 1549, p. 32.

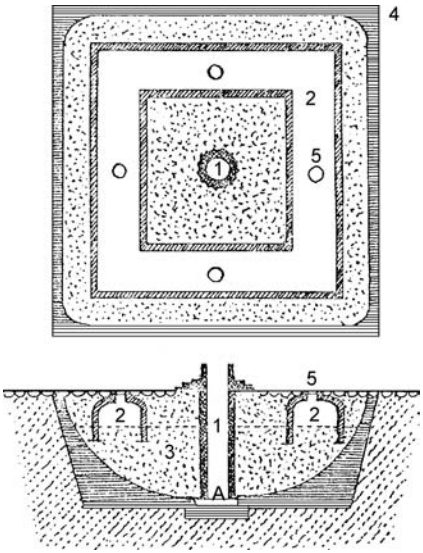

Fig. 18: Venetian well – filter cistern: 1. ceramic pipe ("canna", il condotto in mattoni*), 2. rainwater collectors, 3. filtering sand, 4. the walls and the bottom lined with clay, 5. openings of the collectors. After: Braudel 1967, vol. I, p. 170.*

Fig. 19: Conducting water through gutters to public cisterns in town, after: Crescenzi--Trzycieski 1549, p. 32.

The town had a relatively dense network of cisterns (fig. 20) that was constantly supplemented (e.g. in 1322 the authorities decided to build fifty additional cisterns[538]), also by building private cisterns of the same construction as described above that covered the needs of one – usually patrician – family at the most.[539] Nevertheless, this network was insufficient to satisfy the needs of drinking water of the inhabitants of Venice. What is more, some of the tides coming in were much higher and stronger than had been expected and they caused enormous damage to Venetian cisterns: saline sea water got into the filtration layer before the openings with holes in the covering of the cisterns were sealed with clay (this was the course of action taken in such circumstances[540]). Among expenses of particular *sestieri* were sums of money paid for cleaning cisterns by rinsing them out with fresh water.[541] In 1318 the Great Council sanctioned a different way of supplying drinking water to the town, namely transporting it on barges. The water was drawn from nearby rivers, unfortunately, it was sometimes drawn too near the lagoon, which represented a serious health hazard to the people drinking it.[542] However, this way of supplying Venetians with water remained only an addition to the central role performed by rainwater filter cisterns.

538 Crouzet-Pavan 1997, p. 764.

539 Op. cit., p. 763.

540 Op. cit., p. 780, footnote 219. Sealing the openings with clay may have been aimed at a total "shutting" of the filtration system of the cistern, but also at obtaining fresh water, the latter aspect being mentioned by L.B. Alberti (after Solinus) in the course of describing the construction of such a cistern: Alberti 1988, p. 342–343. (Polish translation: Alberti 1960, p. 286). Obtaining fresh water from salt sea water using another type of filter, namely wax, was described by Aristotle in *Meteorology*, book II (Polish translation: Arystoteles, 1990, p. 487).

541 Crouzet-Pavan 1997, p. 764.

542 Loc. cit.

Fig. 20: Venice. Casing of a filter cistern together with four openings at the level of the pavement through which rainwater could pass. Photograph: U. Sowina.

Rainwater containers were also used as additional points of drawing water – in case of its shortage in towns resulting from the fact that there was too little water in relation to the needs of the inhabitants, or from the fact that water in other reservoirs was of a low (or unsuitable) quality. However, it is not known in every case precisely which of the two factors proved decisive. The following remark made by Jean-Pierre Leguay can be listed among exceptions: he stated that in Breton towns, including Rennes, dug wells were rare due to natural causes, as groundwater drawn from them was usually of poor quality and of salty taste. This is why inhabitants of these towns were forced to use cisterns to collect rainwater.[543] It was rather the scarcity of drinking water in dug wells that decided the emergence of such cisterns in 14th-century Rome.[544] Unfortunately, it is not known whether this was brought about by the growing number of inhabitants and their needs, or by the decreasing amount of water in dug wells due to natural causes (problems with the water-bearing stratum). The coexistence of rainwater cisterns with dug wells

543 Leguay 1981, p. 229. For the same reason, i.e. poor quality of water in dug wells, rainwater reservoirs are supposed to have existed in Paris; water from these reservoirs was used for bathing/washing clothes with soap and for cooking vegetables, cf. Gerards (1991 (1908)), p. 202, but without citing any source evidence.

544 Hubert 1990, p. 161 – about dug wells and cisterns in the backyards of mediaeval Roman houses.

also in other mediaeval European towns is sometimes evidenced in their monographs (e.g. of Siena[545] or Chartres[546]), however, not in such detail as to make it possible to judge the importance of these tanks in the process of supplying drinking water to the inhabitants.

A mention referring to Siena: *cum puteo sive cisterna* directs our attention to yet another difficulty: namely connected with distinguishing between these containers and dug wells in the case of the lack of consistency found in written sources. This problem was also noticed by Paolo Squatriti in relation to early mediaeval Italy.[547] He remarked that in the Lombard laws cisterns (*cisternae*) were almost universally called wells (*putei*), although a distinction between the two obviously different constructions was made. In Ravenna, a town situated on marshes, with saline groundwater, water tanks generally referred to in 10th-century sources as *putei*, had a clear dominance.[548] Paolo Squatriti placed the blame for confusing these terms on Isidore of Seville, because the latter derived the etymology of the word *puteus* from the word *potatio*, meaning "drinking", without taking into consideration where the water found in wells and the one found in cisterns/water tanks came from.[549] Authors writing after Isidore (and often following his example) also did not find this difference important and used the same word to describe these two types of water containers.[550] However, judging from monographs concerning Italian towns of the mature Middle Ages (like e.g. Rome or Siena), notaries made this distinction. Therefore, there emerges the question concerning the chronology and the prevalence of cisterns in mediaeval Italian towns, considering P. Squatriti's

545 Balestracci/Piccini 1977, p. 88 – *cum puteo sive cisterna*.

546 Billot 1987, p. 114. Cf. op. cit., p. 110 about conducting water through gutters to cisterns in this town. This author's description reveals that the situation was exactly the same as L.B. Alberti had presented it. According to C. Billot's research, cisterns in Chartres (mentioned in written sources together with houses) stood mainly in the backyards, and thus they were private reservoirs.

547 Squatriti 1998, pp. 23–24.

548 Loc. cit.

549 Op. cit., p. 24, footnote 38, where he quoted Isidore: *Puteus est lacus defossus ex quo hauritur aqua, a potatione dictus* (IsidoriEtym., 1911, liber XIII, 21, 5). Cf. also Part I of the present work.

550 Apart from early mediaeval Italian writers, mentioned by P. Squatriti (1998, p. 24), we can list Bartholomeus Anglicus, who referred directly to Isidore of Seville also in this respect, and Pietro de Crescenzi, who in his description of the filter cistern presented above used the word *puteus* when writing about the inner container with water that had already been filtered – cf Crescenzi 1548, lib. II, cap. X, p. 17.

opinion that they were probably more widespread in Italy than dug wells[551] on the one hand, and Etienne Hubert's statement that mentions of cisterns immediately adjacent to near Roman houses appeared only in the 14th century on the other hand.[552]

Without quoting more examples, but bearing in mind the above-mentioned and other not fully explained circumstances of the co-existence of rainwater cisterns with dug wells, we should note that in European literature it is sometimes generalized that dug wells were preponderant in the north of Europe, whereas cisterns collecting rainwater (either directly or indirectly: through filtration) were predominant in the south, exposed to heat and irregular rainfall.[553] Such a division seems a simplification, because it does not take into account centres situated in the north that relied on rainwater cisterns as the main water supply due to the fact that there were no other sources of drinking water. They were centres suffering from the lack of fresh water owing to a similar hydrographic situation as in Venice or situated on hills without access to drinking water. Some Dutch towns[554] can serve as examples of the first type of such centres, including Amsterdam[555] where rainwater cisterns were predominant (e.g. in 1505 nine new cisterns were created) and water for drinking and cooking, also for the needs of brewers, was transported on barges. The Bohemian town of Tábor can be taken as an example of the second type of such centres. Tábor's difficulties with supplying the town

551 Squatriti 1998, p. 23.

552 Hubert E., 1990, p. 161. Danielle Alexandre-Bidon, a French researcher, in the course of presenting archaeological and iconographic evidence referring to mediaeval wells, wrote – unfortunately without quoting the source – that in Rome collecting rainwater in cisterns was confirmed as having existed as early as from the 11th century. To illustrate her point about the activity in question in the 13th century next to one of the Roman houses, she cited the following quotation (also without mentioning the source): *cum due canalibus ad aquam defluendam infra et cum stillicidio et de cursu aque pluvialis*, cf. Alexandre-Bidon 1992, p. 543. This excerpt, however, cannot be deemed a sufficient piece of evidence testifying to collecting rainwater in cisterns: it may have referred as well to conducting water away through channels and gutters.

553 Alexandre-Bidon 1992, p. 542. The author provided an example (p. 543) of 16th-century Montpellier, where the functioning of cisterns was a rule. To confirm this thesis, she cites Thomas Platter's description concerning a large number of such reservoirs in the town, although Platter listed stone cisterns only in the third place, after Saint-Gilles fountain and after numerous dug wells situated in the streets and inside houses; cf. Platter 2000, p. 108, 611 (footnote 11).

554 Braudel 1967, p. 169–170.

555 Wijntjes 1982, p. 193.

with water became proverbial in the entire Bohemia.[556] There were no dug wells in the town, only tank cisterns collecting rainwater (fig. 21) until a water supply system was built at the turn of the 15th and 16th centuries. Through this system water was supplied to these cisterns from an artificial lake called Jordan.[557]

Fig. 21: Tábor, Czech Republic. A 15th/16th-century tank cistern. Photograph: U. Sowina.

As regards other mediaeval Bohemian towns, Radek Široký noted that too few stone cisterns had been excavated to date to properly evaluate their share in the

556 Votruba L. et al. 1988, p. 9, where a 17th-century phrase coined by John Amos Comenius: "It's impossible to conduct water to Tábor" was quoted to refer to an unfeasible feat. Water was not found even during the construction of spacious, deep cellars under the town. In order to obtain water, caves of ca 2–10 meters deep were carved in the rock, so that water (conducted there in wooden channels, and even soaking through the rock or flowing/dripping down the stone walls of the cellars) could collect there. We must bear in mind, however, that the choice of this particular place to build the town of Tábor, founded by the Hussites, was determined by religious considerations. All workshops and baths could manage, because they were situated in the suburbs, down low on the River Lužnice and on a stream called Tismenický potok, to which watercourses two gates led from the town; cf. Široký 2000, p. 389.

557 cf. Votruba et al. 1988, p. 10; Široký 2000, p. 389.

water supply of these centres. Without taking into account the tank cisterns from Tábor, only taking into consideration the filter cisterns known to him from German towns, this researcher expressed his opinion that the construction of the latter type of cisterns in Bohemia was too expensive even for wealthy town investors.[558]

While describing rainwater reservoirs, we should also mention numerous mediaeval castles, fortresses or residences in Europe lacking other possibilities of water supply and reliant on rainwater cisterns.[559] Taking into consideration the examples presented above, one can come to the conclusion that the occurrence (and surely the dominance) of cisterns with rainwater used for drinking and cooking was mainly subject to the criterion formulated by Pietro de Crescenzi, an inhabitant of the "dry" southern Europe, that such cisterns were built where no water was to be found: *cum aqua deest*.

On the basis of written sources and archaeological findings, it is hard to establish the role of rainwater cisterns (especially as containers of drinking water) in towns in the Polish lands in late Middle Ages and at the beginning of early modern times. The names used in the written sources to describe these containers constitute an additional difficulty. The above-mentioned Polish translation of Crescenzi's treatise done by Andrzej Trzycieski in the fragment concerning rainwater cisterns remains very close to the original. However, at the beginning Trzycieski provided

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558 Široký 2000, p. 358 – about a filter cistern found only in the Prague Castle in Hradčany and further reading on such findings in German towns.

559 Cf. e.g. Grewe 1991a, p. 48 and 54, about using "Tankzisterne", i.e. tank cisterns, and "Filterzisterne", i.e. filter cisterns of an identical construction to that of Venetian cisterns. It must be noted that where possible also in such cases cisterns were accompanied by other sources of water supply, e.g. in the seat of the Primate of the Hungarian Church in Esztergom on the River Danube; the seat was situated on a high rock on the river and possessed two very deep wells, three cisterns and a 15th-century water supply system: cf. Kubinyi 1981, p. 184. About tank and filter cisterns and deep wells-shafts in burghs and castles of the Holy Roman Empire and the Old Swiss Confederacy, cf. Hoffmann A., 1995, p. 87–105 and Boscardin 2004, p. 35–40. Cf. also a 17th-century French treatise: Jean-Francois, 1653 and 1665, p. 28 – underlining both the universality of rainwater which falls in every place and its good quality, the author wrote about using cisterns in numerous monasteries, towns and fortresses built on rock, e.g. Saint-Malo and Mont St Michel. („L'Vniversalité des Eaux de pluie, qui tombent en tout lieu, & la bonté de ces eaux me font traiter des continens qui les reçoivent, les retiennent, & puis les rendent, quand on en a besoin. On les nomme des Cysternes, qui font en vsage en plusieurs Monasteres, és Villes & Citadelles basties sur le Roc, comme est S. Malo, S. Michël, etc….").

the Polish reader with a broader definition of the Polish word "żąp" which was the equivalent of the word "cisterna" used by Crescenzi: "*Żąp* is a place where water (either flowing or carried into this place) is stored until the time it is needed."[560] While describing cisterns with rainwater suitable for drinking, Trzycieski used the same word that had been used e.g. in court books of towns in the Polish lands to describe water containers forming part of mediaeval water supply systems,[561] hence surely containers with drinking water. The words "żąp", "rząpie" was also used by Sebastian Petrycy in his translation of Aristotle's *Politics*, published in 1605 to describe a rainwater container.[562] For the sake of completeness of the description it is worth adding that the word "żąp" was used in the context of mines in reference to containers (often vats) placed in holes hollowed out in the thill to which water was carried through drainpipes.[563]

The common name "zą̨p/rząp/rząpie", used to refer not only to rainwater containers and reservoirs forming part of a water supply system, but also to mine containers, was undoubtedly derived from the German word "Sumpf", although in the case of "rząpie" in the sense of rainwater containers or water supply system containers, from which water was drawn, a different etymology is possible, namely derived from the word "schöpfen" (*Wasser schöpfen*), meaning "to draw [water]", especially if we take into consideration the Toruń "czappenborn", mentioned in Toruń written sources in 1430 and in 1452, situated in the Wielka (Grand)

560 Crescenzi-Trzycieski 1549, lib. I, p. 32.

561 In mentions written in German cf. e.g.: Goliński 2001a, p. 105 and p. 117–123: "Somp"; in Latin mentions cf. e.g. ANK, SC 8, p. 166, year 1463: "sampt", SC 10, p. 750, year 1527: "zamb" and SC 11, p. 42, year 1528: "zamb", ANK, CC 435, p. 220, year 1533: "zamp" etc. In Kraków mentions in books of municipal officials called *quartalienses* from the 16th–18th centuries written in Latin and in Polish, the most commonly used word to denote private or public water tank forming part of a water supply system was "rząp" ("żąp"), cf. e.g. KsWiertelKraków 1997, p. 5 ("rora albo zomp") et seq. numerous mentions of "rząp/rząpie" on plots.

562 Zarębska 1986, p. 185.

563 Instr.górn. 1963, pp. 120 and 152, about mine workers ("rząpiowi") who drained water from "rząpie" (mine water containers) (instruction from 1743, pp. 99–179).

Street in the Old Town,[564] and also close Flemish terms used to denote containers forming part of a water supply system: "Waterscip", "Waterscup", "Waeterschap".[565]

As regards the word "Sumpf", it is worth noting that it had also another meaning: "swamp" or "bog" (also figuratively). The Czech word "žumpa", i.e. sewage pit, latrine, was derived from it. In Polish written sources "żąp" in this sense was used in a Poznań law passed by the city council ca 1600, that is, in a later written source than the scope of the present research. This law concerned keeping the town clean and in order and forbade e.g. "pouring out filthy things, throwing stinking things into the Market Square and into the streets" and ordered people to carry their waste "to the pit ["ząb"] next to the town walls, away from the people, at night."[566] This kind of a "żąp" was probably in question in Kraków on the last day of 1544: in the town councillors' books is a mention of an inspection carried out at the command of the town authorities on the plot belonging to Stanisław Pyszek in Szczepańska (St. Stephen's) Street following a conflict between Pyszek and his neighbour, a Kraków patrician Stanisław Salomon. The Hauptmann of the Town Hall and the town master fountain-builder testified that they had seen on Stanisław Pyszek's plot an overflowing "puteum alias zumb" with a drainpipe carrying the waste to his waste pit. Due to the frost nothing soaked into the ground and Pyszek's waste filled not only his two waste pits, but also the neighbouring latrine belonging to Stanisław Salomon. What is more, this caused damage to the foundations of the cellar in Salomon's malthouse.[567]

To date, there are no written sources and no archaeological findings which would prove that public and private filter cisterns existed in towns in the Polish lands. Considering the high construction cost of these cisterns, this could be a sign of limited financial possibilities of such centres as Płock, Sandomierz and even Nowe Miasto Toruń (the New Town in Toruń), which had serious difficulties with

564 KsŁawStToruń 1992, nº 111, p. 21 ("eyn erbe, gelegen in der Grosengassen bie dem czappenborne"), KsŁawStToruń 1993, nº 1663, p. 134 ("eyn erbe, gelegen in der Grosengassen bey dem czappenborne"). KsŁawStToruń 1993, p. 269 (index – translated as "zdrój uliczny"). The same reservoir was also referred to as "born", which fact was established on the basis of an analysis of a mention in: KsŁawStToruń 1993, nº 1661, p. 133.

565 InvBruges 1871–1885: *Glossaire*, vol. II, 1973, p. 548, where also a French equivalent: "abreuvoir", encountered in mediaeval sources from Bruges. In a 1524–1525 description of the water supply system in Rouen such a container was called "cuve" – Le Lieur 1911, *passim*.

566 WilkierzePozn., part I, 1966, nº 119, p. 57.

567 ANK, CC 439, p. 716.

water supply (as is shown in written sources). Of course, one can explain this by the lack of possibilities of transferring the construction technology of filter cisterns, this, however, seems doubtful at least in the case of Toruń, bearing in mind the knowledge of European organizational and technical models in the State of the Teutonic Order and its high economic potential. In the above-mentioned centres existed, at the very most, containers collecting rainwater used for various purposes and/or containers in which water that had been carried or carted to the town was stored, this, however, is characteristic not only for towns in which *aqua deest*. Source materials confirming the existence of such reservoirs are poor (or rarely taken into account by authors of town monographs) and late. Ryszard Szczygieł's research revealed that on plots belonging to burghers of Sandomierz were to be constructed reservoirs in which (according to the local laws from the 1570s) water was to be stored for firefighting purposes.[568] Barrels with rainwater on plots were also mentioned in Kraków books of municipal officials called *quartalienses* (contemporary with the sources pertaining to Sandomierz); we must remember, however, that in Kraków other sources of water were much easier to find than in Sandomierz (e.g. in Kraków on many plots existed dug wells and – less frequently – water storage reservoirs connected to the water supply system). Archaeological research conducted in Płock showed that in cellars of buildings, near their corners, stave barrels were dug in. These barrels are interpreted as drainage wells[569](fig. 22). Nevertheless, in this town, suffering from the lack of water, they could be water tanks (fig. 23)[570] with water from underground pools of stagnating water or with rainwater carried there through conduits (coming in through cellar windows or openings). A written mention of 1342 pertaining to Kraków can lead us to the conclusion that rainwater flowed to tanks from roofs through drainpipes, which would be the simplest way of collecting such water, however, not mentioned directly in written sources from Polish towns. According to this mention, Marcin Gousman

568 Szczygieł 1993b, p. 80.

569 Polak 2000, p. 65.

570 Cf. the same type of constructions: dug wells of a stave construction (made of barrels), found e.g. in Berlin Spandau (Kowalewski/Nobis-Wicherding 1991, pp. 293–296) and "tonwaterputten", "puits à tonneaux", discovered in 1994 in an abandoned 15th-century Flemish village called Walraversijde near Ostend (Pieters 1994, p. 226). Dendrochronological studies of the latter type of wells revealed (Pieters 2005, pp. 16–17) that they were built of barrels made of oak cut near Gdańsk. Made by Baltic coopers, these barrels, as containers for goods in Hanseatic trade, were used by Danish fishermen, and later, filled with herring they caught, the barrels were found at the fairs in Ecluse (Sluis) in Burgundian Flanders. They were eventually re-used as "tonwaterputten".

sold a malthouse measuring 34.5×17 ells (ca 20.22×9.96 m), situated at the back of Gousman's plot (*curia*) in Sławkowska Street, to Michał, Amilegiusz's son-in-law, before the Kraków *advocatus*. On the strength of this record water from the roof of this malthouse was to flow in three directions: on both sides to the two neighbouring plots (backyards) and from the middle to the Gousman's plot on which the malthouse stood.[571] Considering the principles of this decision and bearing in mind the need to maintain good neighbourly relations and a proper functioning of the microcosm of every plot, one might assume that this was a solidary way of supplying all the three parcels in rainwater, especially so, because at least one of them probably did not have its own dug well, since it used Gousman's well.

571 KsRachKraków, I, 1878, nº 1466, p. 161: *Eodem anno xLII coram Advocato lekschiko resignavit […] Martinus gousman Michaeli genero Amilegij braseatorium XXXIIII vlnas cum dimidia in longitudine et in latitudine XVII continens, retro eum iure hereditario possidendum taliter, quod ex una parte tecti aqua cadere debet super hereditatem domine de lelouia, et lux obstrui non debet per Edificationes ex eadem parte; Ex altera uero parte aqua cadere debet super Martinum Drobne, et aqua, que cadit de medio Canali, cadere debet super hereditatem Martini gousman. Ita venditum est braseatorium.*
Locating Gousman's plot in Sławkowska Street and calling it a plot (*curia*) was possible thanks to the next mention dating from 10 January 1343 – cf. KsRachKraków, I, 1878, pp. 161–162, nº 1467: *Aluscha Relicta iohannis de lelouia cum pueris suis Pescone, Nyczkone, Manytha et Katherina domum ipsorum cum fundo, sitam in Plathea Slaucouiensi, Margarethe Relicte lodwici de Teschin et bertoldo filio eius, prout ipsam tenuerunt, iure hereditario; murus enim martini gousman medius est iamdicte Margarethe et bertoldi, ita quod possunt cum ipso muro facere quicquid uolunt, et ius est murare ad murum et frangere in murum et fons, qui stat in curia Martini pretacti, de illo frui debent Margaretha et bertholdus, quam diu durabit.*

Fig. 22: Płock. Two barrels made of oak staves, placed in the corner of a cellar of a house from the end of the 14th century, Grodzka Street 6, after: Polak 2000, p. 65.

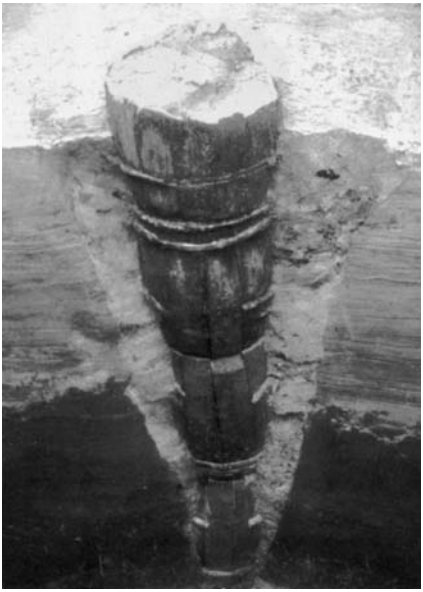

Fig. 23: A barrel well in the corner of a house in an abandoned 15th-century Flemish village called Walraversijde near Ostend, after: Pieters 1994, p. 226 and id., 2005, p. 16.

The situation concerning data on public water storage reservoirs, including rainwater, does not look any better. Robert Kola and Leszek Kotlewski quoted a mention from the beginning of the 18th century written by the burgomaster of Toruń Jan Baumgarten of collecting rainwater in cisterns in the New Town which suffered from the lack of water.[572] Admittedly, this source is too recent in relation to the present work, nevertheless, it is valuable, because it confirms the important role of rainwater cisterns only in places where no other water was available. As regards an earlier period and other centres, one can mention the "pool", i.e. a water reservoir dug in the Market Square of the Teutonic Chełmno to the west of the Town Hall, probably used mainly for firefighting purposes. This pool measured ca 25×35 m, hence its surface area equalled ca 875 m², which was several times greater than the surface area of the Town Hall in Chełmno, which amounted to ca 170 m².[573] However, a wooden water container excavated near the town hall in Krosno[574] testifies to the ambiguous character of archaeological findings, because it could be as well a water storage reservoir connected to the water supply system, considering the fact that next to it archaeologists discovered a wooden water supply system that was to carry water to the Town Hall. A similar situation occurred in the case of a wooden water container excavated in the central part of the Bishop Nanker's Square (*Ritterplatz*) in Wrocław.[575]

Thanks to archaeological research carried out in Płock we know that in the Middle Ages existed two natural, rather vast pools of stagnating water: one in the Market Square and the other one on one of its sides,[576] that fulfilled the same function as the above-mentioned tank cisterns, namely primarily connected with firefighting. The fact that they were kept for a long time (from the 14th century until the mid-15th century) should be explained by a general water shortage in the town.

Rainwater canals are much better documented in written sources than rainwater cisterns.[577] In Kalisz after the great fire that swept through the town in 1537 particular importance must have been attached to the presence of rainwater canals on the rebuilt plots, since records in books of the city council mentioned only houses and these canals and never listed other elements of the plots: *aream suam cum canale subterraneo pro decurrenda aqua pluviali; …domum suam in Circulo*

572 Kola/Kotlewski 2003, p. 10, footnote 4.
573 Rutkowska-Płachcińska 1978a, p. 200; Atlas Chełmno, 1999, p. 7.
574 Muzyczuk/Gancarski 2003, pp. 24 and 41.
575 Janczewski 2005, p. 94–95.
576 Polak 2000, pp. 47, 57 and 73.
577 Cf. more: Sowina 2002c, passim and Sowina 2011, passim.

cum meatu aque pluvialis.[578] Perhaps water from these canals was to be used to extinguish fires: it flowed through underground (*subterraneae*) canals to private or public containers (barrels or cisterns) or was drawn directly from open canals. In the latter case – like e.g. in the Mazovian town of Łowicz, where after the 1525 fire the owner of the town, the Archbishop Jan Łaski ordered the following: "To build a ditch in which water from the River named Bobrowa would flow to the town through fields, meadows, gardens and plots belonging to the burghers and to subjects from villages; everybody is obliged to clean and renovate the ditch on their stretch of land every year according to the needs."[579] Of course, also rainwater flowed in this open ditch, thus serving not only firefighting purposes, but also e.g. to irrigate gardens.[580] Such ditches-canals also took away sewage and waste,[581] which fact excludes the hypothesis that e.g. in the New Town area the ditches carried "fresh water" that was used by brewers to brew beer.[582] In this case a more probable source of water supply was a little river flowing through the New Town's Market Square and through Bielawska [Bleachery's] Street; perhaps in this street stood a bleachery which also required water.

The lack of sufficient source material does not allow to show organized forms of supplying rainwater to towns in the Polish lands. This is also due to the fact that such records as the following are exceptionally rare: a record found in Kraków town books of the year 1544 stated that a part of a house that had belonged to the late Kraków patrician Jan Cymermann and that was being divided by municipal officials called *quartalienses* was to have a free flow of rainwater and not of any other water, including wastewater.[583] The latter stipulation suggests that this very canal was used (like canals in Kalisz) to supply rainwater to the plot. The unique character of this expression could result from the still vivid terror connected with the great plague of 1543 and from sanitary restrictions introduced at

578 APP, Kalisz I/6, p. 8, year 1537 and 252, year 1544.

579 StatutyŁowicz, 1998, pp. 22–23.

580 Skiełczyński 1986, p. 143.

581 Loc. cit.; Zbigniew Skiełczyński noted also that "maintaining a system of canals […] was difficult, as they were often overgrown. Inspectors […] pointed to neglect on the part of burghers in terms of maintaining canals near their plots, who even sometimes filled them with rubbish."

582 Morawski 1986, p. 87.

583 ANK, CC 439, p. 481: *sors* […] *domus* […] *habeat liberum defluxum aquae pluvialis et nullius alterius aquae, aut alicuius immundiciei*. Ibidem also rules concerning participating in financing of the construction of this canal: the owner was to cover 2/3 of the cost, and the user (also the tenant) – the remaining 1/3 (for every 2 denarii paid by the owner, the user was to pay 1 denarius).

that time and perhaps still in force.[584] In that case it would be aimed at limiting the contamination of rainwater canals in general. On the other hand, rainwater canals were the subject of numerous records from both small and large centres, showing the exact ways of carrying away, i.e. getting rid of rainwater.

III.2 Dug wells

III.2.1 Construction technique and function of wells

Despite relatively low opinions concerning well water found in treatises and encyclopaedias, dug wells in towns performed a primary role in the current water supply to local people throughout many centuries. Wells were dug even if it was found that water drawn from them was unsuitable for drinking, e.g. because of its salinity, as was mentioned above. In his synthesis concerning Czech towns, František Hoffmann noted (somewhat exaggeratedly) that together with the establishment of towns, the art of digging wells became widespread. He also mentioned dowsers, unfortunately without referring to specific centres, who found not only veins of precious metals, but also places with good water.[585]

While describing the commonly known and prevalent methods of determining the right places in which wells could be dug, L.B. Alberti wrote about finding water with the help of a dowsing rod.[586] He also presented the technique of building wells that was very widespread and used (with some modifications concerning mainly the material) from antiquity until the present day. A well – according to Alberti – could be built in two ways: either straight into the ground, or by a longitudinal channel. Those who dig wells are sometimes exposed to danger connected either with poisonous gases coming from the shaft or with the collapse of the sides of the well. "[…] Against gas we are advised to take the following precautions. Keep the air ventilated and in continual motion, and use lamps, so that if there happens to be any light gas the flame will burn it, but if it is denser, the

584 These restrictions were issued on 13 July 1543; the plague was the most severe from the beginning of July until mid-December of that year; it struck again (although with a lesser intensity) in 1544 and 1545 – cf. Walawender 1932, pp. 234–235.

585 Hoffmann F. 1992, p. 92. About dowsing, commonly used in attempts to locate underground ores – Maślankiewicz 1957, p. 75, with a reference to Book II of G. Agricola's treatise "De re metallica". However, before describing the functioning of a dowsing rod (called a twig) in detail, Agricola made the following stipulation: "There are many great contentions between miners concerning the forked twig, for some say that it is of the greatest use in discovering veins, and others deny it." –Agricola 1950, p. 39.

586 Alberti 1988, pp. 327–329.

diggers will be able to protect themselves against the noxious danger and escape in time: for as the gas builds up, it will extinguish the flame. But if there are any heavy and persistent gases, they advise us to sink vents to the right- and left-hand sides, to give the noxious gases freedom to breathe.[587] Against the danger of collapse construct your work as follows. At ground level, where you intend to build your well, lay a cornice of marble or some other very strong material, the same width as your desired well. This must serve as the base for your work. On this raise the sides of the well to a height of three cubits and allow them to dry. Once they are dry, dig out the inside of the well, removing all the earth. As a result, the more you dig, the more this walled structure will sink, tending downward. Then, by gradually enlarging both the hole and structure together, you will safely reach the depth you desire. Some prefer to build without plaster, so as not to obstruct the veins of water. Others recommend a triple wall, to purify the water as it seeps into the bottom. The location of the well is particularly important. The earth is made up of different strata, one above the other, and sometimes rainwater is trapped at the first dense layer it reaches below the topsoil. This we should reject as being impure. On the other hand, sometimes when water has been found, it will disappear and vanish before your eyes, if you attempt to excavate any further. This is because you are digging through the base of the vessel in which it is contained. For this reason some prefer to make the base of the well as follows: as if they were constructing barrels, they line the inside of the excavated well with a double wall of wooden rings and panels, and allow a gap of one cubit to separate the two layers; into this gap they pour a paste of coarse gravel, or preferably chips of flint and marble, mixed with lime; they give the work between the two linings six months to dry out and harden. This acts as a complete vessel, through the base of which, and from nowhere else, the lightest and purest water wells up and flows in."[588]

The purpose of digging wells was thus reaching the water-bearing stratum, namely the "underground water veins", and not collecting water that flowed into it (e.g. rainwater). Water reached that way was the "living water", because it flowed through a water vein and sprang out from the bottom of the well as from a spring.

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587 This was the aspect on which Vitruvius focused while discussing digging wells – cf. Vitruvius: VIII, 6, 12–13. Web. Vitruvius did not present the technique of digging wells because he described the reality of Rome in the 1st century BC, namely the conditions he knew from experience, where water was commonly supplied in aqueducts, and the supply was satisfactory, or even rich, so he treated dug wells as a much less important way of obtaining water.

588 Alberti 1988, p. 330. Cf. also Palladius 1807, Book IX, Chapter IX, p. 253–254.

The method of digging wells by gradually lowering the casing, described by Alberti, referred both to wells with surface water and to those with underground water, irrespective of the material used. Prevalent until the present day in the construction of ring wells, this method was also confirmed for mediaeval wells, e.g. in French mediaeval wells the ring that moved down as the digging of the well progressed, was made of oak wood; it was on this oak ring that a brick wall was built.[589] Judging from extensive archaeological data pertaining to mediaeval, fully wooden wells built in Wrocław (that can be deemed characteristic of lowland towns situated on rivers, in which the water-bearing stratum was shallow and rich), also in that city the above-mentioned method was used until the 14th century in the entire Old Town, and later within the whole agglomeration.[590] However, wells in Wrocław were also dug differently: "in a wide pit"[591] (fig. 24). Water was to be sheltered from contamination by the tightness of the construction, obtained by a careful execution of the bottom and top casings and by building a low sand mound around the latter (using the so-called sand filter), which was meant to prevent any contaminants from passing through.[592]

589 Viollet le Duc 1993, p. 14.

590 Piekalski 2004, p. 11.

591 Loc. cit. However, it was not stated to what depth this method was used, and from what depth the method of lowering the casing was applied. A detailed discussion of the technique of building wells discovered in the New Town in Wrocław, presented by Zdzisław Wiśniewski (1991, passim), shows the method of building five such reservoirs of a maximum depth of, respectively: 1.6 meters (object no. 4 – pp. 112–113), ca 2.6 meters (object no. 6 – pp. 118–124), 1.8 meters (object no. 10 – pp. 124–128), 1.9 meters (object no. 14 – pp. 128–132), and 2.05 meters (object no. 19 – pp. 132–135). Therefore, it results from the information provided by the author that the first stage of building wells of a minimum depth of 2.6 meters was digging a pit of any shape (an irregular circle, oval, rectangle), but at an appropriate angle, so that the ground would not subside. These pits reached the level where water emerged from the ground. Then the walls of the well (the casing) were built according to the typical post-and-beam frame construction, using mainly oak timber. This method of building wells was used also in other places, which can be evidenced e.g. by excavations conducted in Berlin-Spandau – Kowalewski/Nobis-Wicherding 1991, p. 293–296. Cf. loc. cit. about the above-mentioned stave constructions ("barrels"), the second way of building dug wells, archaeologically confirmed in Flanders (Pieters 1994, p. 226; id., 2005, p. 16–17) – cf. part III.1 of the present work: "Rainwater cisterns".

592 Wiśniewski 1991, p. 136 and Piekalski 2004, p. 11. Due to the fact that on burghers' plots wells were next to sewage pits, archaeologists are not always able to tell these objects apart, which is why in such cases they call them "wells-sewage pits". As a distinguishing criterion, they adopted "the presence or absence of a sand filter between

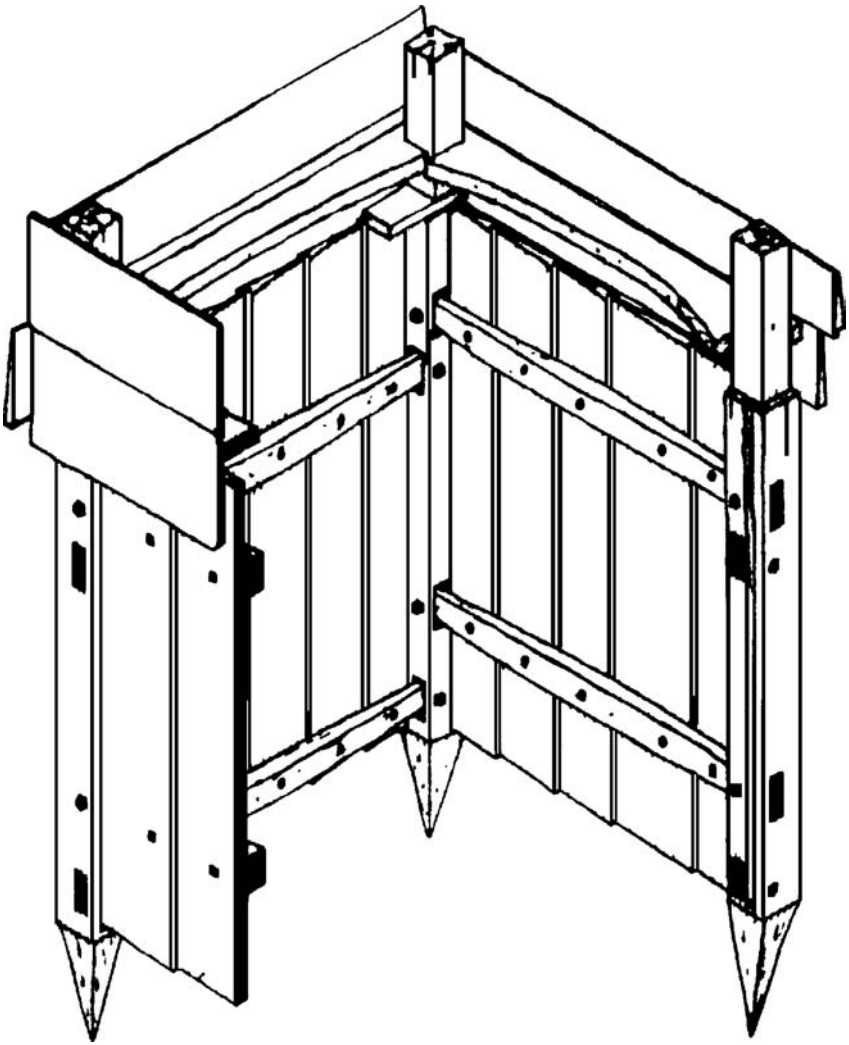

Fig. 24: An example of the structure of a mediaeval shallow well from the New Town in Wrocław, after: Wiśniewski 1991, pp. 132–135 (object 19, depth 2.05 m).

the wooden casing and the surrounding ground". The objects equipped with a filter are considered as wells, whereas those without it are deemed to be sewage pits, as e.g. in Głogów – cf. Buśko 1995, p. 89 and id. 1998, p. 94: the same remark accompanying the presentation of wells in Wrocław.

The art of building wells described by Alberti, including their sealing, is difficult to find in mediaeval mentions;[593] it can sometimes be found in 16th-century European contracts[594] and in 17th-century treatises.[595]

593 Although expenses made towards works connected with wells were recorded in accounts of such towns as Bruges or the Walloon town of Mons, the preserved mentions of the way these objects were constructed are usually exceedingly laconic. Only very rarely (e.g. from accounts from Mons) can we learn that wells ("puch" – "puits") were built of stone ("quins") and lime ("cauch") – Mons Comptes 1971, série T 31, p. 179 and InvBruges 1871–1885: Glossaire, vol. II, 1973, pp. 151–204.

594 Cf. e.g. contracts to build wells in estates belonging to Paris patricians from the years 1528 and 1543 – Recueil Actes Paris 1905, pp. 40–41, no. 193, p. 200, no. 982 (28 November 1528) and p. 513, no. 2789 (9 November 1543). Under the first of the contracts, a bricklayer was to build a well in a garden of a Parliamentary lawyer and a stove in the house of his leaseholder for a total sum of 14 livres tournois. The well, 3 feet wide, i.e. ca 1 meter wide (1 foot = 0.324–0.325 m – according to JournalBourgeois 1990, p. 453 – Annexe III and Cerné 1930, p. 414) was to be built of hewn stone, the overground part of the casing was to be 3 feet high and made of gypsum (alabaster), the water-bearing stratum of the best and the lightest water was also to be 3 feet deep, irrespective of the time and season ("Marché entre Pierre Hilaire, mâçon à Sucy et Jean Le Cirier, avocat en Parlement, seigneur du Plessier-sur-Auteil, pour la façon: 1° d'un puits de trois pieds de large, dans le jardin de sa maison de Sucy, maçonné de pierre de blocaille, à prendre dans le domaine, sous conditions de remplir les trous pratiqués pour l'extraire. Le hault sera faict et enduict de plastre, et avec ce asseoir la mardelle qui luy sera baillée, et icelluy puis fouller et prendre et choisir de la meilleure et plus ligière eaue tellement que en icelluy il y ait en tous temps et saisons troys pieds d'eaue"). Under the second contract a person who was a gardener and a mason was to build a well for an aromatist-apothecary from Paris for a sum of 35 livres tournois. The well was to be built of crushed stone, lime and sand, and reach the level of "living waters" whose layer was to be 4 feet or at least 2 feet, in every season. Cf. also op. cit., pp. 40–41, no. 193 (23 March and 11 April 1527) – a contract with a bricklayer-mason to deepen an existing well by 6–7 feet, i.e. by 1.95–2.275 m, until "the first rock" ("jusques dedens le premier roc"), with an insulating layer and outlets, for 27 écus d'or soleil worth 54 livres tournois, and an annexe to this contract for another 50 livres, because the new depth turned out to be insufficient.

595 Cf. e.g. Jean-Francois 1653 and 1665, p. 25: "Si on y éleuve vne muraille en rond pour arrester les terres & les empecher de tomber, on la bastit en bas de pierres seches, pour donner passage à l'eau au travers de telles pierres: & puis on continuë la muraille, liant les pierres auec mortier, pour empecher l'eau de la pluie détrempée auec la terre d'y entrer, pour lequel effet on met du Conroy à l'entour, dans la profondeur de 3. ou 4 pieds".

Wherever possible, people tried to dig wells several meters deep at the most, which would use surface water. As was mentioned before, lowlands situated on rivers with a rich water-bearing stratum enjoyed the best situation in this respect: not only suburban gardens, but also entire urban agglomerations. Problems arose when the water-bearing stratum could be reached only by digging through the whole height of an escarpment above a river on which a town was built. The hardest task connected with reaching the underground water strata was cutting deep well shafts in solid rock. Instances of admiration and praise for such constructions and for their builders can sometimes be found in written sources. In the mid-15th century L.B. Alberti described the famous well (still existing) in the Tuscan town of Bolsena as being exemplary. It was carved in rock and the water level was ca 65 meters deep: "In the Etruscan hilltop town of Volsconium they sank a very deep well – and had descended 220 feet before they reached any vein – until water was found at the same level as the springs gushing out elsewhere from the side of the mountain. You will find that this will almost invariably be the case with hilltop wells."[596]

Great praise was offered for the carving of a well in rock for the Augustinian Monastery situated on the Castle Hill in Kłodzko.[597] The works began near the "old kitchen" in 1393, when Maciej was the administrator of the Monastery, and ended in 1402, when the function of the Monastery's provost was performed by Piotr, the third provost since the establishment of the Monastery. The chronicler noted it scrupulously[598] and called for prayers for both of them, "as they did a particularly good thing (*nam valde bonam rem fecerunt*)". The great importance of this well (and thus the former lack of water on the Castle Hill) is testified by the fact that mentions of its construction were twice positioned on the first place in descriptions concerning the Monastery's property: apart from the one quoted above in which the piece of information about the construction of the well was predominant in the description of the monastic estate, another mention was devoted to the completion of the well and presented the most important events that happened during the time when the above-mentioned Piotr was the Monastery's provost. The chronicler also commanded the soul of Wenczesław *fossor*, the builder of the well, to God, "because, as had been evaluated, he created the most durable thing and often, having finished his daily work, he carried pieces of rock he had crushed (broken) in his sleeves or folds [of his habit]. And still, he

596 Alberti 1988, p. 326.
597 About the location of this well (still in existence) – cf. Dziewulski 1957, p. 458.
598 KronikaAugKłodzko 2003, pp. 8–10.

remained persevering until the work was done, which thank God was successful, as we can see it today."

Wells were carved in rock in mediaeval towns both in the south and in the north of Europe, e.g. in the French town of Carcassonne (Cité),[599] Hungarian: Esztergom[600] and Buda,[601] the Prague Castle (Pražský hrad),[602] but also the Czech town of Písek[603] or the Polish towns: Krosno,[604] Chełm[605] and Kamieniec Podolski (at present in Ukraine as: Kamyanets-Podilsky), the latter situated on a rock ca 50 meters above the bottom of the Smotrych River valley,[606] to mention just a few of the instances confirmed by research. This way of supplying water was

599 Viollet le Duc 1993, II, p. 14 – the main well of the fortified town, described by the author as built in ancient times (i.e. probably in a Roman defence settlement, established in the 2nd century BC), was 30.2 meters deep (in Viollet le Duc's time).

600 Kubinyi 1981, p. 184.

601 Pálóczi-Horváth 2005, p. 234, with a reference to: I. Holl, *Mittelalterliche Funde aus einem Brunnen von Buda*. Studia Archaeologica IV, Budapeszt 1966, fig. 1.

602 Široký 2000, p. 387 – about a well in the third courtyard, dug in the early 14th century, 66.04 meters deep (on the basis of archaeological studies by its discoverers, quoted there).

603 Široký 2000, p. 384.

604 Muzyczuk/Gancarski 2003, pp. 24–27.

605 Bronicki/Kadrow S/Tokarski 1991, pp. 117 et seq. The public well in the Market Square in Chełm, confirmed in written sources in 1781, according to its discoverers-archaeologists, was carved in the 15th century in chalk as a square shaft 24.5 meters deep, measuring 2.5×2.5 meters near the base. A strong, wooden, lap joint structure, the bottom casing was placed at the depth of from ca 22.5 meters to 24 meters. Above, namely along the length of 22.5 meters, carved in solid chalk, the shaft was to be lined with planks, as not requiring reinforcement. Unfortunately, the state of their preservation did not allow the authors to form any opinions concerning this part of the construction. It results from the description dating from 1781 that at that time (in the 18th century) the upper casing (above the ground) was made of brick. The well probably functioned until the end of the 18th century or the beginning of the 19th century.

606 Brzeźniak/Lewik, 2005, pp. 44 et seq., also more detailed information concerning the geological structure of the hill of the Smotrych River on which the town was built, inter alia, about modest water resources, accumulated in the ground owing to a small surface of the land and draining them because of a considerable depth of the canyon, and also about subsurface groundwater flow and seeps in the wall of the canyon resulting from the fact that the strata were deposited in horizontal layers. Also Brzeźniak/Cabaj/Lewik/Nowak, 2005, p. 69 – an example of a well called "Armenian", near the Town Hall in the Polish Market Square in Kamieniec Podolski, carved in rock, whose depth to the water table equalled 33 meters. However, according to Brzeźniak/Lewik, 2005, p. 49, this well was built as late as in 1638.

characteristic mainly of burghs, towns on rocks (fig. 25) or fortified castles built on rock. The construction of the deep well shafts built in these places was the same as mine shafts (fig. 26), which is why both of these constructions were referred to as (die) "Brunnenschächte".[607]

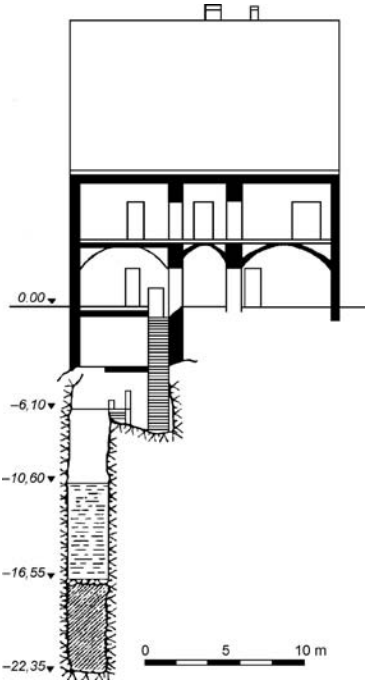

Fig. 25: A mediaeval well 22.35 m deep, carved in rock next to a house in Buda, after: Pálóczi-Horváth 2005, p. 234, with a reference to the work by I. Holl, Mittelalterliche Funde aus einem Brunnen von Buda. *Studia Archaeologica IV, Budapest 1966, fig. 1.*

607 More about such mediaeval wells-shafts in the lands of the Holy Roman Empire of the German Nation and the Swiss Confederation, as a second way of supplying these lands in water – besides cisterns, and also about the structure of these wells on the basis of archaeological research – cf. Hoffmann A. 1995, p. 89 ("Brunnenschächte, Burgbrunnen mit Schachttiefen" – including a 16-meter deep well at the Heidelberg Castle), p. 93 – a table with a list of 50 late mediaeval castle wells in Central Europe with the shafts 60–195 meters deep) and p. 97 – a drawing of a mine shaft with a mine water hoist ("Brunnenschacht mit Förderwinde") – quoted from: Meyer W., Zisternen auf Höhenburgen der Schweiz. Zum Problem der Trinkwasserversorgung auf mittelalterlichen Burganlagen. Burgen und Schlössen 20, p. 85. The same drawing, as "Sod(brunne)", cf. also: Boscardin 2004, p. 36.

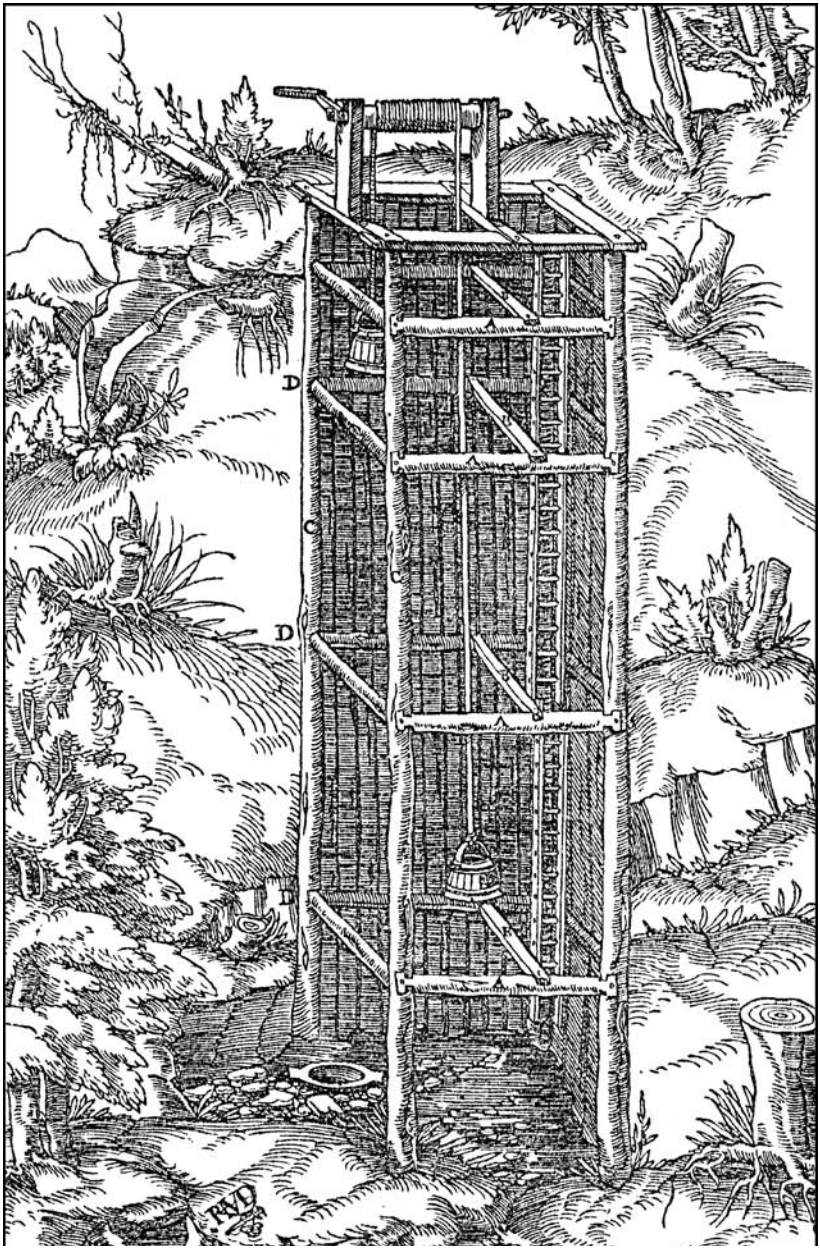

Fig. 26: Mine shaft, depiction from the mid-16th century, after: Agricola G., 1928, p. 94.

Without discussing deep castle wells,[608] we should mention wells built on the Wawel Hill, elevated ca 25 meters above the surrounding terrain.[609] Archaeological research revealed that within the Upper Wawel Castle among the main palace complex, in a cellar under the Deputies' Staircase existed a well (*fons*) carved in limestone rock, ca 40 meters deep (hence, its depth must have consisted of: the above-mentioned height of the Wawel Hill and 15 meters below the base of the hill), renovated in the 1530s.[610] A mention was found among expenses made for buildings and equipment for the Royal Castle in 1531 of paying 7 groschen and 9 denarii for iron for the repair of a bucket for a well in the Canon's House from where – as was noted in the mention – water was drawn for the Queen.[611] Therefore, at least two wells carved in limestone rock existed on the Wawel Hill. What is interesting is that drinking water for the Queen was not taken from the castle water supply system, installed 30 years before to conduct good water to Wawel. The author of the present study is inclined to link this fact with problems connected

608 Undoubtedly, a well in the royal castle in Olsztyn near Częstochowa was a deep well. In 1411 King Ladislaus Jagiellon ordered Jan of Szczękociny, the castellan of Lublin, to repair and restore this well (*fons castri*) together with other castle buildings that required such treatment owing to their age and the state of destruction, so that when the King and his wife, Queen Anne, would arrive there, Jan could receive them with full honours and provide services on a lavish scale. This was one of the conditions on which the King endowed Jan with 600 marks on this castle – cf. Latin text, in: KodMp., IV, 1905, nº 1129, pp. 132–133. The overground casing and a partly buried shaft, perhaps of this well, have remained until the present day near the castle tower, which fact was confirmed in summer of 2008 by Andrzej Zienkiewicz, MSc., whom the author of the present work would like to thank. About a well at the castle in Chęciny, drilled in marble for a long time in the 1560s (in 1780 this it was 100 ells deep), and about problems connected with it – cf. Kubicki 2005, p. 398, where also a quotation of a piece of advice from 1569 that such wells should be drilled in winter.

609 Radwański 1995, p. 11.

610 Pianowski 1984, p. 135. About this well as "the castle well in the cellar" – cf. also: Pianowski/Firlet 2002, pp. 12, 13 and 15 and Stępień 2002, p. 50 (a "well hall" with the entrance to the cellar above the well).

611 RachWawel 2000, p. 37: *[Maii] 13. Item sabbato ante dominicam Rogationum [13 v 1531] a reformacione venae ferro ad fontem, ubi aqua hauritur pro Reginali Mte in domo canonicorum marc. – gr. 7 den. 9*. The editor's reading *venae* is erroneous; it was probably a bucket (*urna, -ae*), whose reinforcement with iron might have cost that much (cf. further on in the present chapter). *Venae* meant a water vein (water-bearing stratum), in this case very deep below the surface, hence it is difficult to imagine its being "repaired" for 7.5 groschen.

with this water supply system that occurred at that time, which will be elaborated on in the subsequent section of this work.

Constructing a well that would supply enough water was not an easy task also in towns situated on hills and escarpments (on rivers) that were built of loose sedimentary rocks in which wells were dug, not carved.

In Sandomierz, an upland town, where the water-bearing stratum was found in the bottom of the layer of loess,[612] it was necessary to dig well shafts up to 40 meters deep, because this was the height of the escarpment on which the town was built.[613] The construction of such a difficult well to build in Sandomierz in 1504 extended in time for a professional well builder who came originally from Stará Ľubovňa[614] in the Spiš region and was hired by the city council of Sandomierz. As was recorded in the oldest preserved town book, *providus Johannes alias Hanus de Lubowla fontanus* appeared in person before the council and committed himself – pledging his good reputation (*sub conservatione honestatis seu bone fame*) – to return to Sandomierz before Christmas in order to finish his work, namely the building of the well. The work was interrupted because his affairs neccessitated his return to his home town, i.e. to Ľubovňa. However, he gave his word of honour that he would come back to "decently" complete the construction of the well, for which he had received payment in full.[615] Perhaps it was for that reason that he was willing to pledge his reputation and good name that he would return.[616]

Although the Płock escarpment was comparable with the one in Sandomierz in terms of its altitude, because it was also ca 40 meters high, however, its formation was different. It was made up of deposits of dense and sandy boulder clay with glacial erratics, whose most characteristic feature was its negligible permeability referring to rainwater and meltwater. Hence, pools of stagnating water and even swamps emerged (in the humus layer of the soil, when it occurred directly on boulder clay,[617] but in 15th- and 16th-century records it was unanimously stated that the town suffered from the lack of water. Jędrzej Święcicki wrote in 1583: "wells, although dug deep due to the elevation of the town, provide little water through near-dried canals leading from the sources".[618] This clearly indicates – as the present author noted earlier – that it was necessary to reach the underground

612 Buko 1993, p. 11. Cf. also: part II of the present work "The town and the river".
613 Buko 1993, p. 7.
614 The local castle well was ca 150 meters deep – cf. Chalupecký/Smatana 1987, p. 34.
615 AKS, rkps/MS 84, folio 17.
616 About the good name – cf. Zaremska 1996, pp. 229–236.
617 Gołembnik 2002, p. 44.
618 Święcicki 1974, p. 180.

waters probably on the level of the river. This condition may have been met by two dug wells of whose existence in the courtyard of the Dominican Monastery we learn from the preserved archives of this Monastery. In 1447 an old well (*fons sive puteum*) was mentioned there, derelict and ruined to such an extent that in the same year it was rebuilt by the prior Stanisław Tylicki, "a zealous and highly celebrated man". It survived until ca 1509. It was then that in the same courtyard a new well was dug; it was equipped with necessary "instruments", including a "pretty large" cogwheel hung above it on a strong wooden structure and a big bucket to draw water. The well was roofed; a stone step was built all around it.[619] The use of the cogwheel testifies to the fact that it must have been a deep well shaft.[620] However, this could only be proved by archaeological and hydrogeological research. Such research was carried out in the Silesian town of Świdnica, situated on a hill over a river,[621] and brought very good results concerning deep water wells. Thanks to Dobiesław Karst's archaeological research (including hydrogeological drillings) it is known that these wells supplied water from quaternary aquifers existing at the depth of about 15 meters.[622] Thirteen mediaeval wells from Świdnica that were subjected to archaeological research were built of brick in rocky ground.[623] It can be added that they were probably built using the technique described by Palladius and later by Alberti. They were 16–18 meters deep; one of them measured 2 meters in diameter at the top and 1.25 meters at the bottom.[624] Thus, they were reservoirs of underground water that was the best for drinking; let us recall the words of Bartholomeus Anglicus that among the types of well water, the one taken from deep dug wells was the best.[625] The validity of this opinion can be proved by the high quality and an international renown of beer from Świdnica, brewed using water from these wells.[626] And this is a reliable

619 ADKr., Pd 4, p. 182.

620 Solski 1959 (1690), pp. 20–21, 27–28 and 288–289.

621 Goliński 2003, p. 66.

622 Goliński 2004, p. 76, with a reference to: Karst: *Średniowieczne browarnictwo w Świdnicy*. Wrocław 2000, typescript of a doctoral thesis at the Institute of Archaeology, University of Wrocław, p. 114 (non vidi).

623 Chorowska/Karst/Lasota/1998, p. 164; Goliński 2003, pp. 72–73.

624 Chorowska/Karst/Lasota 1998, p. 164; Goliński 2003, p. 73, footnote 128, where the author observed that these wells were very deep – "indeed, they were incomparable with objects discovered in other Silesian towns, measuring 1.5–8.5 meters in depth" (reference to: Buśko 1996, p. 94).

625 Bartholomeus, 1519, lib. XIII, cap. I, *De puteo*.

626 Chorowska/Karst/Lasota 1998, p. 157, where also earlier literature was cited. Goliński 2003, p. 67 and id. 2004, p. 76 et seq.

factor for all the lands on which "the civilization of beer" flourished, namely in all of the places where the cultivation of grain was predominant. For the inhabitants of these lands beer was more than just a beverage. Being of considerable nutritive value, it was an ingredient of many dishes (e.g. various types of beer soups) and constituted one of the main elements of mediaeval diet of all social groups.[627] It was also used for its medicinal properties. The production of beer consisted of preparing malts in maltings (*braseatoria*), grinding them in mills and brewing beer in breweries (*braxatoria*).[628] Both maltings and breweries were placed at the back of the plots, in direct proximity to one another or together. While brewing beer did not require a separate brewery, because it could be done in the burghers' houses (e.g. a certain widow from Sieradz brewed beer in her chamber which was at the same time her only abode[629]), maltings had to be separate buildings not only because of the technique of producing malt, but also due to the fact that it constantly posed the risk of fire.[630] There survived some descriptions of maltings

627 Apart from the lands of "the civilization of beer", e.g. in the Burgundian town of Dijon, it was – besides wine – a beverage of the upper classes. The poor, including workers, had to make do (except for a mediocre wine – "les piquettes") with a drink of Gallic origin ("cervoise"), similar to beer, but without hops – cf. Leguay J.-P., 2002, pp. 221–222.

628 About the technique of beer production cf. Rutkowska-Płachcińska 1978a, pp. 186–188 and Klonder 1983, pp. 46–60: in maltings, usually between August and May (grain had to be fresh, stored until the hungry gap at the most), healthy and cleaned grain was at first soaked in vats or troughs for several days until the husk was separated from the grain. Secondly, the grain was left to germinate on large surfaces made of burnt brick, clay or stone. Grown grain became malt, which was dried on malt dryers or directly on stoves, sometimes in separate buildings-sheds for drying malt. Ground in a mill, the malt was supplied to breweries, although sometimes malt ready to be brewed was kept for a period of time (e.g. for a year), because it was thought to develop into still better beer. In breweries water was poured over the malt and this was heated in vats until malt mash was obtained, which was later strained. This procedure produced clear liquid, called wort, which then was boiled again with the chaff and with hops in brewing cauldrons, the most important pots in the brewery, according to which the gyles of beer were counted (1 cauldron = 1 gyle). Finally, the compound was strained once more, cooled and poured into barrels in which after the addition of yeast the fermentation process took place.

629 This situation was to last until all the instalments were paid off by the person who had bought her house – cf. Sowina 1991b, p. 131.

630 Cf. Jan Długosz's dramatic description of the burning of this part of Kraków on a Friday night, 31 March 1475: *Cracoviensis civitatis pars igne in braseatorio exorto exusta est. Die Veneris ultima Martii, hora octava noctis, in Cracoviensi urbe ignis de*

as buildings with a number of rooms and several storeys. In 1570 Kraków municipal officials called *quartalienses* inspected one of the local maltings in Pijarska (Piarists') Street and noted that the malthouse stood behind the front house, next to the wall of the plot. It had a cellar and three storeys, and its own well nearby, with an oak casing. From the first floor grain was poured down – to the cellar, where it was soaked and then left to germinate. The building was sorely neglected, with a leaky roof, the casing of the well was partly rotten and the device with a wheel for pulling out water was also seriously damaged.[631]

Archaeological research into mediaeval and early modern malthouses in Wrocław brought very similar results concerning these devices. Among brick (but also wooden, still in the 16th century) maltings in Wrocław, one of them, dating from the Middle Ages, was built on an elongated rectangular plan and had two storeys, the lower one being almost entirely underground; lit by small slot windows, it was covered with a high, steep roof with a four-storey attic. In early-modern malthouses the first underground storey was identified as a growing floor where grain began to germinate; later it was transferred to the second storey for drying (ventilation), and then into the kiln; malt that was ready to be crushed in a mill was transferred to the attic.[632] According to

braseatorio ioannis Gehans erumpens, omnes domos a porta nova, usque ad portam S. Nicolai, centum numero, inter quas et castellum Tharnoviensium, item duas turres civitatis optimas et cum bombardiis, item domos altaristarum Beate Virginis, et mansionariorum Sanctae Barbarae sua potenti flamma quam magna multitudo frequenter tentando nequicquam restringere poterat, voravit – Długosz 1878, vol. V, liber XII (XIII), p. 627.

631 KsWiertelKraków 1997, pp. 141–142.

632 Chorowska/Karst/Lasota 1998, p. 162, with a reference to other works and with descriptions of several maltings discovered archaeologically on plots in the middle part of the south side of the Market Square in Świdnica. The remains of a building identified as a maltings on a plot at Market Square no. 19 allowed their discoverers to describe it as measuring 20×25–26 meters and ca 2.2 meters high, with slot windows and a well in front of its north wall with the casing made of broken granite. For the sake of comparison, let us quote the example of an archaeologically confirmed maltings in one of the suburban plots in Sezimovo Ústí-Nové Město [Sezimovo Ústí New Town], with a well rich in water, measuring 1.8–2 meters in diameter and 6.3 meters in depth, built of stone to the depth of 4 meters, the bottom part being sunk in rock. The maltings itself was identified not as a single building, but as a complex consisting of a separate part ("humno"), where grain was soaked until the chaff was separated, and of a combined growing floor and an oast, located behind the front house – cf. Krajíc 1989, passim, including drawings of the whole complex on pp. 163 and 171. Water was conducted to the "humno" through a trough from

information provided by M. Goliński, "a malthouse near St Dorothy's Church" in Wrocław was sold in 1492 for 80 guldens.[633]

Ingredients of beer, such as grain for the production of malt, ready malt or hops could be taken from a supplier (a farmer, a grain merchant or a malster) and sometimes even from one's own fields or gardens, whereas water, indispensable on every stage of production, had to be constantly available both in malthouses and in breweries. The quality of the ready product was mostly dependent on the quality of water used on the second stage of production, i.e. during brewing beer, which is why it is believed that this activity was one of the most important reasons for the establishment of water supply systems in towns in the Polish lands.[634] Nevertheless, it must be noted that this becomes clear and repeated only in late mediaeval and early 16th century royal privileges to build such systems, which, however, were – even more importantly – often issued later than the surviving source material confirming the fact of brewing beer in a given centre. For example, opinions voiced in Kraków in 1423 about "the good beer from Proszowice"[635] and about it being drunk at the royal court,[636] as well as the confirmation of 86 plots in Proszowice on

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the above-mentioned well situated at the back of the plot – op. cit., pp. 162–164 and 169–171; and pp. 176–182, where the process of malting grain was presented, including, inter alia, the following items of information: soaking grain lasted from 48 to 100 hours; in the mid-20th century 2 hectolitres of water were used per 1 quintal of soaked barley.

633 Goliński 1997, p. 166, footnote 650 (in the quarter: "Słodownicy" ["Malsters"]).

634 Rutkowska-Płachcińska 1978a, p. 188.

635 Kiryk F., 2000a, p. 59.

636 In the 15th century beer from Proszowice was drunk by the royal family, their court and their guests also during important feasts: according to accounts of the Royal domain under the management of the governors of Kraków from the year 1471, 1 achtel, namely ca 140 litres of beer from Proszowice cost 20 groschen at that time, and the following amounts were purchased on various days of that year: an achtel for the Queen's maidservants – 12 May; an achtel for the Princess – 14 May; 2 achtels (apart from 6 achtels of beer from Kraków for 13 groschen for an achtel) for the main meal – dinner (*prandium*) and supper on 19 May for the King, the Queen, and their guests sitting at (their) table, including the Bishop of Kraków and the Bishop of Kujawy, deputies from Greater Poland, voivodes and castellans, and also for the Emperor's envoys and the starost of Brześć Kujawski; an achtel for the Queen on Pentecost; an achtel for the royal cellar; 2 achtels (apart from 9 achtels of beer from Kraków) for dinner and supper to mark the occasion of Ladislaus Jagiellon becoming King of Bohemia (the dinner was attended by all Polish and Bohemian nobles); an achtel for the King's dinner attended by canons and citizens of Wrocław; 2 achtels (apart from 9 others); an achtel for the King's dinner attended by the Tatars; for

which beer was brewed in 1456[637] are much earlier than the privilege to establish a water supply system in Proszowice issued in 1532 from which it follows that it served mainly those who brewed beer.[638] Thus, before the year 1532 beer from Proszowice (just like the one from Świdnica) must have owed its high quality to water from the local wells.[639] According to contemporary data, prepared and made available in literature for five wells in Proszowice that have survived to the present day, water in these wells was drawn from quaternary underground aquifers in the layers of alluvial soils and loess. The depth of these wells to the level of water ranges from 6 to 10 meters, and to the bottom from 9 to 13 meters, the depth of the layer of water being between 2 and 4 meters.[640] It is a pity that despite having such hydrogeological data and knowing from a 15th-century source the "addresses" of the "beer" plots in Proszowice no excavations have been conducted at least on some of them. Interdisciplinary research – always extremely valuable – concerning the urban plot[641] would probably reveal some information as to the supply with water of the "beer" plots in Proszowice, i.e. mainly about dug wells. This kind of valuable data was acquired in the course of archaeological research carried out in the centre of mediaeval Płock,[642] where beer was also brewed, although due to its low quality the local inns rather sold beer brought from other towns.[643] The results concerning 54 dug wells, collected to date by Maciej Trzeciecki, show a large number of

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a Sunday dinner and supper on 1 September for all teachers, students and town councillors of Kraków; an achtel for the King's Sunday dinner with the castellan of Lithuania and the voivode of Kiev; and an achtel for dinner with the Teutonic Knights (RachWielkorz. 1951, pp. 377, 381, 383, 389, 391, 394, 415, 420, 421).

637 Kiryk 2000a, pp. 71–76.

638 MRPS IV/2, 1912, nº 16342, p. 415 (summary) and AGAD, MK 47, p. 376 and ANK, IT 47, p. 109 (text).

639 The same must have been true for Nowe Miasto Korczyn, also an important centre of beer production, from where beer was sent to Kraków from the 14th century (Kiryk 1994, p. 79). The earliest piece of source evidence testifying to the existence of a water supply system there dates from the mid-16th century (ANK, SWPM I-24, pp. 85–86–93, quoted by: Kiryk 1994, pp. 79–80 and footnote 32 on p. 81).

640 Lach 2000, p. 28 and pp. 30–31.

641 The present author underlined the necessity of conducting such research earlier: Sowina 1995, p. 324. The case of Proszowice is one of many examples of the fact that archaeology and history don't always go hand in hand.

642 These are the results of excavations conducted in Płock by Andrzej Gołembnik, Zbigniew Polak and Maciej Trzeciecki. The present author extends her thanks to the latter researcher for fruitful cooperation and for making documentation concerning dug wells in Płock available to her.

643 Szacherska S.M., 1973, pp. 129–130.

only wooden wells on plots in three blocks around the Market Square (no excavations were made on the fourth side), in a block between Grodzka (Burgh) and św. Michała (St Michael's) Streets (almost on every plot) and in a block between Tkacka (Weavers') and Dobrzyńska (Dobrzyń) Streets. This is the same region for which written sources confirmed the existence of breweries.[644] Undoubtedly, water for their needs was drawn from these wells. Archaeologists dated the wells to the 14th–16th centuries, though most of them were built in the 16th century. The depth noted for 15 of them varied from ca 1 meter to 7 meters; their construction was similar to the one of the above-mentioned wells in Wrocław, used in case of a shallow water-bearing stratum. Therefore, they can't have been deep (A. Święcicki mentioned deep wells); water must have been found also within the escarpment (in the form of a water-bearing stratum? underground pools of stagnating water?). The fact that wells in Płock were relatively quickly changed into sewage pits can testify to a rapid depletion of water, and thus to its small amount in these reservoirs. This together with the problems (described in the preceding part of the present book) connected with drawing water from a river situated much below the town and with difficulties of obtaining water from deep wells forms an image of a town indeed suffering from a severe lack of water. This situation must have been the reason for the efforts to establish a water supply system, lasting for many years (from 1498 at least until 1537); what is more, it is not known whether these efforts were successful, if we consider not only the lack of any material traces of a water network on the well-studied site of the Płock Market Square, but also the above-mentioned large number of 16th-century dug wells.

An archival research conducted for the purpose of the present work in court books of towns of the Crown of the Kingdom of Poland showed that generally relatively few source mentions of dug wells were usually found precisely in relation to information concerning devices used for beer production that were situated close to these wells. This means that dug wells possessed a special value for the functioning of these devices in towns. Such mentions come from e.g. Little Poland's town of Ciężkowice from 1431: of a well belonging to a malthouse (*braseatorium*) situated near one of the houses,[645] and Old Warsaw from the year 1512: of a private well serving both a malthouse and a small garden, situated in Długa

644 Archival research concerning, inter alia, breweries on plots in Płock was carried out (on the basis of: KsŁaw Płock, 1995) by Maciej Trzeciecki who published its results in: Trzeciecki 2000, pp. 61–62.

645 AGAD, Biblioteka Baworowskich 275, folio 7v.: *braseatorium circa domum… obligavit cum fonte…ad eundem braseatorium*.

(Long) Street on a plot owned by a butcher-suburbanite.[646] Also a socio-topographical reconstruction of several neighbouring plots in Sławkowska (Sławków) Street in Kraków revealed the existence in 1342/1343 of a well and a malthouse on a 14th-century plot (*curia*) belonging to Marcin Gousman.[647] Another mention concerning Kraków dating from the year 1336 showed that the functioning of a maltings on one of the plots in Św. Krzyża (Holy Cross) Street depended on a nearby well situated opposite the Holy Ghost Hospital.[648] The existence of a well near a malthouse on the border between two plots was confirmed for the year 1537 for Greater Poland's small town of Pleszew.[649] A closer look at the neighbourhood of one of these plots[650] revealed that it was situated in the suburb, near "clay pit ponds" and a suburban Church, in a cluster of plots called "malt plots".[651] A well (*fons*) was located *inter Braseatorium honeste Elizabet Janeczkowa et inter domum vel edificia Nicolaj Lyssek*. Following the decision of arbitrators, Mikołaj sold his half of the well to Elżbieta for a threescore of groschen, with the full right of ownership that he had possessed. He was, however, to be able to exit his cowsheds and his house in the direction of the "clay pit ponds" (*versus paludem als na glynky*) without having to make a detour to the right of Elżbieta Janeczkowa's maltings either with his cart, or with his horse. The record concerning the suburban well in Pleszew is the only mention from small towns of the Crown found in the course of the archival research done for the present study that provided the information about the price of the object in question (the whole well would cost 2 times threescore of groschen, i.e. 120 groschen, namely 4 florins or 2.5 marks). Thanks to this uniqueness, it is a highly valuable mention in Polish written sources dating from the 15th and the 16th centuries.[652]

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646 KsRadzStWarszawa, 1963, no. 975, p. 284 (year 1512).

647 KsRachKraków I, 1878, pp. 161–162 (no. 1466 and 1467) – cf. also Part III.1: "Rainwater cisterns".

648 KsRachKraków I, 1878, p. 128 (6 September 1336).

649 APP, Pleszew I/2, p. 77.

650 APP, Pleszew I/2, folio 32v. and 36.

651 Let us recall that the existence of "malt plots" *aree braseatoriales (braseatorii)* near the town walls, but still *intra muros*, was also confirmed in 16th-century Kalisz. However, no information concerning wells was noted there – cf. Sowina 1995, p. 329. Malsters' plots as forming part of the estate of the Sieradz *advocatus* were mentioned when this estate was being sold in 1445: AGAD, CS-LibInscr., 25, pp. 267v.–269v. – – *cum braseatorum areis in prefata Civitate siradiensi et districtu eodem sitis* – – cf. more: Sowina 1991b, p. 163 and footnote 44.

652 This mention provides us also with information about the layout and the development of this suburban plot: about its decidedly farming character – with a manor

Whole groups of mentions of the presence of wells near private malthouses were found in court documents of Poznań from the second half of the 15th century and of Środa in Greater Poland from the first half of the 16th century.

Source mentions from Poznań reveal the existence of maltings on plots in various parts of the town (in the southern part: in Woźna (Beadles') Street (platea bedellica), in the northern part: in Wrocławska (Wrocław) Street, near the Castle, in Wroniecka (Wronki) Street, and also at the back of one plot in the Market Square) and at the same time they show their complete dependence on wells by informing that the latter belonged to the malthouses[653] or at least were very close to them.[654]

Consequently, this is precisely this type of water intakes that seems to have played the most important role in the process of preparing malt in Poznań malthouses in the second half of the 15th century, including maltings on plots around the town malt mill called "Bogdanka" which had a monopoly on milling the burghers' malt.[655] In the light of the fact that private wells existed in immediate proximity to maltings, thus ensuring their owners' independent (their own) access to water, it is difficult to state whether mentions of the topographic proximity of some malthouses to a pond called "Bogdanka" near the Castle and to a watercourse of the same name (known also as "Flisa" – from the German word "Fluß" meaning "river"), flowing at the back of plots in Wroniecka Street, near

house, sheds for animals, a maltings and a well. Unfortunately, it does not contain information concerning the value (price) of the entire estate, which would make it possible to calculate the ratio of the value of the estate to the value of the well itself. Estimations of the value of wells can be found in European literature – cf. F. Braudel (2004, p. 76), who on the basis of studies by E. Le Roy Ladurie stated that the value of a well with a windlass, called "seigne", in Lower Languedoc amounted to 30% of the value of the garden in which it stood. The name of the well suggests that it was deep and that the "windlass" was a construction of the "noria" type (which will be discussed further on) – the Arab "as-sania/saniya", lifting water from deep wells in dry climate – cf. Delpech/Girard/Robine/Roumi 1997, p. 238.

653 Wells belonging to maltings: ARadzPoznań I, 1925, no. 762, p. 275 (year 1458 – Wrocławska (Wrocław) Street): […] *aqua de fonte ipsius braseatorii* […]; op. cit., no. 931, p. 340 (year 1462): *debet itaque Andreas prefatus fontem ad dictum braseatorium attinentem propriis impensis reformare* […]; and: Stadtbuch von Posen, 1892, p. 45* (from: Acta Scabinalia 1473, folio 248): *braseatorium in postico domus murate in Circulo civitatis situm una cum fonte ad dictum braseatorium pertinente*. Cf. also: ARadzPoznań II, 1931, no. 1253, p. 49 (year 1475).

654 Wells next to maltings in Woźna Street (*platea Bedellica*): ARadzPoznań II, 1931, no. 1229, p. 39 (year 1473) and no. 1286, p. 65 (year 1477).

655 Kaniecki 2004, pp. 375–376.

St. Catherine's Monastery, in the direction of the moat,[656] can be treated as evidence that the malthouses of this region also used these two water reservoirs (perhaps only when there was no water in one's own well).

To date, researchers have not recognized the role of dug wells in the burghers' production of malt in Poznań in the 15th century. This production was flourishing, which is confirmed by the large number of malthouses mentioned above. The fact that they functioned at the back of many burghers' plots which belonging not only to malsters means that every burgher who owned a malthouse dealt with the entire process of beer production and possessed the right to brew beer (not more frequently than once a week).[657] In the case of maltings owned by Poznań malsters, this testifies to the professionalization of their work performed within the scope of the guild. In 1460 the town authorities of Poznań issued a decision concerning the re-establishment of the malsters' guild (*fraternitas braseatorum*).[658] According to this document, a person could become the master *artificii braseatorie* after three years of apprenticeship served in the town or elsewhere; malsters' duties consisted of measuring the volume of wheat for malt, preparing malt and selling it. Malsters were not allowed to use different measures (also to measure hops) or to make malt using various kinds of grain, i.e. mixed grain. They were allowed to make malt from oat only for their private needs, since producing such malt for sale was penalised with its confiscation.

Braseatores obtained a high social and economic position in late-mediaeval Poznań.[659] They had their guild with two representatives (like all other guilds)

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656 Stadtbuch von Posen, 1892, p. 44*, footnote 2 and 4 (quotations from, respectively: Acta Scabinalia p. 164, year 1470 and p. 3v., year 1497 – non vidi!): …*braseatorium sub castro circa stagnum Bogdanka*… and: *braseatorium inter Czechota et inter claustrum monialium s. Katherine circa rippam decursus aquae situm*…

657 WilkierzePoznań I, 1966, no. 32, p. 10.

658 ARadzPoznań I, 1925, no. 884, pp. 320–321. According to this document, a person could become the master *artificii braseatorie* after three years of apprenticeship served in the town or elsewhere; malsters' duties consisted of measuring the volume of wheat for malt, preparing malt and selling it. Malsters were not allowed to use different measures (also to measure hops) or to make malt using various kinds of grain, i.e. mixed grain. They were allowed to make malt from oat only for their private needs, since producing such malt for sale was penalised with its confiscation.

659 Unfortunately, probably as a result of the ignorance of the brewing technique, including two separate processes: malt production (*braseare*) and brewing beer (*braxare*), Poznań malsters were erroneously called brewers in literature (Gąsiorowski 1975a, pp. 33–34, id., 1975b, p. 263 and id., 1988, p. 260; W.Maisel, in: WilkierzePoznań III, 1969, no. 8, p. 5). This error became the reason for the reversal of roles of the *braseatores* and the

in the town *communitas iuratorum*; the lists of the representatives to this body survived from the year 1440 onwards.[660] The following people were repeatedly listed among *iuratores omnium fraternitatum* as representatives of *braseatores*[661]: Jan Fredrich (Fredericus), Jan (Hanusz) Berger, Andrzej Bedirman, Walenty słodownik (malster), Jan Pierzykoszula. Some malsters formed part of the town authorities: the echevins and the council, e.g. Wawrzyniec the malster (Laurencius Melczar), an echevin in 1444,[662] Walenty the malster, a councillor in 1506,[663] or Andrzej Bederman (Bedirman), who between 1483 and 1506 was not only the malsters' representative in the *communitas*, but also an echevin, a councillor, the burgomaster and the *advocatus*. In 1495 two of the above-mentioned masters, namely Andrzej Bederman the then echevin, and *iuratus* Jan Pierzykoszula, together with the second representative of malsters Andrzej Czechota, headed a rebellion of the *braseatores et braxatores cerevisie* and renounced obedience to the town authorities (which was forbidden on the strength of the above-mentioned law passed by the city council in 1460 concerning the malsters' guild). The causes and the course of the conflict were described in detail in a letter from the burgomaster with the town councillors, the *advocatus* with the echevins and the *iurati* (*proconsul consulesque, advocatus et scabini necnon seniores iurati tocius communitatis civitatis Posnanie*) sent to the King John I Albert (Jan I Olbracht).[664] The conflict started when during Lent the *braseatores* asked the city council to reduce charges for the storage of beer. The council replied by making accusations against malsters (also on

braxatores in the professional and social hierarchy of late-mediaeval Poznań reconstructed by: Jacek Wiesiołowski (1982, passim, especially pp. 44, 50–51, 53, and also pp. 60, 65–66, 152–156, 187–188), according to which rich "brewers" (in fact – people referred to in sources as *braseatores*, namely malsters) belonged to the "upper middle" group, whereas much poorer "malsters" (in fact – people referred to in sources as *braxatores*, i.e. brewers!) – to the "lower lower" group. For the sake of comparison it is worth adding that in Wrocław at the turn of the 14th and 15th centuries malsters (*braseatores*) occupied the foremost and most honourable places in the corporate structures of the town of Wrocław (Goliński 1997, p. 465).

660 Gąsiorowski 1975a, p. 33; Wiesiołowski 2003, p. VII.

661 ARadzPoznań I, 1925, pp. 107, 112, 140, 154, 174–175, 183–184, 196–197, 228, 250, 265, 282, 301, 315–316, 331, 349, 357, 374, 393, 410, 424, 436; ARadzPoznań II, 1931, pp. 13–14, 26, 38–39, 43–44, 47–48, 54, 129–130, 162, 172, 206, 212, 217, 231, 242, 252, 262–263, 317, 342, 349–350, 359–360, 396; ARadzPoznań III, 1948, p. 57.

662 Stadtbuch von Posen, 1892, p. 18.

663 ARadzPoznań III, 1948, nº 2262, p. 151.

664 ARadzPoznań II, 1931, nº 1618, pp. 290–296.

behalf of their customers) of using false measures of wheat in malt and achtels (barrels) and by ordering them to improve (not only their conduct, but also the quality of the beer they produced) before their request could be considered (an additional reason for postponing the case was that only three councillors were present, the rest being away in Lublin or dead). When neither of the parties met their mutual expectations, an open conflict arose: the assembly of the *braseatores et braxatores* joined by a member of the butchers' guild decided not to brew beer and sent their complaint to the Poznań voivod. The growing disorder was aggravated even further by the local porters (*portatores cerevisie*) who refused to cart beer when the city council rejected their request to cart also herrings considering the fact that less beer was carted. According to the city council's version, it were the *braseatores et braxatores* who persuaded the porters to take this step. A decision was taken to sentence 17 malsters to imprisonment in the Town Hall tower. The town authorities in plenary session met with the rebellious group formed of over 80 *consocii* (described above the two groups of craftsmen) headed by the above-mentioned malsters: Pierzykoszula, Czechota and Bederman, accompanied by the butcher named Benko. The town authorities reminded the group that according to the law in force in the city and approved by the King, he who conspires or does something in the city without the council's consent, is to be condemned to death.[665] The leaders of the rebellion were sentenced to imprisonment in the Town Hall tower; before that, however, they were to take an oath of allegiance to the council. Andrzej Bederman broke out of it by escaping to the castle and finding shelter at the starost's. The city council also issued a prohibition on performing anytime any functions in the town authorities by all the four leaders. Through the intercession of the *plurimi boni homines* the town authorities changed the death penalty for Pierzykoszula, Czechota and Benek the butcher to a fine. The same course of action was taken towards Bederman on behalf of whom Jan Ostroróg, the Castellan of Poznań and starost of Greater Poland, interceded. Without going into detail of the subsequent stages of the settlement of the conflict let us only state that eventually – after the rebels had humbled themselves before the council and after the King had mediated in the case of Bederman and after a number of royal documents mitigating these and other conflicts in town had been issued – the conflict ended on Christmas Eve of 1495 with the

665 ARadzPoznań II, 1931, no. 1618, p. 293. Cf. also WilkierzePoznań I, 1966, no. 41, p. 11.

revocation of all the sentences.[666] In the following years the above-mentioned rebels again performed public functions, e.g. Andrzej Bederman became town councillor, burgomaster and *advocatus* only after the events of 1495.

It follows from the collected source documents (merely touched on in the present work, as they merit a separate elaboration) concerning late-mediaeval Poznań malsters (*braseatores*) that they should be perceived as rich entrepreneurs who controlled the whole process of beer production and trade: from measuring grain for malt to selling the ready product. This activity resulted in their high social standing. *Braxatores* occupied a decidedly lower position (in the documents referring to the conflict of 1495 described above the two groups of craftsmen were referred to collectively as *braseatores et braxatores cerevisie*, which was treated as a synonym for *braseatores*), perhaps also due to the fact that they were employed by malsters as hired brewers. The high position of Poznań malsters in the economic and social hierarchy of late-mediaeval Poznań resulted mainly from the profitability of their malthouses.[667] The production of malt which took place there constituted the first important stage in the organization and control of beer production. For that reason Poznań maltings were also owned by merchants belonging to the local ruling elite, e.g. the *pannicida* Jakub Grodzicki who owned a malthouse with a well in Woźna (*Bedellica*) Street. It must have been a lucrative business, otherwise Jakub would not have invested his capital in it. The efficient, i.e. uninterrupted functioning of the maltings was a sine qua non of its profitability. It relied not only on grain supply, but also on a permanently and directly accessible water intake. In source material from Poznań, like in mentions from other towns described above in the present chapter, the only documented kind of water intakes for burghers' maltings

666 ARadzPoznań II, 1931, no. 1647, p. 316.

667 In Elbląg, a much more important brewing centre compared with Poznań, this concerned the brewers-entrepreneurs, who did not engage directly in beer production, but as owners or leaseholders of breweries and as those who possessed the capital and the raw material, they used the structures of beer production organized within the framework of the brewers' guild, namely they delivered the material to maltings and town mills, and they hired brewers to work in their breweries – Klonder 1983, pp. 24–28 and Czaja 1992, p. 47. This enabled non-professionals to become brewers-entrepreneurs. In the second half of the 15th century, coincident with the plunge in profits from the great trade, merchants and people from the circle of the town council formed a growing share of such brewers-entrepreneurs in Elbląg (Czaja 1992, p. 47) (the fact that people connected with the town council became brewers-entrepreneurs was a result of a greater engagement of the town in the organization and control of beer production than in other centres – cf. malthouses and mills belonging to the town in the 16th and 17th centuries – Klonder 1983, p. 24).

were dug wells. The only sources of water on burghers' plots until the establishment of a water supply system in Poznań (i.e. at least until the 1490s, as convincing evidence about the functioning of a water network in the town dates only from that period, which will be elaborated on in the next part of the present work), dug wells must have been used for brewing beer, an activity undertaken on the majority of such plots, as was mentioned above.

As far as wells near maltings in Środa in Greater Poland, are concerned, an analysis of neighbouring plots for the first half of the 16th century showed that such wells were situated on plots or on their borders, starting from one of the corners of the Market Square and a nearby Targ Świński (Pig Market),[668] continuing along Piekarzy (Bakers') Street (*platea pistorum*) up to the local monastery and to the town walls.[669] At the end of *platea pistorum* was a town well called Walkmyn, mentioned in records as a landmark for the private maltings located in its vicinity.[670] Such an accumulation of malthouses with wells in this part of the town (no mentions exist of maltings in other parts of Środa) testifies to the existence of a rich water-bearing stratum in that place. This can be confirmed by the fact that apart from malsters,[671] these plots with maltings were owned also e.g. by furriers[672] and leather craftsmen (*sutores*)[673] who needed water to perform their crafts. The fact that they had their own maltings shows that they dealt with the whole process of beer production (just like the owners of malthouses in Poznań): not only with brewing beer, but also with the first stage of this process, namely making malt. A similar situation must have existed in Sieradz, where the local burghers left their heirs in their last wills grain for malt, ready malt and equipment used for brewing, storing and selling beer.[674] Examples from Środa and Sieradz indicate that making beer still had a home-made rather than professional character in early modern small towns that by no means were important centres of brewing beer (this could also be confirmed by the lack of brewers (*braxatores*) in either of the towns). The fact that some malthouses in Środa were owned by malsters was an indication that there existed also a professional branch of the local malt production (like in Poznań). However, the fragmentary character of written sources pertaining to Środa make it difficult to say anything about the stage of this professionalization,

668 APP, Środa I/30, p. 168, year 1527 and p. 196, year 1532.
669 APP, Środa I/30, pp: 168 (year 1527), 340, 401, 465v., year 1554.
670 APP, Środa I/30, p. 81, year 1518.
671 APP, Środa I/30, p. 430.
672 Op. cit., p. 196, year 1532 and p. 367, year 1548.
673 Op. cit., p. 401, year 1550 and p. 430, year 1552.
674 Sowina 1991a, p. 12.

its dimensions or organizational forms, and thus it prevents us from comparing it with a few decades earlier late-mediaeval image of malt production in a larger centre, namely in Poznań, and from drawing a conclusion that e.g. the same processes occurred at different times in a small centre and in a large one. Nevertheless, both in Poznań and in Środa burghers (including representatives of the town and local elite) were very interested in owning a malthouse, which fact undoubtedly proves the profitability of these enterprises.

III.2.2 Wells within the town space: ownership and management

In the course of analysing written sources, it is not always possible to pin down precisely the main function of wells, as was done in the cases described above showing their close relation to beer production. The general statement that dug wells supplied (or contributed to supplying) towns with water is a reflection of a commonly accepted opinion encountered in literature that dug wells performed many functions. While most of such generalizations are true, some of them do not account for the most important functions of wells or for those that they could not have performed. The most important question is of course whether water from these wells was suitable for drinking. Exceedingly rarely given in a direct form, the answer to this question is worth looking for in mutual relationships between the technique in which these intakes were constructed, their location and the ways of managing them in the private and public urban space. On the basis of an analysis of historical and archaeological sources on the one hand and of such literature that contains relevant information for this sort of analysis on the other hand, at least three situations can be identified. Firstly, well water that was suitable for drinking and easily accessible from a shallow water-bearing stratum translated into (1) a large number of private wells that were easy to build and therefore cheap, constructed on private plots, but (2) less care taken by the town authorities of organized forms of building public wells, and thus their small number. Secondly, well water that was good, but less easily accessible or accessible with great effort, translated into (1) private wells constructed on plots that were especially valued (and as such recorded in written sources), expensive to build and to maintain, (2) forms of using neighbours' wells that were organized and fixed by the town authorities, concerning wells built on borders between two plots and those belonging to more than two neighbours (also in town quarters), (3) a constantly expanded network of public wells treated as points of drawing water open to the public, sometimes with a reservoir/waterhole for animals, especially horses. Thirdly, water that was unsuitable for drinking, but easily accessible from a shallow water-bearing stratum translated – like in the first case – into (1) numerous private wells and single public wells (the latter as public

investments were dug to deeper, and thus better strata) and (2) repeated opinions about the lack of drinking water in the given town. It should be added that in all of these cases efforts were made (with greater or lesser success) to establish water supply systems.

The first situation can be observed in lowland towns on great rivers with a very shallow water-bearing stratum, e.g. in Milan, a city described by its 13th-century apologist as having 6000 dug wells, because every house in the town had its own "source of living water";[675] in London, situated in the lowest place on the River Thames, where dug wells (together with streams flowing through the town) played a very important role both in the Roman times and in the early 14th century;[676] in Strasbourg, where a very rich water-bearing stratum of water that was suitable for drinking was found ca 0.5–2 meters deep,[677] and also in the Wrocław agglomeration, with a large number of private wells ca 2.5 meters deep and with public wells (archaeologically studied to a far lesser extent) in squares and streets,[678] not noted socio-topographically among the basic public utilities.[679] The third model undoubtedly reflects the situation found in the Norman town of Rouen in which thanks to a shallow water-bearing stratum wells existed in every house (usually in the cellar) or were shared by two neighbours.[680] In spite of this, according to J. Le Lieur's assertion, before a water supply system had been built, the town suffered from a major lack of drinking water.[681] The common feature of both of the above

675 Boucheron 1994, p. 133 and id. 2001, p. 190 and footnote 52 – with a reference to a work by the main writer of 13th-century Milan, Bonvesina de la Riva, "De magnalibus Mediolani" (Le meraviglie di Milano, testo a fonte di G. Pontiggia, Milano 1974). P. Boucheron noted a rare fact in Italy: because of an easy access to water that was good for drinking (and a low cost of sinking wells with good water) no public fountains were built in Milan, whereas in other centres they were the expression of care and the symbol of exercising authority in the town.

676 Keene 2001, pp. 164, 170–171.

677 Cf. geomorphological and archaeological studies concerning Strasbourg, including the situation of its three rivers, i.e. Bruche, Ill and Rhine – Schwien 1992, passim, especially pp. 22–23.

678 Piekalski 2004, p. 11.

679 Goliński 1997 – no dug wells were noted e.g. in the Market Square or in the Quarters.

680 Quenedey 1926, p. 101.

681 Le Lieur 1911, p. 13 (2) and 29 (48). Let us recall that also the quality of water from the rivers flowing through the town was not good; one of the rivers was called "white", and the other one "red" owing to a high content of calcium and iron respectively (professor A. Guillerme's opinion). As was mentioned above, they were used for energy and production.

situations (the first model and the third model) is that wells were exceedingly rarely recorded in written sources due to a low value of these intakes resulting not only from the easiness of their digging, but also from the fact that water became rapidly contaminated (in the first situation)[682] or was unsuitable for drinking (in the third situation). Being the most capacious category, the second situation can be illustrated by numerous source examples taken from both large and small towns. However, owing to the fragmentary character of the sources and/or various stages of research concerning a given centre, it is not always possible to identify all of the features considered to be characteristic of this situation. We deal with the second situation in Poznań (situated on the second terrace of the River Warta), where – according to A. Kaniecki's study – underground water was relatively shallow, namely from 2 to 5 meters deep;[683] in Kraków, where – as maintained by the local researchers – underground water of the middle terrace was found at the depth of 5–7 meters;[684] as well as in the above-mentioned Świdnica, where the level of well water was 15 meters deep.[685]

A point of departure for the presentation of the forms in which the management of wells in towns occurred, the proposed classification to a certain degree – like most models – is not free from a schematic character. Let us take a look at a joint analysis of written sources and results of archaeological studies concerning Płock. It revealed that both the first and the second situations described above were found in that town, namely shallow dug wells, rather characteristic of lowland towns situated on rivers, with water suitable for drinking (including beer production), as well as deep dug wells. Apart from two above mentioned wells in the courtyard of the Dominican Monastery dating from the mid-15th and early

682 In the case of wells in Wrocław, these factors were pointed out by M. Goliński (2003, pp. 73–74). The contamination of the "sweet, healthy, and clear water" in London wells and streams increased together with the growing number of inhabitants of the town. According to D. Keene (2001, p. 171), this could be testified the fact that already in 1179 by a church situated in a street near Cheapside was called "the foul church" (*lafullecherche*) "after the wet and filthy conditions in the street"; and also by the disappearance of the name of the parish church of St. Margaret Lothbury – called as late as in the early 13th century "Froscherch" because of frogs living in nearby waters that in turn must have been clean, as only in such conditions can these animals survive.

683 Kaniecki 2004, p. 585. More about the hydrological conditions of the Old Town – id., 1993, pp. 86–88 and 2004, pp. 75–77.

684 Rajman 2004, p. 36 and Krasnowolski 2004, part I, p. 92 – the results of earlier research, including hydrogeological studies, were collected in both of these works.

685 Goliński 2004, p. 76.

16th centuries, a private well belonging to a bricklayer/mason called Jurga dating from 1515 can be assigned to the second category.[686] At the beginning of May of that year, Jurga gave 6 feet of his plot to Jan Żur, a carpenter, as payment (or its part) for building his house. However, due to the fact that on the part of the plot given to Żur a well (*fons*) was situated, Jurga made a stipulation that he and his posterity could use the well without any restrictions and fence a path leading to the well.[687] Therefore, this must have been a particularly valuable intake of high quality water, especially so as is was to be used longer than by one generation. This condition was not satisfied by rather shallow wells because of their becoming rapidly contaminated and as such changed into sewage pits. The fact that Jurga's well was referred to as *fons*, i.e. "source" (of an excellent quality "living" water, namely springing from the ground) can testify to its supplying good quality drinking water for a long time. Here again, as in the previous chapter, we encounter the problem of the terminology used in written sources to describe dug wells. Conclusions concerning the well owned by Jurga the bricklayer were drawn on the basis of a comparison of Latin terms used in various towns (hence by various municipal scribes), mainly in centres in the Polish lands. Consequently, even though due to the deficiencies of the source material (its laconic, fragmentary and scattered character) this conclusion cannot be considered a rule, nevertheless, it can be perceived as a clearly noticeable tendency, at least for centres in the Polish lands.

In mediaeval towns of western and southern Europe dug well was usually described as *puteus*; the term *fons* (plural form: *fontes*) was reserved for fountains connected to water supply systems or for water supply systems themselves,[688] because these were the networks that supplied the best quality water, closest to the "source" ideal. This is clearly visible in town accounts from Bruges written in Latin dating from the years 1282–1299[689] and in this town's subsequent financial

686 KsŁawPłock 1995, no. 526, p. 281.

687 A separate, direct access (from a street) to a well, the free area measuring 1 ell in width, was also recorded e.g. in one of 15th-century transactions before the echevin court from Poznań (dating from the year 1478): *domus in platea Wronicensi penes domum Simonis braseatoris in acie ex opposito ecclesiae s. Katherine sita cum medietate fontis et una ulna terre libere ad dictum fontem de platea intrando* – quoted from: Stadtbuch von Posen, 1892, p. 45*, footnote 5.

688 Cf., inter alia, examples from Moulins, Dijon and Rouen of using the word "fontaines" to describe water supply system conduits – Laurent 1998, pp. 80–83; Beck 1992, p. 499; Cerné 1930, p. 52.

689 De Rekeningen 1965, p. 348: "*pro plumbo ad fontem supra forum 188 lib. 9s. 3d.; pro puteo extra Echout 47 ½ s.*" etc. In reference to water supply systems, inter alia,

registers written in Flemish ("pit/pitten" for wells; "fonteine" for fountains and water supply system), as well as in their commentaries written in French.[690] In accounts from Bruges drawn up in Flemish another word is used to describe dug wells: "borne" – just like in German mentions the term "Born" can be encountered; both of these terms constitute an equivalent of the Latin term "fons", but used in the sense in which Alberti used it to describe a dug well: "They say that a well is also a spring, only a deep one."[691] Apart from the above-mentioned terms, the words most frequently used in German mentions as another counterpart for the Latin "fons" were "Brunnen" ("Brunne") used to refer to fountains connected to water supply systems (e.g. in the form "Schönbrunnen"), and "Schacht" used to describe a deep well shaft[692] and mine shaft.[693]

In archival records pertaining to towns in the Polish lands dug wells are described using the term *puteus/puteum* as well as the above-mentioned *fons* and its German counterpart *Born*, sporadically also *Schacht*. From the mid-16th century the Polish word "studnia" ("well") began to be used interchangeably with Latin terms.[694] The author of the present work has not encountered in such sources the word "studnica"[695] (used e.g. in 15th-century Polish translations of Biblical texts) as an equivalent of the two Latin terms: *fons* and *puteum/puteus*.

The use of the term *fons/fontes* to describe both dug wells and intakes of water supply systems creates confusion and uncertainty as to telling these constructions apart, especially so when the case concerns the time when water supply system already functioned in the given centre (or at least it is supposed it may have functioned). This can be referred e.g. to Kraków: we learn that the word *fontes* was used to describe dug wells, and not water storage reservoirs connected to a water supply system, only from the context of the mentions: town accounts from the year 1390 contain a record of paying to diggers 1 threescore of groschen, 1 mark and 4 groschen (112 groschen in total) for "a new well" (*super nouo fonte*);[696] records

op. cit., p. 715 (year 1298/99): "*Item fossoribus fodientibus extra Wulfhaghe pro pipis ibidem ponentis ad capud foncium 12 lib. 5 s.*".

690 InvBruges, 1871–1885, p. 369.

691 Alberti 1960, p. 277. Id. 1988, p. 332. Cf. also Part I of the present work: "Opinions concerning the quality of water in the Middle Ages and at the beginning of the early modern period".

692 Hoffmann A., 1995, p. 93 and Boscardin 2004, pp. 36–39.

693 Agricola 1928 (1556), book 6, pp. 129–131, 142 et seq.

694 E.g. APP, Środa I/73 (1545–1564), p. 47 and 90.

695 SłStaropol., vol. VIII, 1977, pp. 491–492, with numerous quotations.

696 ANK, rkps/MS 1587, p. 57.

from the years 1395–1399 provide us with information concerning expenses made towards digging wells (*fontes*) near two baths in Kraków: "Rogacka" in 1397 and "Żydowska" (Jewish) in 1399;[697] and also those incurred for chains or wheels for the local town wells (*fontes civitatis*).[698] From the times of Adolf Warschauer, i.e. from the end of the 19th century, the confusion as to the meaning of the Poznań *fontes* ("Brunnen") has not been cleared up in literature; the determination of the meaning of this term is definitely needed, considering the fact that Warschauer deemed mentions of many of such constructions to be equivalent to the functioning of a water supply system in this town.[699]

The fact that in mentions concerning various towns we can find the term being specified as *fons sive puteum* (like in the case of the Dominican well in Płock dating from 1447 described above or one of the town wells in Lelów from 1515[700]) or the two terms being used interchangeably in various records to refer to the same object (e.g. the town well called "Walkmyn" in Środa, a town in Greater Poland[701]) or to the same group of wells (*fontes civiles*, *putei civitatis* in Lelów[702]) shows that this was how dug wells that had good quality water were described; on the contrary, it does not mean that this was how dug wells were distinguished from water storage reservoirs connected to a water supply system, as in the above-mentioned towns there was no such network. The consistency in using the words *puteum*/*puteus* and *fons* in western European sources and the lack of such consistency in

697 ANK, rkps/MS 1589, p. 147, year 1397: *pro fonte stube balnearis retro cornutos.* The same accounts testify to the existence of a dug well next to the Jewish bath – APKr 1589, p. 324, year 1399: *primo super fossione fontis.*

698 ANK, rkps/MS 1589, p. 111 (year 1396).

699 Stadtbuch von Posen 1892, p. 45* et seq.; W. Maisel (1954, p. 83 and 2003, p. 28) presented only those water storage reservoirs connected to a water supply system open to the public that stood in the Market Square; he called all of them wells. This matters have not been set in order also in A. Kaniecki's work (2004, p. 597 et seq.), in which are instances of confusing dug wells with water storage reservoirs connected to a water supply system.

700 ANK, IT 230c, p. 351.

701 APP, Środa I/30, p. 81, year 1518: *braseatorium quod iacet prope valkmÿn in vicinitatu inter aream desertam ex una et fontem valkmÿn parte ex altera*, p. 202v., year 1532: *penes fontem civilem dictum Walkmyn*, p. 309, 1542 r: prope *fontem dictum Walkmyn* Środa I/73, p. 65: *A reformacione Statuę circa puteum walkmÿn iiij gr.,* p. 89*: a reformacione putei walkmÿn 16 gr.;* p. 94: *pro quercu ad puteum walkmin 4 gr*., p. 94v.*: a reformacione putei walkmin 4 gr.*

702 ANK, IT 230c., p. 152, year 1499 and p. 437, year 1520: *fons Civilis*, p. 249, year 1509: *putei civitatis*.

archival mentions pertaining to the Polish lands – in the opinion of the present author – constitutes a reflection of a more advanced development of the "water supply system civilisation" in the post-Roman Europe than outside the *limes*. This also argues a greater significance of dug wells than water supply systems in the overwhelming majority of towns in the Polish lands.

In terms of ownership, organisation and administration, dug wells in the space of mediaeval towns are usually divided in literature into private and public. Private dug wells constituted an important element of the microcosm of a burgher's plot, if natural conditions enabled their construction and functioning (the indispensable existence of a water-bearing stratum for all dug wells). Public dug wells were treated as water points open to the public and were situated in convenient places that were easily accessible, mostly in the main square of the town which also formed its centre of trade[703] and in streets, also at their intersections or in places where the streets were widened.[704] The expression *putei publici* can sometimes be found in source mentions, e.g. in one of communal statutes from Arezzo dating from 1345.[705] However, this very statute contains a piece of information in the light of which the most commonly accepted division into private and public wells described above proves too simple. The authorities of Arezzo introduced a ban on washing cloth and throwing waste in the vicinity of any public well or any well that was common for many neighbours (*prope puteum publicum vel pluri(m)um vicinorum comunem*); they also imposed a ban on placing toilets pits-near such a well. This fragment refers to wells shared by neighbours, and as such it has tremendous

703 The choice of the place for such a centre of trade made while establishing the layout of the town may have resulted from the fact that that was the place where water was found in a sufficient amount to sink a well. Due to their character, places of commerce had to have water. Cf. mediaeval names in towns like: "puits du Grand-Marché" etc.

704 Among numerous examples, e.g. in Moulins in Bourbonnais, the earliest known well stood on the junction of two main streets and functioned from the Middle Ages until the 19th century – Laurent 1998, p. 79. The significance of wells in the space of streets was reflected in many street names connected with wells: e.g. Rue du Bon Puits in Paris – cf. Recueil Actes Paris 1905, Table analytique, p. 864, with 31 references to the name of this street. Public wells in the suburbs are omitted here, because they were discussed in Part II; they were located near farmlands, like e.g. wells in the suburb of Warsaw among gardens in Długa (Long) Street – KsRadzStWarszawa 1963, no. 189 and 190, p. 64, year 1482 and no. 609, p. 176, year 1502.

705 "*Nullus audeat lavare pannos vel aliquid proicere turpe seu ponere turpe prope aliquem puteum publicum vel pluri(m)um vicinorum comunem per unam tabulam. Et nullus habere possit aliquem locum necessarium,* […] *prope talem puteum per unam tabulam*" – Vita e salute 1988, p. 17.

importance because it allows to recognize a third intermediate category of wells (between private and town wells) and enables researchers to trace the changing organised forms of supplying mediaeval towns in water drawn from dug wells, and to define the role of such wells in the life of the local communities on the level of the family, in the neighbourhood and in the community of the town.

III.2.2.1 Private wells

The simplest case concerned private wells that were used by one family: the family of the owner of the plot (and his tenants or servants at the most) on which the well was built. Such wells were usually placed in the so-called utility part of the plot, namely in the backyard behind the front house, which is confirmed by iconographical and written sources.[706] L.B. Alberti noted: "Wells, in particular, should be built in a public or accessible part of the house, provided the site they occupy is not too important or inappropriate."[707] In the next sentence he added: "The naturalists maintain that those open to the sky produce the purest and most natural water",[708] hence we can assume that what he had in mind was rather a yard (a patio or a backyard) adjacent to the house. Like many other excerpts from Alberti's treatise, this fragment is not only a theoretical instruction, but also a description of an optimal situation that actually existed and that Alberti knew from experience[709]: either from Italian towns of which he had a good knowledge, or from other towns in Western Europe.

There is plentiful archaeological evidence for the existence of dug wells in the backyards.[710]

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706 Likewise e.g. in mediaeval Rome – cf. Hubert 1990, p. 161 and in French towns – cf., inter alia, Piponnier 1992, p. 483 (Dijon), Alexandre-Bidon 1992, p. 524, Gouédo-Thomas 1995, p. 68.

707 Alberti 1988, p. 32.

708 Ibid.

709 In the years 1430–1431 Alberti made a long tour of France, Belgium and Germany – cf. Alberti 1960, p. 8 (K. Dziewoński's foreword to the Polish edition).

710 E.g. in the light of numerous Czech archaeological studies, including Klápště 1983, p. 478 et seq., and also German studies, e.g. of mediaeval Regensburg: Dallmeier 1998, p. 287. An attempt to systematize the location of wells on mediaeval plots on the example of Wrocław archaeological evidence – cf. Buśko 1995b, pp. 345–348, with the division of plots into five zones; dug wells together with sewage pits were classified in the fourth zone called "sanitary". Following Buśko, this division was adopted by Piekalski 1999, p. 237. This division does not take into account wells in cellars (i.e. in an enclosed space), like e.g. in mediaeval Regensburg (Dallmeier 1998, p. 286) or in Buda (cf. Pálóczi-Horváth 2005, p. 234).

The cost of building and maintenance of such a well was borne by the owner of the plot. The interdependence between the owner's wealth and having a private well, underlined in literature,[711] obviously concerns the cases when the costs were high because of considerable technical difficulties that had to be overcome. Sometimes the costs were too high for the owners to meet; this happened to Wacław Thommendorf, a patrician from Świdnica: a well on his plot dried up and water had to be carted to his house a whole year.[712] However, such wells as the ones built in Wrocław, namely easy to dig and with good drinking water, cannot be treated as a sign of wealth. Consequently, it has to be repeated that the existence of wells on private plots was mainly dependent on the water-bearing stratum, the water veins through which, according to Bartholomeus Anglicus who himself studied ancient writers, the earth evaporated inside.

In case of property ownership division mainly occurring between family members (but also as a result of the sale of a part of the house or production devices, e.g. of a part of a malthouse or brewery), wells were among the devices that were to be used and maintained jointly (but still within the same plot).[713] In such cases various agreements between neighbours concerning the conditions on which they could have access to the well and use it, but also referring to its joint maintenance by all of the users proved necessary. Even more complicated were

711 Squatriti 1998, p. 26) took such cases into account, mainly on the basis of source material from early mediaeval Italy; he generalized this interdependence also in the light of the situation present in Rome between the 10th and the 13th centuries (from: Hubert 1990, p. 161) and in mediaeval France (from: Alexandre-Bidon 1992, p. 523). This opinion can also be found in: Piponnier 1992, p. 483. In Polish literature cf. Berdecka 1982, p. 127: "Rich burghers, mainly those whose profession was connected with an increased demand for water, built them on their own plots. However, in the Middle Ages wells in towns were scarce". Not documented in sources, the above-quoted two vague sentences must be dismissed – in the light of archaeological findings and archival research done within the scope of the present studies. We deal with an opposite generalization, i.e. with the opinion that wells were widespread both on the scale of cities and on the scale of individual plots (without considering various hydrological conditions) in: Bogucka/Samsonowicz 1986, p. 99. More detailed information about this subject is provided by such data as e.g. for 15th-century Munich, where 54% of dwelling houses were equipped with wells (Ciriacono 1998, column 2064–2065).

712 Goliński 1998, p. 38.

713 In copious 16th-century descriptions of such divisions in Kraków records and books of municipal officials called *quartalienses*, among devices used jointly were usually also stairs, the stove, roofs and gutters, as well as wastewater canals and water supply system conduits.

cases like the one concerning the above-mentioned well belonging to a bricklayer from Płock named Jurga: having given a part of his property to someone else, he retained the sole right to use the water intake situated in that part of the plot. Another difficult case took place in Kraków on 10 January 1343: Alusza, the widow of a local patrician Jan of Lelów, appeared before the court together with her four children and sold a house with a plot in Sławkowska Street to Małgorzata, the widow of Ludwik of Cieszyn, and to her son Bertold, together with a sole right to a wall separating the property in question from a plot belonging to a neighbour, Marcin Gousman, and with the right to use a well (*fons*) situated on Marcin's plot.[714] Despite the fact that the sold property (like other properties in this neighbourhood in that time) was probably a full plot (*curia)*, it was not equipped with a well, only with the right to use a neighbour's well that in turn (as was mentioned above) was connected mainly with a malthouse.

As potentially conflict-provoking, all such cases required not only appropriate court judgements, but also maintaining good neighbourly relations. Also other ways (identified in sources) of using wells situated within a block of plots necessitated continuous positive relations between neighbours, e.g. when a well situated on the border between two plots was used jointly by the two neighbours or when water from a well situated on a given plot was granted to people who did not live on the plot in question.

Examples of the first of these ways of using wells can be encountered in rulings of the town courts concerning the use of wells and other devices situated on the border between two plots, such as border (fire) walls[715] and wastewater (also rainwater) canals.[716] In 1504 in Nowy Sącz[717] as a result of a ruling of the town court following the obligation of a joint maintenance of neighbourly devices in a proper condition, apparently neglected, Maciej Brubach and Marcin, a cooper, together were to lay a canal, whereas Marcin alone, who caused the damage, was

714 KsRachKraków, I, 1878, p. 161–162. Cf. also: Rajman 2004, pp. 169, 230 and 248–249, about the activity and property of Ludwik of Cieszyn, a Kraków town councillor, identified with the then Kraków *advocatus*, in the years 1311–1332, including his stone/brick house-manor on the corner of the Market Square and Sławkowska Street, and also about his and his wife's relations with newcomers to Kraków – like themselves – from Silesia (Małgorzata's business with her brother Hank of Kietrz and with Jan, a seller from Racibórz).

715 More about these devices cf. Goliński 2002, passim.

716 Sowina 2002c passim and eadem 2011, pp. 269–270.

717 ANK, AD 49, p. 659, year 1504.

to fix the fence at the back of the plots and clean the well on both sides. Moreover, he was to remove a pigsty he had built near the well.

Apart from such situations as the one described above, which resulted from a damage done to neighbourly devices including a well, in town records we can find agreements between two neighbours setting temporary or permanent conditions concerning the use of wells built on the border between two plots and/or the rules of their maintenance.

In Kraków archival records from the early 16th century we can come across a case concerning a well. It involved Paweł Zelczer, one of the then most prominent Kraków goldsmiths, and his neighbour Marcin Czarny. At the beginning of 1503 the arbitrators and the neighbours of both parties, namely Maciej Schwob and Jan Czimermann, both goldsmiths, and Adam, a painter, decided that the cost of maintenance of the well – (der)"Schacht"- situated between the house belonging to Paweł Zelczer, a Kraków goldsmith who was an elder of his guild for a number of times, standing on the corner of Grodzka and Szeroka Streets (in a district inhabited by goldsmiths and painters), and the house belonging to Marcin Czarny, standing in Szeroka (Wide) Street, will be divided as follows: Zelczer would pay 2 groschen, whereas Czarny – 1 groschen.[718] It follows from this mention that it changed a decision of 1450 on the strength of which the parties-owners of these plots paid 3 and 1 groschen respectively. The case presented above was one of a number of similar cases in which town courts had to establish the rules of using wells situated on borders between plots, because neighbours could not come to an agreement.[719] However, in this case we can acquire more information about the well itself from this source mention than from other sources. Firstly, it had been used for a long time (over 50 years before the date of the case, i.e. until 1503, and even longer, as follows from the mention). Secondly, it was the object of court rulings as many times as twice. Hence, it must have been an especially valuable device. Its function was to supply people with water, consequently, its value must have resulted from the fact that it supplied good quality water which was hard to obtain in this particular place. This is confirmed by the term "(der) Schacht" used in this source mention in reference to this well. This term was sporadically

718 ANK, CC 431, p. 173; CA II/1, 1936, no. 38, p. 14; CA Suppl., 1990, pp. 96–97. Cf. also CA II/1, 1936, no. 92, p. 38–39 (1505 r.), no. 95, p. 40 (1505 r.) and CA Suppl., 1990, p. 59.

719 Cf. e.g. a decision of Kraków municipal officials called *quartalienses* concerning devices on a border between two plots, namely a sewage pit and a well in the boundary wall between plots belonging to Maciej Strosz and Jodok Decjusz in św. Jana (St John's) Street in the year 1537 – ANK, CC 436, p. 406.

used in Kraków manuscript archival sources for wells within the town space; it denoted – as was explained earlier – a well shaft dug very deep, or even a mine shaft. It is unknown, however, whether the well in question reached the depth of the above-mentioned very deep wells, archaeologically explored and described in literature, or whether by using this term the scribe only wanted to underline the depth of this well that was greater than of other wells. Nevertheless, the following conclusions can be drawn. The long existence of a deep well (from 1450 at the latest) on the corner of Szeroka and Grodzka Streets, i.e. on an escarpment of this part of the terrace on which the town chartered with German law was situated (further there was a gorge, and still further, again on an escarpment – Okół[720]), testifies to the fact that not in every place of this terrace good quality water could be drawn from the layer that was ca 5–7 meters deep. Perhaps in this particular case the reason was an underground sewage canal functioning at least from the late 14th century (until the 19th century) in close vicinity of the well in question, namely from Szeroka Street and a brick dwelling house called "Podelwie", along the border of the Dominican and town property up to the town walls and the Rudawa-moat.[721] If so, then the existence of a deep well in this particular place would be a conscious ecological decision. Nevertheless, the opposite situation cannot be excluded: the above-mentioned canal might have functioned for such a long time due to the fact that the water-bearing stratum with water suitable for drinking was situated deeper than in other places.

The above-mentioned sums devoted by the two Kraków goldsmiths to the maintenance of the well situated on the border between their plots undoubtedly referred to the ratio of their respective expenses connected with all necessary repairs of the well: according to the first decision of 1450 this ratio was of 3 to 1, whereas according to the arbitration of 1503 – of 2 to 1. The initial inequality of the expenses must have resulted from a disproportionate share of the co-ownership of the well, which must have been reflected in the ratio of the expenses made towards the maintenance of the well. Such an interpretation can be validated by a mention pertaining to Środa, a town in Greater Poland and by M. Goliński's research on wells in Świdnica. The mention pertaining to Środa dates from 1532: on Friday after the third Sunday of the Lent (*Dominica Oculi*) it was decided before the local town court that one half of a well belonging to a malthouse near Targ Świński between Dalewski's plot and the back of a brick dwelling house was

720 Such a picture results from the reading of: Rajman 2004, p. 37 (on the basis of geological and archaeological research conducted, inter alia, by Jerzy Setmajer and Kazimierz Radwański – cf. op. cit. – relevant literature).

721 Sowina 1996, pp. 223–226.

to belong to (this) malthouse owned by Jadwiga, a furrier's wife, and the other half of this well was to belong to the malthouse owned by Mikołaj, a malster (*braseator*) from Włostów, as had been the case for a long time (*ex antiquo*), because the well had belonged to both of these malthouses. The cost of its repairs was to be divided equally between the two parties: hence, if one party paid one groschen, the other party was to pay another groschen.[722] The annotation given at the end that the agreement was binding only for the two parties to the contract and their heirs indicates that such documents were drawn up every time the ownership of each of the malthouses was transferred to somebody else. Indeed, also in the case in question the agreement was entered into because one of the maltings had just changed ownership: Mikołaj of Włostów acquired it from Zofia Czarnocka and her cousin Katarzyna, whose family had owned the malthouse for at least two generations (i.e. from the times of Zofia's and Katarzyna's paternal grandfather, since they were noted together as one party to the transaction).[723]

In Środa court records a mention was preserved of yet another way of drawing water from a well situated on the border between two plots. It consisted in conducting a trough from that well to a malthouse owned by one of the neighbours. In 1552 *providus* Jakub Jarosław gave up one of his maltings (standing next to his other malthouse) together with a half of a well (i.e. the right of co-ownership of a half of the well) and the right to conduct water through a trough from the above-mentioned half of the well (*resignavit Braseatorium alias mielcuch sittum parte ex una Prefati Jacobi Brasearii Mielcucha, et in postico Blasii sutoris Gregorio Nyznik, nec non cum medio putei proxime sitto, et cum admissione transionis aque de prefato medio putei alias Rynną* liacz[724]). Apparently, direct access to this well was hindered for the buyer. The same technique was used also in Środa to solve the problem of conducting water from a well to a malthouse built on a plot that was not situated directly next to the plot on which the well was standing, but that belonged to the same owner. Following a dispute over a well, in 1549 before the local echevin court a settlement was reached between two malsters: Fabian and Benedykt. According to this settlement, Benedykt let Fabian (but only him or his heirs) conduct a gutter through Benedykt's plot without payment from Fabian's well to his malthouse (*libere admisit Canna alias Rynne fieri per aream suam a fonte fabiani ad brasearium illius ipsi soli fabiano et eius successoribus*[725]).

722 APP, Środa I/30, p. 196–196v.

723 APP, Środa I/30, p. 196v.

724 APP, Środa I/30, p. 430.

725 Op. cit., p. 390. Thus, at that time Fabian the malster owned at least two developed plots.

Such an interference of the court headed by the *advocatus* in the topography and the arrangement of Benedykt's plot (today we would call it "easement establishment") is a visible sign of the fact that a hereditary right to a town plot of one of the neighbours could be outweighed by the need to provide water for the other neighbour so that he could perform his profession.[726] This example shows that there were limits to using a town plot freely; outside these limits the *advocatus*' (who represented the owner of the centre) control began which was aimed at an efficient functioning of the town as a whole.

The cases of co-ownership of dug wells, clearly presented in written sources from Środa in Greater Poland, should undoubtedly be supplemented by examples from Świdnica, thoroughly researched by M. Goliński. Wells in Środa were usually situated in topographical proximity to the device together with which they constituted the object of transaction. However, the situation was different in Świdnica. Wells in which shares were sold together with a plot were not situated on the plot being the object of transaction that was to be registered in the land book, but on a plot belonging to one of the neighbours; free access to these wells was guaranteed to the people who owned the shares.[727] Working out such a well-functioning system (undoubtedly forced by the above-mentioned hydrological conditions in Świdnica), in which water from dug wells was a commodity subject to transaction, was possible thanks to a good cooperation between neighbours who organized their living and working space in harmony and thus efficiently.

The analysis of the above examples in which the court clearly stated the division of advantages and obligations arising from a joint ownership of a dug well should be followed by a presentation of cases in which owners of dug wells let people who did not possess any ownership rights (shares) to these reservoirs use water from these wells. In such cases, though, the rules according to which the water was granted, were not always established. The following mention dating from the year 1423 from Kraków town coucillors' books can serve as an example of a court record in which such rules were stated. The town council of Kraków allowed Hanusz Hoze, one of the most prominent burghers,[728] to conduct water from his baths in a canal through the city up to the town walls near Nowa Brama (New Gate).[729] In return for this permission he was to pay the councillors 1 mark a year and maintain the canal in good condition. In addition to that, the

726 This might have stemmed from an old custom, but this hypothesis has not been confirmed by source evidence.

727 Goliński 2004, p. 76.

728 Echevin in 1425, owner of a house in Grodzka Street, a cutler – CA I, 1917, no. 248.

729 ANK, CC 428, p. 200.

councillors being in charge of the town's money (*Lohnherren*) were to be allowed to use his private well next to the above-mentioned baths. There is no trace of a mutuality of benefits in the following agreement entered into in 1477 before the town council of Poznań. On the strength of this agreement Jakub Grodzicki,[730] a cloth merchant, cloth-cutter (*pannicida*) and town councillor, acquiesced that Jerzy Bok,[731] his fellow craftsman and burgomaster, and his heirs could use a well standing next to Jakub's malthouse and opposite Jerzy's brick baths in Woźna Street.[732] Hence, according to this eternal contract Jakub's well was to supply water to the above-mentioned baths as well as to Jakub's maltings. Water for the needs of the baths was to be drawn without any restrictions or obstacles on the part of Jakub or his heirs, i.e. the owners of the well. All obligations concerning the maintenance of this water reservoir rested with the latter, namely with the party that granted the water.[733]

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730 A patrician from Poznań: in the years 1475–1489 – echevin and town councillor for several terms of office, *pannicida* – these pieces of information collected in: ARadzPozn., II, 1931, passim and op. cit., III, 1948, p. 198 (index) and in: Stadtbuch von Posen, 1892, part I (research according to the index on p. 442): pp. 26–30. Cf. also: Wiesiołowski 1982, p. 148.

731 A Poznań patrician from Gdańsk: in Poznań town authorities from 1452 as echevin, later – until 1482 – town councillor and burgomaster in office for many terms; pannicida, owner of a mill behind St Adalbert's Church on the route to Winiary and of suburban fields – information collected in: ARadzPozn., II, 1931, passim and op. cit. III, pp. 166–167 (index) and in: Stadtbuch von Posen, 1892, part I (research according to the index on p. 439): pp. 20–28. Cf. also: Wiesiołowski 1982, p. 56 – information about Bok's death in 1482, and pp. 66 and 149 – about his participation in the town authorities, about his profession (cloth cutter) and about the fact that he lived in a house in the Market Square.

732 Hence, the well belonging to this baths must have run dry – a mention in echevin books of Poznań dating from several years earlier (1473) testifies to the fact that such a well existed. The mention concerned the sale of a brick baths with a house, a courtyard and a well "with contiguities" in Woźna Street by Łukasz, the dean of the parish, to Jerzy Bok (*balneum suum muratum una cum domo, curia et fonte cum contignis in platea Bedellica*) – quoted from: Stadtbuch von Posen, 1892, p. 45*, footnote 7, with a reference to a source: Acta Scabinalia 1473, k. 260v.

733 ARadzPoznań II, 1931, no. 1286, p. 65 (year 1477): *Providus Jacobus Grodziczky… condescendit et admisit usum totalem fontis sui in platea Bedellica penes braseatorium sive siccariam suam versus et ex opposito balnei murati famosi Georgii Bok siti prefato Georgio Bok pro dicto balneo suo et suis successoribus, dicti balnei possessoribus, ita quod ipse Georgius et eiusdem balnei possessores haurire aquam, tociens quociens opus fuerit, pro necessitate dicti balnei libere et sine cotradictione ipsius Jacobi Grodziczsky*

In yet another, earlier mention also pertaining to Poznań neither the rules concerning granting water to neighbours nor the names of the neighbours (or a group of neighbours) were defined. The town council on 24 September 1466 decided that a well (*fons*) next to a newly-built house belonging to Jan Biały, a tailor (the second plot from the Market Square in the direction of the castle[734]), was to be incorporated into his plot and its exclusive use was to be given to him and his heirs. If neighbours wanted to use the well, they should do it with Jan's (or the current owner's) knowledge and consent.[735] The agreement between Grodzicki and Bok may have been a reflection of Grodzicki's obligations to Bok within the scope of their mutual economic interests as two people of power (water was supplied to their respective lucrative devices), whereas reading between the lines of the mention concerning Jan Biały, a different, by no means less interesting, situation can be revealed. As follows from the mention, the incorporation of the well into Jan's plot took place immediately after his house had been built there. It can be assumed with a high degree of probability that this was closely connected with removing the effects of the great fire of 8 September 1464.[736] This involved developing the space anew, apparently considerably damaged, as it was necessary to re-establish the borders between plots. The neighbours' general access to the well owned by Jan the tailor, only restricted to his or his heirs' consent, probably had one main reason: the access to water in case of a fire in this region full of flammable malthouses, especially so, as not every plot had its own dug well (this conclusion can also be drawn on the basis of the mention in question).

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ac successorum suorum, eiusdem fontis posserorum (s), poterint imperpetuum. Quem quidem fontem ipse Jacobus Grodziczsky semper instaurare et reformare propriis impensis et laboribus, prout se submisit et successores suos, eiusdem fontis possessores, obligat. Actum sabbato in vigilia Mathei et ewangeliste et appostoli (20 Septembris 1477) anno etc. Despite the perpetuity of the agreement, it was no longer valid as early as in 1497, since the then owner of the baths, also a Poznań burgomaster, obtained the permission to conduct water from the town moat to this baths, which fact was mentioned in Part II of the present work, together with a reference to the source: ARadzPoznań II, 1931, no. 1694, pp. 348–349.

734 About the neighbouring house belonging to Bartosz the tailor and about a malthouse behind this house, which was put in pledge (with lease) on 17 March 1462 against a loan of 20 marks to Andrzej Falker – cf. ARadzPoznań I, 1925, no. 931, pp. 339–340. Until the repayment of the debt, Andrzej was to draw all benefits from the malthouse including the rent, but also – for his own benefit – he had to take care of a well belonging to this malthouse, as well as of the latter's equipment.

735 ARadzPoznań I, 1925, no. 1072, pp. 402–403.

736 AcCap., vol. II, 1902, no. 1304, p. 587.

III.2.2.2 Between the private and the public space: wells belonging to neighbours' communities

The cases analysed above concerned dug wells situated in space that was called private, namely on plots or on borders between plots. The example of the well from Arezzo (*puteum publicum vel pluri(m)um vicinorum comunem*) shows that a different spatial solution from the one described above (but also forced by hydrological conditions) was neighbours' co-ownership of wells placed outside private space. This solution, confirmed in sources at the stage of a far-reaching control exercised over towns by their authorities, is interpreted in literature as an administrative decision of the town authorities. This explanation is given e.g. in cases when there was one well (usually placed at the crossroads) in one *viciniae*.[737] Notwithstanding, the establishment of such a well was not (or at least not always) a result of an administrative decision of a developing commune; it was rather a piece of material evidence of the neighbours' community being long-standing and of its inner organization,[738] as well as of the division of towns into *viciniae*. This can be supported by the above-mentioned example of the 14th-century well from Arezzo that constituted the strongest source of inspiration for the present analysis, but also by two examples from Munich[739]: one dating from the end of the 14th century and the other one from the beginning of the 15th century. The first one described the following situation: in 1387 five local citizens owned a common well built at their expense in the "Wine Close". The second example referred to the fact that in the early 15th century Munich was divided into so-called wells-municipalities, each of which operated on its own as a company and was responsible for supplying water to "its" part (quarter) of the town. As opposed to W.C. Wijntjes, who quoted these two examples separately (failing to notice the "neighbours'" wells), we need to look at them as two subsequent stages of the same process, namely of the establishment and the functioning of such water reservoirs in a circle of neighbours. The town commune only adopted this organizational form. Initially, these wells were used only by neighbours' communities, they were not water reservoirs open to the public and financed by the town authorities. This statement can be confirmed by charges found in certain towns for using some of the wells located in squares and streets imposed on properties that were situated in their immediate vicinity.

737 Panero 1988, pp. 181/182 (the town of Alba).

738 In Polish literature Halina Manikowska (1996, pp. 35–37) pointed to the importance of communities, including neighbours' communities, in the social reality of mediaeval Italian towns.

739 Wijntjes 1982, p. 200.

Such charges paid already to the town that maintained the well can be considered as a counterpart (relic?) of neighbours' "shares" in the above-mentioned wells in Środa in Greater Poland and Świdnica in Lower Silesia. In terms of organization both of these forms were similar and they can be traced back to the early Middle Ages, which fact was pointed out by Paolo Squatriti, who cited examples of "wells-municipalities" from 9th-century Milan and 10th-century Ravenna.[740] Seen in this context, A. Guillerme's observation that e.g. in the 12th and 13th centuries in towns of the northern France public wells situated on rivers were taken care of by people who lived by the riverside,[741] also pertains to wells belonging to the territorial and neighbours' community. Probably the same applies to the statement concerning mediaeval Dutch towns that the obligation to maintain "public" wells in these centres rested with the owners of the houses that stood in close proximity to these wells, irrespective of whether they had their own, i.e. private water intake. For example, in Leuven the charges were different depending on the width of the front of the house (hence, also the neighbours' "shares" were different – U.S.), and the town authorities made sure that the charges were paid in a timely manner.[742] The correctness of the above conclusions for Flemish centres is supported by Chloe Deligne's new findings concerning Brussels: in the Middle Ages dug wells were under the management of neighbours' communities and only in the second half of the 15th century – due to settlement intensification – they began to be managed by two people who were in charge of each part of the town.[743]

In the same manner we could also try to understand the still unexplained Kraków "well charge" found by Stanisław Kutrzeba in the Kraków town accounts from 1414 and by Elżbieta Ligęza in these accounts from 1407, although only on condition that we accept these researchers' interpretation. Having come across an entry *pecunia fontalia (s) et circulatorum*[744] among the Kraków income from the year 1414, Stanisław Kutrzeba noted that while it was known what the second part of this phrase referred to, the meaning of *pecunia fontalia* remained unclear. He wrote that since the water supply system seemed to have not been ready yet, it must rather be assumed that what we were dealing with here was also some sort of tax imposed for a purpose, e.g. intended for the repairs or building of wells, or maybe for further works on the water supply system. In a footnote Kutrzeba

740 Squatriti 1998, pp. 30–31.
741 Guillerme 1985, p. 193.
742 Van Uytven 1985, p. 94.
743 Deligne 2008, pp. 90–91.
744 This is how S. Kutrzeba (1900a, p. 91) wrote it; the original version reads: *pecunia fontalis et circulatorum* – ANK, rkps/MS 1595, p. 16.

explained that he did not include the *pecunia fontalia* in his tabular presentation of Kraków taxes, "because it was both collected and recorded together with *pecunia circulatorum*, which is why it is impossible to separate them."[745]

Just like S. Kutrzeba, also E. Ligęza treated *pecunia circulatorum et foncium* found in accounts from the years 1407 and 1414[746] as two different charges. She rejected the *pecunia circulatorum* (having erroneously perceived it as "stróżne" – a charge for guarding individual quarters of the town), which in her opinion was unrelated to the tax on wells: *pecunia foncium*.[747] Again in the same way as S. Kutrzeba, without analysing the type of these intakes (whether they were dug wells or water reservoirs connected to a water supply system), E. Ligęza wrote that it was unknown "whether in 1407 it was already a tax on the water supply system", namely the "rurne" (pipe tax), which "on its introduction was combined with a tax put at that time on wells."[748] This statement was to be confirmed by the fact that both the *pecunia circulatorum et foncium* and the "rurne" were payable on each Ember Days (*Quattuortempora*)[749] and that the amount of the revenue was the same[750] (or, to be more precise, comparable[751]). Consequently, both of these researchers understood

745 Kutrzeba 1900a, p. 91 and footnote no. 1 and table II: "Wykaz dochodów Krakowa z lat 1390–1487 [List of Kraków income from the years 1390–1487]" (after the text).

746 Cf. ANK, rkps/MS 1594, p. 9.

747 Ligęza 1971, p. 59. Whereas the joint occurrence of *pecunia circulatorum et foncium/fontalis*, consistently throughout the whole period in question, resulted from the fact that *pecunia circulatorum* was a charge for municipal cleaning services provided in the public space within the town's quarters (comprehensively about their structure in recent literature – cf. Suproniuk 2006, passim). These services included the care for all town water reservoirs.

748 Ligęza 1971, p. 59.

749 Namely quarterly, on Wednesday, Friday or Saturday after the first Sunday of the Lent (*Dominica Invocavit*, date: *Cinerum*), after Pentecost (*Penthecostes*), after the Feast of the Exaltation of the Holy Cross – 14 September (*Exaltatio s. Crucis* – the term shortened to *Crucis*), and after St Lucy's Day – 13 December (*Lucie*) – ANK, rkps/MS 1595, year 1414, p. 16 (percepta): cf. *Pecunia fontalis et circulatorum: Cinerum, Pentecostes, Crucis, Lucie* amounted to 80 marks and 17 scots in total.

750 Ligęza 1971, p. 60.

751 Cf. the identity of the records and similar sums in comparison with: *Pecunia fontalis et circulatorum* from the year 1414 – in: *Pecunia quattuortemporum* from the year 1431 (ANK, rkps/MS 1596, p. 14), *Quatuortempora* – year 1487 (ANK, rkps/MS 1597, p. 4), for the years: 1517, 1518, 1523, 1524, 1530, 1531, 1533 – as "*quattuortempora* Ror(n)gelt", and eventually for the years 1535 and 1537 –*quattuortempora rorne soluitur* – PrawaPrzywilejeKraków, 1885, p. 949, year 1517; p. 955 (ANK, rkps/MS 1598, p. 154), year 1518; p. 961 (ANK, rkps/MS 1599, p. 23), year 1523; p. 965 (ANK,

pecunia fontalis/foncium as a different tax from the pipe tax (rurne); they suggested that initially it was a tax on dug wells, i.e. the only public water intakes at that time, considering that the construction of the water supply system was still in progress. An analysis of all the preserved Kraków revenue accounts (*percepta*), conducted for the purpose of the present study, revealed that the *Pecunia percepta de fontibus civitatis* appeared for the first time in Kraków town accounts not in 1407, but in 1400.[752] It was recorded directly after *pecunia circulatorum* as a separate entry, however, the revenue from both of them was summed up (unlike in the case of other revenues) to obtain the total sum of 95 marks, 1 ferto and 0.5 groschen, including the new charge amounting to 12 marks, 1 ferto and 5 groschen (calculation: U.S.). Before that, i.e. in the earliest preserved accounts pertaining to the decade of 1390–1399 only the *pecunia circulatorum* was recorded.[753] The same situation occurred every year between 1401 and 1404.[754] In 1405 *pecunia de fontibus* (or *fontes* in short) appeared as a constituent of the *pecunia circulatorum* (this was the general title of the whole entry, but only in two time quarters, i.e. in the second half of the year, namely *Crucis* (mid-September) and *Lucie* (mid-December), however, almost in all the town quarters (the sum pertaining to the Butchers' Quarter under the entry *de fontibus* for September is missing).[755] In 1407 (accounts from the year 1406 were not preserved) the entry discovered by E. Ligęza bearing the general title *Pecunia circulatorum et foncium* (the prevailing system being still the *quattuortempora*) included the same record as in 1405 (namely with the charge *fontes/de fontibus* written separately) three times during the year in question (*Cineris,*

rkps/MS 1600, p. 21), year 1524; ANK, rkps/MS 1601, p. 23, year 1530; PrawaPrzywilejeKraków, 1885, p. 969 (ANK, rkps/MS 1602, p. 23), year 1531, p. 972 – year 1533 (from the year 1523 – read by editors as: *Borngelt*, which could also mean a charge on water storage reservoirs connected to a water supply network); *Quatuortempora Rorne soluitur* – for the years 1535 and 1537 – ANK, rpks/MS 1604, p. 24 and rkps/MS 1605, p. 26.

752 ANK, rkps/MS 1590, p. 12.

753 The earliest mention of *pecunia circulatorum* was found in the account book of income and expenditure for the years 1392–1393 – ANK, rkps/MS 1588, p. 110. Kraków accounts for the year 1394 were not preserved. *Pecunia circulatorum* was also noted among the town's income from the years 1395–1399 (for every year separately) – cf. ANK, rkps/MS 1589, pp. 62 (year 1395), 76 (year 1396), 134 (year 1397), 200 (year 1398), 276 (year 1399).

754 ANK, rkps/MS 1591, p. 18 (year 1401) and p. 106 (year 1402) and rkps/MS 1592, p. 16 (year 1403) and p. 108 (year 1404).

755 ANK, rkps/MS 1593, p. 20. Here the *pecunia circulatorum* was collected in the *quattuortempora* system.

Penthecostes, Lucie), but referring only to the Grodzki town quarter from which the following charges (*de fontibus/fontes*) were made respectively: 0.5 mark and 6 groschen, 7 fertones without 2 groschen and 1.5 marks.[756] For the years 1408–1410, with the system of recording the revenues and the expenses of the town being changed into a weekly mode,[757] we know the exact dates on which the payment in question was charged (entitled *(pecunia) circulatorum et fontalis*). Therefore, we are able to tell that while in the years 1408–1409 it was noted four times each year,[758] the situation changed in 1410. Although the preserved accounts reach only the Feast of the Exaltation of the Cross, namely the third date on which payments were due according to the *Quattuortempora* system, the fact of receiving the *Pecuniae circulatorum et fontalium* was recorded only once: *sabbato dominice Oculi*,[759] i.e. on the first Lenten date (what is more, the payment was about one week late[760]). As opposed to the previous years, between 1408 and 1410 not even once was the component *de fontibus/fontes/fontalis* specified.

The appearance of *Pecunia percepta de fontibus civitatis* in the year 1400 coincided with "conducting water to the town through pipes" (*aque ductura ad civitatem per cannas*),[761] namely with the building of the water supply system with the water-work (*Wasserkunst*) in Kraków (which will be elaborated on later). In the opinion of the present author, this means that at that time that the town authorities introduced the pipe tax ("rurne"), i.e. a charge made for the possibility of using water storage reservoirs connected to the water supply system open to the public, bearing in mind that both these water storage reservoirs and water supply systems were referred to in Western European written sources (which was mentioned before) as *fontes*, namely the same word as the one used for dug wells. Nonetheless, it is especially the source mention dating from the year 1400 that suggests that it might have concerned town dug wells naturally referred to as *fontes civitatis*; in that case, however, the payment in question would not only have appeared in the preserved accounts from before 1400, but also after that date it would have constituted (in the new accounting system) their permanent (and not so irregular) element (e.g. the lack of these charges in the first two quarters of 1405 would mean

756 ANK, rkps/MS 1594, p. 9.
757 ANK, rkps/MS 1594, p. 23 et seq.
758 ANK, rkps/MS 1594, p. 35.
759 ANK, rkps/MS 1594, p. 172.
760 In this system of registration such delays happened – cf. also op. cit. subsequent dates of *Quattuortempora* payments in the same year.
761 ANK, rkps/MS 1590, p. 46, year 1400.

that either all the dug wells in town ceased to function, or the whole town was exempted from paying this tax).

In the course of a pursuit of analogies in literature, we have to note that Helena Piskorska presented the same understanding of charges made for water in Toruń. The money from these charges was used to cover the cost of the construction and maintenance of public wells; control over this process was exercised by the local "quarter's office".[762] The above-mentioned researcher added that "at that time town wells were actually water supply systems: water was conducted from considerably distant springs through wooden pipes to public and private wells in the town."[763] The fact that wells in Toruń were not wells dug to the water-bearing stratum, but that they were water storage reservoirs connected to a system of subsurface conduits open to the public found its confirmation in the results of archaeological research, published by Robert Kola and Leszek Kotlewski in 2003 in an exemplary manner.[764] Consequently, to date there is no evidence of the functioning of dug wells in Toruń.

III.2.2.3 Town wells

As was shown in the example of Brussels and Arezzo, late-mediaeval neighbours' wells situated outside private space sometimes fell under the management of the town; in that case it was the town that had to maintain the wells and as a result it had to cease to levy charges on people living in their vicinity. Together with wells built by the town, they became water intakes for everyone to use for free. There exists no information about such neighbours' dug wells in towns in the Polish lands.

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762 Piskorska 1956, p. 16 (Reformatio Sigismundi from the year 1523).

763 Op. cit., p. 17. Unfortunately, Tadeusz Maciejewski omitted this aspect while analysing Toruń laws passed by the city council; as a consequence, his work lacks the distinction between dug wells and wells-reservoirs connected to a water supply network – Maciejewski, 1997, p. 47, and footnote 11, p. 130 – a piece of information (also based on laws passed by the city council from the beginning of the 17th century) that water charges were collected "annually during eight days after the Feast of St John the Baptist", and an explanation that "after this date municipal servants distrained the debtor's property. The town prosecutor accused him before the quarter's office, which could give him a fine in the amount depending on the circumstances of the case. The amount of the charges was usually set on every house and every shed. Once a year, after Reminiscere Sunday, the quarter's office was obliged to account for managing the wells to the town council, which was closely connected with the general discussion of structural and economic matters of the town before the upcoming elections."

764 Kola/Kotlewski 2003, p. 40.

The case from Kraków described above cannot be interpreted in this way, because having assumed that the *pecunia fontalis* was in fact the pipe tax ("rurne"), we have to dismiss the idea that this charge could testify to the "neighbourly" origins of public wells in Kraków, or, to be more precise, that it could serve to pinpoint the time when the first form changed into the next one. Nevertheless, without any doubt written sources confirm the existence of public dug wells. Due to the fragmentary character of these sources it is difficult to determine the number of such wells both in large and in small centres in the Polish lands. In studies concerning Western European towns public wells were counted. For example, according to research conducted by Jean-Pierre Sosson in Bruges, at least 30 public wells functioned there in the years 1281–1299[765] (inter alia a well open to the public standing next to the entrance to the *leprosorium*[766]). The same number of wells was established for 15th-century Strasbourg,[767] whereas in Nuremberg in the mid-15th century there were about 100 public wells.[768] Unfortunately, this data was not followed by reflection on whether the number of these reservoirs was large or small in relation to the local demand for water (the number of inhabitants) and what kind of relationship existed between the number of wells and the water-bearing stratum in the centres in question. Contrary to appearances that suggest that the selection of these centres and their juxtaposition are random, it is only from such comparisons that conclusions can be drawn. All of these towns were large centres in their economic heyday. 30 public wells in Bruges whose number of inhabitants in the mid-14th century is estimated in written sources at ca 45 thousand,[769] and the same number of wells in 15th-century Strasbourg inhabited by ca 30 thousand people is respectively a little over 5.3 and 3.5 times less than 100 public wells in 15th-century Nuremberg whose number of inhabitants amounted to 28 thousand.[770] Bearing in mind that in the periods stated above water supply systems were being built

765 Sosson: *Eaux potables*, p. 6. The present author would like to express her heartfelt thanks to Professor J.-P. Sosson for making the text of his speech (unpublished at that time) available to her in 1998. The speech in question was delivered during the I Round Table at the University of Strasbourg in March 1993 entitled "Water and the City".

766 De Rekeningen 1965, p. 456, line 26 (year 1294): *Item pro puteo faciendo ante introitum domus leprosorum.*

767 Gouedo-Thomas 1995, p. 44, with reference to: Jacques Hatt, *Une ville du XVe siècle: Strasbourg*, Strasbourg 1929, p. 130.

768 Alltag im Spätmittelalter 1984, p. 51 and review by Janusz Sztetyłło, in: *KwHKM* 33 (4) 1985, p. 468.

769 Sosson, op. cit.

770 Dirlmeier 1981, p. 132 (data concerning the population of Nuremberg).

in Bruges and in Nuremberg, the difference in time in this comparison proves irrelevant. In a comparison of the number of wells in centres which are similar in terms of size, number of inhabitants and economic potential, one more factor has to be considered, the one that is the most important and always present, namely the dependence of the number of public wells on the water-bearing stratum and its quality.[771] It was precisely this factor that performed the central role in the division into three types of "situations" concerning dug wells in towns, outlined above. Wells in Strasbourg, dug to a shallow stratum bearing potable water, represented the first situation, as was discussed before, whereas wells in Nuremberg represented the second situation. Owing to the fact that sufficient data on the quality of water in dug wells in Bruges has not been gathered by the present author, the case whether they fell into the first or the third category must be left unresolved in the present work, especially so in the light of an opinion found in older literature that public wells were dug in that town "for a very long time", mainly for the purposes of fire safety.[772] Keeping in mind that the supply with water for production purposes and for consumption was a necessary condition for a sustainable economic development of large European centres, it can be assumed that Bruges, referred to in the early 11th century as a great sea port, whose heyday began in the 1130s, must have solved this problem before the establishment of a water supply system in the 13th century.

The construction, equipment and later maintenance of public wells were financed by the town authorities, which is why information concerning these intakes can be found in documents that remained after these authorities, mainly in town accounts. However, the permanent features of such records, namely the laconic and fragmentary character of mentions referring to wells in Polish towns, make it possible to trace only certain items of data on the construction elements

771 For the sake of order, let us quote data found in literature that e.g. in towns smaller than the above-mentioned, namely in late mediaeval Auxerre and Chartres, there were eight public wells in each of them (for Auxerre – cf. Gouedo-Thomas 1995, p. 42, with reference to: P. Richard, "Les puits publics de la ville d'Auxerre". In: *Bulletin de la Societé des Sciences Historiques et Naturelles de l'Yonne, Auxerre*, 104 (1973), p. 265 et seq.; for Chartres – Billot 1987, p. 114). A still smaller number of wells was recorded in little towns, as indicated, inter alia, in research on towns in Burbonnais (in the area of the Rivers Cher, Sioule and Allier), e.g. in Villefranche-lès-Bourbon two public wells existed – Laurent 1998, p. 79.

772 InvBruges, 1871–1885, Table analytique, p. 369: Puits publics: "Etablissement à Bruges, dès une époque fort reculée, de nombreux puits en vue de parer aux dangers d'incendie".

and/or the equipment of these intakes. While expenses made towards a new well whose construction was in progress or towards repairs of an existing well were recorded, only exceedingly rarely were they documented in detail. For example, while recording constructional material, its description was usually limited to stating its kind (oak wood in most cases), but the function it was to perform was not specified: whether it was to become an element of the shaft, of the casing, or of the construction used for drawing water. This was the way in which expenses on oak wood for wells in Lelów[773] and in Środa were noted. In the latter town in the mid-16th century the town council spent 4 groschen on oak wood for the well called "Walkmyn" and 2 groschen for poles for one of the town wells.[774]

For that reason a mention from Kraków accounts for the year 1487 of a "wooden" public well called "bornbretir" is extremely rare and thus valuable.[775] It can be assumed that its description in the first place referred to what was visible above the ground, i.e. its wooden casing, and later to its natural underground continuation in the form of the wooden construction of the shaft. Another matter is whether a wooden public well in Kraków in the late 15th century was an exceptional or a typical construction. Judging from the context of the 1487 expenses under the entry for *fontes*, the author of the present work would concur with the first possibility, if only because other wells were not specified as the one in question. Consequently, this reinforces the image of public wells as having stone casing found in iconographical sources: either rectangular – like the one depicted in the Wenzel Bible (Bible of King Wenceslaus IV of Bohemia) dating from the years 1389–1400[776] and – probably – like the well represented in the *Balthasar Behem Codex* in the early 16th century near the town walls ("Potter" – fig. 27)[777]; or round, like the one in the townscape from one of the quarters of a painting by an imitator of the Master of the Altar with the Legend of St John the Almoner, entitled: *The Punishment of Unfaithful Wives*.[778]

773 ANK, IT 230c., p. 97, year 1494.
774 APP, Środa, I/73, p. 90 and p. 94.
775 ANK, rkps/MS 1597, p. 21 (*distributa*), year 1487 – entry: *fontes*.
776 Homo Faber, 1967, no. 50.
777 Behem Miniatury, 2000, Garncarz (Potter).
778 Otto-Michałowska 1982, table 26.

Fig. 27: "Potter" from Balthasar Behem Codex *(ca 1505). In the background there is a public rectangular well with a crane. Collection of the Jagiellonian Library in Kraków. Reproduced after: Miniatury Behem, 2000 (photograph: Janusz Podlecki), with the consent of the Jagiellonian Library.*

In town accounts more information referred to elements used for drawing water, such as mechanisms facilitating this activity (e.g. windlasses, pulley) and objects with the help of which water was pulled up, namely poles with hooks (pike poles), ropes, chains and containers, mainly buckets. The importance of such pieces of information lies in the fact that when compared with other sources they make it

possible for us to draw conclusions about whether a well that had good drinking water was deep or shallow. Before we present examples from town sources, let us quote a fragment from *The Decameron*. Having described a pitiful Neapolitan adventure of Andreuccio da Perugia, who was robbed and thrown into a sewage pit, Boccaccio mentioned a public well which was "never without the pulley and a large bucket" ("un pozzo al quale suole sempre esser la carrucola e un gran secchione"). "Arrived at the well, they found that the rope was still there, but the bucket had been removed" ("Giunti a questo pozzo trovarono che la fune v'era ma il secchione n'era stato levato"). Hence, Andreuccio's mates lowered him into the well on this rope so that he could wash himself. "[A] company of patrols, being thirsty (…) came to the well to drink. (…) parched with thirst, (…) [they] fell to hauling on the rope, that it bore the bucket, full of water."[779] The presence of a rope to which a container for drawing water was attached, slung over the rim of the well, without any device that would help to pull water up from the well, testifies to the fact that the well was not very deep; however, it must have been several meters deep since if the poor protagonist fell into it from the level of the ground, he would undoubtedly suffer grievous bodily harm or die. What we can learn from Boccaccio's another novel is that the inhabitants of Arezzo kept buckets with ropes in their houses, like a man named Tofano, who – horrified that his (unfaithful) wife cast herself into the well – "bucket and rope in hand, he flung himself out of the house, and came running to the well to her rescue".[780] These examples can be illustrated with iconographical sources including the depiction of Andreuccio's adventure in the form of a woodcut by Augustino de Zani from and Italian edition of *The Decameron* published in Venice in 1518, showing a round casing and a rope slung over the rim of the well (fig. 28).[781]

779 Boccaccio, *The Decameron,* vol. I (Second day, Novel V), translated by James McMullen Rigg, Project Gutemberg. Web. Boccaccio 1985 (seconda giornata, Novella Quinta). Web.

780 Giovanni Boccaccio, *The Decameron*, Volume II translated by James McMullen Rigg, Project Gutemberg. Web. Boccaccio 1985 (Seventh day, Novel IV). Web.

781 Boccaccio 1972, vol. I, p. 141.

Fig. 28: A round casing of a well and a rope slung over its rim. Woodcut by Augustino de Zani from an Italian edition of The Decameron, *Venice 1518, after: Boccaccio 1972, vol. I, p. 141.*

Other mediaeval and 16th century depictions show that sometimes the rope was hung on a pulley attached to a post standing near the well (fig. 29)[782] or to a whole wooden, stone/brick or metal (iron) construction built above the well (fig. 30, 31, 32 and 33). Among devices used to lift heavy weights, including those used to draw water from deep wells, a metal pulley was mentioned in a treatise dating from the end of the 17th century, entitled *Architekt Polski* (*Polish Architect*), written by Stanisław Solski.[783]

782 Sowina 1999, pp. 28–29 – another such representation, on a fresco by S. Boticelli from the Sistine Chapel "The Trials of Moses" (1482) from: Biblia w malarstwie, 1996, pp. 60–61.

783 Solski 1959 (1690), pp. 24–25 – as a disc (or discs) in the so-called clubs for weight lifting, and pp. 287–289 – as a pulley ("krąg") – an element of devices for drawing water from deep wells.

Fig. 29: The Water of Life Discourse between Jesus and the Samaritan woman. At the well a post stood to which a pulley with a rope for drawing water was attached. Stained glass from St Aignan Church in Chartres, 16th century. Photograph: U. Sowina.

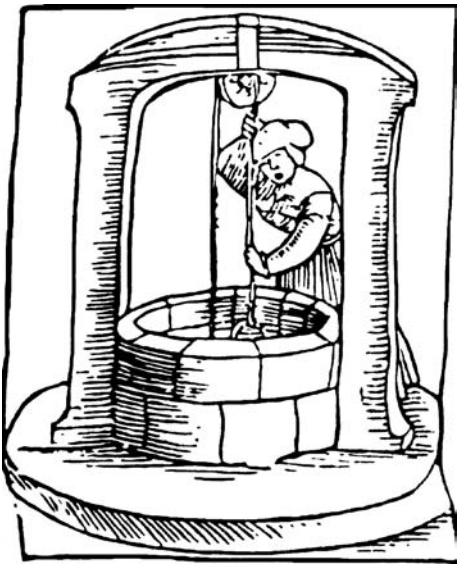

Fig. 30: Drawing water from a well with the use of a rope moving on a pulley attached to a stone or brick structure above the well, after: Crescenzi 1548, p. 17.

Fig. 31: A well with a rope on a pulley attached to a roofed structure. A vessel for carrying water is standing next to the well, after: Crescenzi-Trzycieski 1549, p. 26.

Fig. 32: A well with a 17th-century stone structure for drawing water in the courtyard of the Arsenal at the City Museum of Wrocław. Photograph: U. Sowina.

Fig. 33: A well with an iron structure for drawing water in the courtyard of Jan Długosz's house in Kraków. Photograph: U. Sowina.

Besides, cranes (Polish: "żuraw") were used near wells. The way they worked was described also by S. Solski in his treatise (fig. 34).[784] The basic dimension was the depth of the well from the top of the casing to the level of water. The mast of the crane (called by Solski "socha") was to be placed at the same distance from the well, whereas the length of the moving arm (Solski called it "waga", i.e. "scales") measured from the mast to the well was to be 2 ells greater. A rope or pole/pike pole (Polish: "laska") with a bucket at one end, attached to the end of the moving arm, was to be of the same length as the arm, i.e. 2 ells more than the basic dimension, so that the bucket could dip into the water and not only reach it. Danielle Alexandre-Bidon, a French researcher, correctly observed that cranes could only be used near wells whose total depth (namely the basic dimension found in S. Solski's description) did not exceed 6 meters.[785] For a greater depth, as can be easily calculated, the wells would have to be wider

784 Solski 1959 (1690), pp. 284–285.

785 Alexandre-Bidon 1992, pp. 528 and 530.

and wider. Apart from the above-mentioned iconographical representations of wells with cranes we can also take a look at a later (dating from the turn of the 16th and the 17th centuries) depiction of a public well with a crane standing next to the Town Hall in Łowicz (fig. 35).

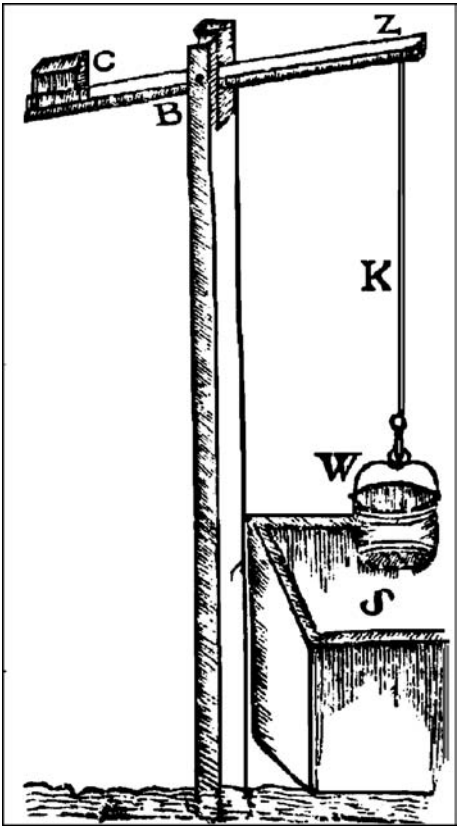

Fig. 34: A well crane, after: Solski 1959 (1690), p. 284, fig. 157.

Fig. 35: A fragment of the earliest panoramic townscape of Łowicz with a well and a crane next to the Town Hall, after: G. Braun, F. Hogenberg (after an illustration by J. Hofnagel), Civitates orbis terrarum, *Cologne 1572–1618, vol. VI, table 51.*

Water from deep wells was drawn by means of windlasses-crankshafts. On the windlasses were wound ropes or chains with one or two buckets.[786] Windlasses were called by S. Solski in his treatise from the end of the 17th century "rams, namely simple shafts with handles (called cranks)" and he counted them among "machines that made loads lighter"[787] (fig. 36). In the same work we read that sometimes "simple cart wheels" were fitted on the shafts to "lighten the weight"[788] (fig. 37) or "stronger machines" were used, namely spools setting cogwheels (with pegs-fingers) in motion. The spools were fixed on an iron spindle set in motion by a person turning the crank. The cogwheels were set either on a shaft on which

786 Cf. e.g. results of archaeological studies on the above-mentioned public well in the Market Square in Chełm, 24.5 meters deep: in its backfill remains of eight buckets and fragments of chains attached to them were discovered – Bronicki/Kadrow/Tokarski 1991, pp. 117 et seq. – which allows of the supposition that the well had a windlass-crankshaft.

787 Solski 1959 (1690), p. 19.

788 Op. cit., p. 20.

a rope with a bucket was wound (fig. 38) or on a "four-angular" shaft at the other end of which there was the above-mentioned pulley on which the chain with two buckets moved. The pulley was to measure an ell in diameter so that the buckets could pass without knocking against each other (fig. 39).[789] One of the constructions with the cogwheel described above was used in the mechanism to draw water from the Dominican well in Płock in 1509 which was discussed earlier. Similar installations (also using spools setting cogwheels in motion) were found in waterworks to lift water to a higher level.

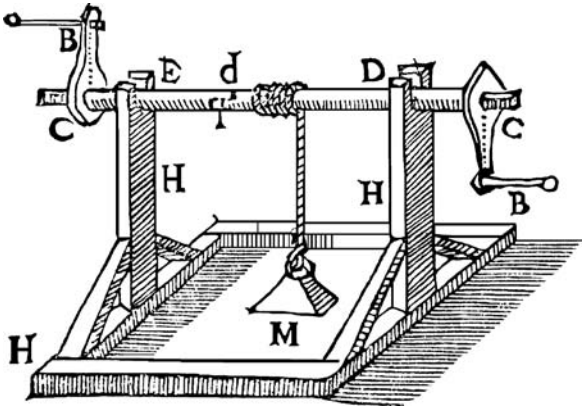

Fig. 36: "A ram, namely a simple shaft with handles (called cranks)" – for masoning, mining, and wells, after: Solski 1959 (1690), p. 19, fig. 11.

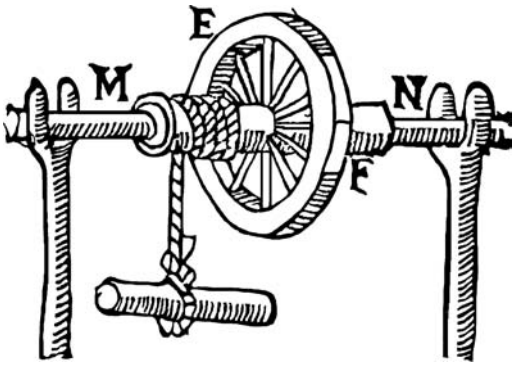

Fig. 37: A simple cart wheel on a pole-shaft on which a rope with the lifted load was wound, e.g. with a bucket of water, after: Solski 1959 (1690), p. 20, fig. 12.

789 Op. cit., pp. 27–28 and pp. 288–289.

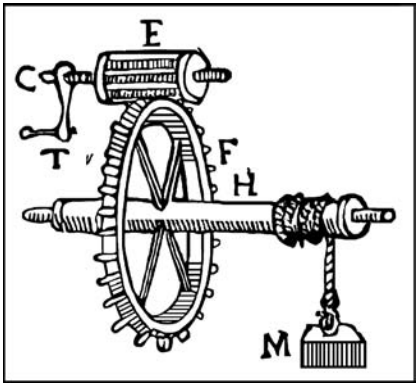

Fig. 38: Spools on an iron spindle set in motion by a person turning the crank. The cogwheel, set on a shaft on which a rope with a load (bucket) was wound, was set in motion by the spools. After: Solski 1959 (1690), p. 28, fig. 20.

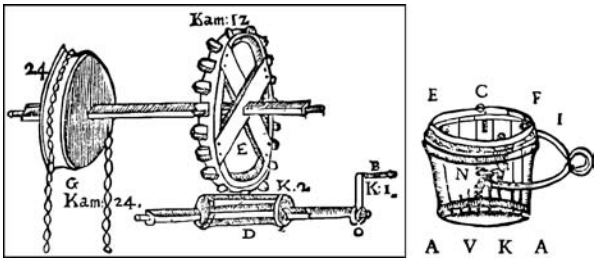

Fig. 39: A mechanism for drawing water from deep wells. Turning the crank (O B) set the spindle (O C) in motion. Spools (D) were attached to the spindle. Spools turned the cogwheel (E) that in turn set the pulley (G) – fixed to the same flat-sided wooden axle – in motion. A chain with two buckets moved on the pulley. Next: a wooden bucket with metal fittings and handle. After: Solski 1959 (1690), p. 289.

In town accounts we can find information about various objects and devices for drawing water that can sometimes be indicative of the depth of the wells. For instance, in 1482 in Lelów 4 groschen were paid to a man named Świerad for making a *statua* at the well standing opposite the house of the *advocatus*.[790] In 1498 7 groschen were paid to Jan the carpenter for the same job at an unknown well.[791] In the same year Mikołaj Wolny, a town councillor,[792] was paid for carting (among

790 ANK, IT 230c, p. 6.
791 Op. cit., p. 120.
792 Op. cit., pp. 159 and 161.

other goods to the town) vessels for drawing water *ad statuam ad fontem*".[793] All of these cases concerned a pole, but it is not known whether it was a pole to which a pulley was to be fixed, or whether it was a crane mast. The same incertitude appears in relation to a record of 1562 from Środa in Greater Poland about an expense made towards "*a statua*" for the town well called Walkmyn.[794] However, there is no doubt as to the way of drawing water either from a well built in Lelów in 1513, since it was recorded in the town accounts as *novum puteum a* zoraw,[795] or from a well in Środa, as in the town accounts from the year 1562 there is a mention of a half of a mark spent on nails *ad Zoraw circa fontem.*[796] The use of a construction for drawing water from deep wells was confirmed in the echevin book of the town Warta in a mention of an expense made towards a repair of a wheel of a local public well[797] and in accounts pertaining to Kraków in which expenses made for iron wheels (*rotha ferrea*) and chains (*cathenae*) to the local town wells were recorded. Expenditures on wheels were recorded there in 1397: for a well described as *ex opposito Zupparii* – 1.5 marks – *ad rationem* and again in the same mention, the same sum, also *ad rationem*, but it is unknown whether it referred to the same or to a different wheel.[798] Expenditures on *rota (ferrea)* were also noted in 1398: on a wheel for a well *ante Bochner* (22 groschen in total, including 10 scots, i.e. 20 groschen for its repair), in 1401: on a wheel probably for a new well in Sławkowska Street (16 groschen) and certainly for a well *Langmichil* (i.e. in front of Michał Lang's house) (15 scots = 30 groschen),[799] and in 1403: on a wheel for a well opposite All Saints Church (0.5 marks).[800] Only the sum of 1.5 marks can be interpreted as the cost of production and installation of such a wheel (namely the cost of the wheel for the well situated "opposite the *supparius*", even doubled, if we assume that both of the above-mentioned records referred to the same construction). The sums recorded in the years 1401 and 1403, i.e. 16, 24 and 30 groschen, were probably spent on repairs of the wheels (like in 1398) or on some unspecified elements of the wheels, or they served as a remuneration for the production of these parts.

793 Op. cit., p. 133.
794 APP, Środa I/73, p. 65v.
795 ANK, IT 230c, p. 333.
796 APP, Środa I/73, p. 109.
797 AGAD, Warta 2, p. 33.
798 ANK, rkps/MS 1589, p. 170, year 1397.
799 ANK, rkps/MS 1591, p. 61, year 1401.
800 ANK, rkps/MS 1592, p. 67.

Expenses made towards chains only rarely can be ascribed to specific wells. For example in 1396 when a half of a mark was paid *pro cathenis,*[801] i.e. for more than one chain, it is not known whether this cost was connected with any of the two wells mentioned in the same record as being under repair (*ante Predicatores, ante piczczin*). The same refers to a mention dating from the year 1402, when 3 fertones without 1 groschen (i.e. 35 groschen) were paid for a chain for an unspecified well.[802] Only in 1400, when 1 mark and 6 groschen were paid for a chain, was it recorded that it was made for a well near the Franciscans.[803] The fact that at least some Kraków public wells were equipped with wheels and chains indicates their considerable depth, exceeding the 5–7 meters confirmed by the above-mentioned hydrogeological studies. One of such public wells in Grodzka Street as early as almost 30 years before (in 1367) was recorded in echevin books as *fons kathenatus*.[804] An additional argument for this thesis is that this well was located[805] on the same stretch of both the terrace and Grodzka Street as the above-mentioned well-Schacht that belonged to two neighbours, namely between the Market Square and Szeroka Street.

It is known from Kraków town accounts dating from the 15th and the 16th centuries that the local public wells were equipped at the town's expense with chains, pike poles (*eculeī*), ropes (*cordae*, *funes*) and buckets (*urnae*); the town also paid for their installation at the well, repairs or replacement. Payments for pike poles were recorded only sporadically, e.g. in 1401 and 1402 when 8 groschen were paid for wood for one pike pole.[806] This wooden pole with a metal hook served various purposes (as a well builder's tool, but also as an important element of firefighting equipment, which will be elaborated on further). It could also perform two functions connected with drawing water from a well: either it was lowered into shallow wells with a bucket hung on the hook, or – which is more probable in the case of

801 ANK, rkps/MS 1589, p. 111: *fontes*.
802 ANK, rkps/MS 1591, p. 159.
803 ANK, rkps/MS 1590, p. 49.
804 It was the point of reference to describe the location of the neighbouring plots of three houses belonging to Bartek the minter (*monetarius*) in Grodzka Street, which Bartek sold to a patrician, Mikołaj Wierzynek – KsŁawKraków, 1904, no. 140, p. 18. Cf. also: CA I, 1917, no. 34, p. 7.
805 As a result of a reconstruction of the structure of ownership, including the possessors of the neighbouring plots of the three houses belonging to Bartek the minter, done on the basis of records in Kraków echevin books – cf. KsŁawKraków, 1904, no. 750, p. 88.
806 ANK, rkps/MS 1591, p. 61.

the public wells of Kraków – it could serve as the "laska" (as S. Solski called it), namely the part attached to the moving arm of a crane, as depicted in the abovementioned illumination from in the Wenzel Bible (Bible of King Wenceslaus IV of Bohemia).

The most frequently repeated expenses under the entry for *fontes* were those made towards ropes and buckets. In the earliest preserved accounts dating from 1390 a half of a mark (i.e. 24 groschen) was paid for a rope (*pro fune*) for one of the wells (*ante Warschonem*); however, the same sum was paid for two ropes for another well (*ante scolas beate virginis*), which would mean that the price of one rope (12 groschen, i.e. 1 ferto) was the same as the sum paid to Mikołaj for four ropes, if we assume they were of the same size (he received 1 mark, i.e. 48 groschen).[807] In accounts from the year 1391 under the entry *fontes* we can find a mention that cannot be considered as useful for the purposes of the present study, which referred to paying 1.5 mark for ropes for wells and "other places" (*Item 1½ marc. datis pro funibus ad fontes et alibi*).[808] Also in 1392 a half of a mark (24 groschen) was paid for one rope, this time for a well *circa Gothfridum*. However, a half of a mark and 11 scots (22 groschen) were paid for more than one rope (*pro cordis*) for the wells: in the Market Square[809] and in front of St Mary's Church school[810] respectively. Hence, the records from 1390 and 1392 suggest that the depth of the wells *ante Warschonem* and *circa Gothfridum* was comparable to one another and that the wells near St Mary's Church school and in the Market Square were shallower than the aforementioned wells, whose considerable depth can be testified by the expense of 18 groschen recorded in accounts for the year 1397 made towards one rope for a well with an iron wheel *ex opposito Supparii*.[811] As far as expenses made at the beginning of the 15th century towards ropes for wells, in 1400 under *Fontes in generali* there is a general record: *…pro cordis iij fert. et iij gr.*, and also *pro fune 1 fert.*,[812] i.e. 1 ferto per rope. Also records from 1401 preserved in the entry entitled *Fontes civitatis*[813] provide us with information about two instances of the payment of 1 ferto, each for one rope: the first one probably for a newly-built well in Sławkowska Street, the other one for a well in Floriańska Street. On that basis (on the condition that the ropes were of the same quality)

807 ANK, rkps/MS 1587, p. 54.
808 Op. cit., p. 128.
809 ANK, rkps/MS 1588, p. 31.
810 Op. cit., p. 60.
811 ANK, rkps/MS 1589, p. 170.
812 ANK, rkps/MS 1590, p. 49.
813 ANK, rkps/MS 1591, p. 61.

we can draw a conclusion that both of these wells were of an equal depth (which was less than the depth of the wells: *ante Warschonem*, *circa Gothfridum* and *ex opposito Supparii*). The same entry contains records of the following expenses: 0.5 threescore of groschen (30 groschen) and a half of a mark (24 groschen), each time *pro cordis*, i.e. for more than one rope. Owing to the laconic character of the mentions we can only suppose that the first expense referred to the well *in fundo*, whereas the second one – to a new well in Garncarska Street.

The year 1402 witnessed as many as 11 instances of buying ropes for wells (*funes*, *cordae*).[814] At first, one rope was bought for 1 ferto (*pro corda fontis 1 fert.*), however, it is not known for which well; later the same price was paid for more than one rope (*1 fert. pro funibus*), most probably for a well near the house belonging to a Kraków patrician called Armknecht. Two ropes were bought for unidentified wells, for 4 groschen each (*iiij gr. pro corda ad fontem; pro corda fontis iiij gr.*). It was perhaps for a well near the meat stalls that a rope-maker produced an unknown number of ropes for which he twice received a payment of 1 ferto. It is also difficult to establish whether it was for a well in Szczepańska Street that three ropes were bought, each of which cost 1 ferto (12 groschen), because in the same group of mentions also different prices were noted: 3 groschen for one rope (*corda*) and 6 groschen for ropes (*pro funibus*). In accounts pertaining to the year 1403 a purchase of one rope (*corda*) for 1 ferto was recorded, whereas in the following year the same amount of money was paid for more than one rope (*pro cordis*),[815] and one year later, in 1405, 9 groschen were paid for 3 ropes "for wells" (*ad fontes*),[816] however, it is impossible to establish for which wells; we can only assume that the ropes were made for reservoirs of various depths, predominantly shallow, thus requiring shorter ropes. In preserved accounts from the years 1407–1410 expenses made towards ropes were noted only sporadically: once in each of the following years: 1408, 1409 and 1410.[817] In this group the lowest price for one rope was recorded: 1.5 groschen. According to accounts from 1414 2.5 groschen were paid for a rope for a well: in that year there were 16 instances of the payment of a sum ranging from 2.5 to 10 groschen (for 1–4 ropes respectively), which amounted to 2 marks and 13.5 groschen for 44 ropes for wells.[818] The price for one rope was twice as high in late 15th century: 5 groschen were twice recorded in 1487.[819]

814 Op. cit., p. 159.
815 ANK, rkps/MS 1592, p. 67.
816 ANK, rkps/MS 1593, p. 69.
817 ANK, rkps/MS 1594, pp. 49, 129 and 170.
818 ANK, rkps/MS 1595, p. 55 (formerly 28), year 1414.
819 ANK, rkps/MS 1597, year 1487.

The difference in the price of ropes (and chains), especially within the same year or in subsequent years, resulted mainly from their different length and thickness, which in turn depended on the depth of the well and on the weight of the buckets that were to be pulled up using these ropes or chains (either ordinary wooden buckets or reinforced with iron fittings) (fig. 40), but also on whether there would be one or two buckets hung at both ends of the rope or chain.

Fig. 40: A wooden bucket with iron fittings and handle from a well in Chełm, functioning from the end of the 15th century to the 2nd half of the 18th century, after: Bronicki/Kadrow/ Tokarski 1991, p. 131.

As far as buckets are concerned, records rarely provide us with their unit price, because the total cost of their repairs or installation was usually recorded in reference to an unspecified number of buckets. For example, in 1390 1 ferto (i.e. 12 groschen) was paid for two buckets for the well *ante Goczonem*.[820] In 1391 3 groschen were paid for one bucket,[821] but in the following year a bucket for a well next to St Mary's Church school cost 6 groschen, the same as in the case of the bucket for the well *ante Goczonem* bought two years earlier. An expense made towards buckets for wells was recorded again only in 1397 when seven buckets were bought for a total sum of 18 groschen (on the same occasion 18 groschen were paid for one rope!); assuming that all the buckets were identical, their unit price was 2.5 groschen. Accounts from the years 1400, 1401 and 1402 provide us with general information that 7 groschen and twice 1 ferto, respectively, were paid *pro urnis*, i.e. for more

820 ANK, rkps/MS 1587, p. 54.
821 Op. cit., p. 128.

than one bucket.[822] However, it can be noted that the maximum price for one bucket (namely 3.5–6 groschen) was comparable with earlier unit prices. In 1402 also 20 groschen were paid to a cooper *pro urnis*, which together with one mention dating from 1403: *XVI gr. pro urnis*,[823] may suggest that the maximum unit price for one wooden bucket was slightly higher: 8–10 groschen. In accounts from the years 1407–1410 expenses made towards well buckets, as opposed to ropes, were not recorded. In the next preserved accounts, from 1414, two mentions were found: the first one of paying 7 scots (i.e. 14 groschen) for 4 buckets, the other one of paying 1 ferto to a cooper "for buckets" (*Item doleatori 1 fertonem de urnis*). Thus at that time the price of one wooden bucket varied from 3.5 to 6 groschen, i.e. it was the same as before. Consequently, we can talk about a fixed price of ordinary wooden buckets throughout the whole period in question; any fluctuations in this price probably depended only on the capacity of the buckets.

Buckets were reinforced with iron fittings. For example in 1414 a blacksmith was paid three times[824]: 1) "for two buckets" – a half of a mark; 2) for iron fittings for 2 buckets – 13.5 scots, i.e. 27 groschen; and 3) for 2 buckets – a half of a mark. Hence, at that time making iron fittings for one well bucket cost 12–13.5 groschen, i.e. almost 1 ferto, a sum that was paid in the same year to a cooper for making at least two ordinary wooden buckets. This raised the price of a bucket to ca 15.5–19.5 groschen. On the other hand, investing in stronger buckets must have been more cost effective than constantly replacing ordinary wooden buckets with new ones, considering the fact that buckets in public wells were used much more intensively than the ones in private wells. Buckets with iron fittings were much heavier than ordinary buckets, the latter being by no means light either (soaked wooden staves and the weight of the water itself – unknown due to the fact that the capacity of the buckets was unspecified). Bearing this in mind, drawing water from a well, even from one that was equipped with devices for lifting buckets full of water, was hard manual work (having drawn the water, the person had to pour it into one's own bucket), sometimes beyond the strength e.g. of women, especially those who were pregnant.

Data concerning expenses made towards well buckets in smaller centres included in the present research, namely from Lelów in Little Poland and Środa in Greater Poland, comes from the end of the 15th century and from the first half of the 16th century. The most numerous items of information come from Lelów and

822 ANK, rkps/MS 1590, p. 49 (year 1400), ANK, rkps/MS 1591, p. 61 (year 1401) and p. 159 (year 1402).

823 ANK, rkps/MS 1592, p. 67 (year 1403).

824 ANK, rkps/MS 1595, p. 55 (formerly 28).

pertain mainly to money paid for repairing buckets. However, there are also mentions which make it possible to establish the price of one bucket for a public well in this town at the end of the 15th century. In 1494 Szymon the cooper received 2 groschen for one well bucket; four years later he was paid the same sum for another well bucket. In 1499 Bernard the cooper was paid 1 ferto for 4 well buckets,[825] which meant that one bucket cost 3 groschen. The latter price was found again in 1509.[826] It has to be mentioned that sometimes 1 groschen was paid for one bucket, e.g. in 1510 (for a bucket for a well in the Market Square) and in 1524.[827] In these two examples it cannot be excluded that this was the cost of their repair, which is confirmed by numerous mentions, including the following, dating from 1494: *Item dedimus Wolny grossum a reformacione urne ad fontem*.[828] An analysis of Lelów town accounts revealed that this service was provided by a blacksmith called Wolny, who also reinforced well buckets with iron, e.g. in 1509, when for that latter service he received 4 groschen.[829] In 1505 3 groschen were paid for iron for one bucket.[830] The fact that blacksmiths took part in repairing buckets, namely in their reinforcing or supplementing with iron elements, was confirmed several times, including in 1495, when a blacksmith called Niemiec was paid 6 groschen for two buckets, and in 1520, when a blacksmith named Paweł received 3 groschen *a reparacione urne fontis civilis*.[831] It can be therefore assumed that in Lelów at the end of the 15th century and at the beginning of the 16th century one ordinary bucket cost ca 2–3 groschen and the same price was paid for its iron fittings. Metal plates were cheaper, they cost 1 groschen.[832]

No expenses made towards ropes were found in written sources pertaining to Lelów (probably because poles "laski" were used in the local well cranes, e.g. the purchase of poles for lifting a bucket from a well for 9 Vierchens was recorded in 1493[833]). However, over half a century later in Środa an expense was incurred *pro corda ad fontem 2 solidos*,[834] i.e. ca 1.5 groschen. Pieces of information concerning buckets for public wells in Środa from the mid-16th century, considerably

825 ANK, IT 230c., p. 105 (year 1494); p. 134 (year 1498); p. 141 (year 1499).
826 Op. cit., p. 260.
827 Op. cit., p. 6 (year 1482); p. 294 (year 1510); p. 484 (year 1524).
828 Op. cit., p. 114.
829 Op. cit., p. 247.
830 Op. cit., p. 208.
831 Op. cit., p. 437, year 1520.
832 Op. cit., p. 106, year 1494.
833 Op. cit., p. 88.
834 APP, Środa, I/73, s. 65v, year 1552.

less numerous than the earlier ones from Lelów, testify to the fact that the cost of one, probably ordinary, i.e. wooden bucket, already called in Polish "węborek", was the same as ca 50 years before in Lelów, namely 2–3 groschen.[835] In one case a joint payment for a bucket and a wooden mug ("węborek" and "faska") was recorded (3 groschen in total).[836] The presence of the mug testifies to the fact that people drank water from the well using the same common container standing on or next to the well. Therefore, the risk of transmitting diseases this way was not taken into account. Obviously, in the "pre-bacterial" era periodic cleaning of public wells was considered as sufficient. It was understood as being aimed at clearing away the things that had fallen or had been thrown into the well, which in every place and at every time has been confirmed by a rich archaeological material. Written sources, including mainly town accounts from Kraków, Lelów and Środa in Greater Poland, registered numerous though small expenses (amounting to several groschen) made towards cleaning the reservoirs in question and water inside them (*pro mundatione fontium, a purgatione aque in puteo*). This was a necessary action taken within the scope of the maintenance of wells.[837]

In Kraków town accounts preserved from the year 1390 onwards, the abovementioned expenses made towards digging *fontes*, and even to a greater extent those made towards chains or wheels for them, leave no doubt as to the fact that they concerned dug wells and not shallow water storage reservoirs connected to a water supply system open to the public. This provides us with a basis to perceive the separate entry in town accounts entitled *fontes* (under which these expenses were recorded) as being devoted to public dug wells. This entry existed from the beginning, i.e. from 1390, and in 15th-century town accounts until the year 1487. However, it was not recorded in 16th-century accounts. In the latter accounts the present author has not found expenses made towards wells (*fontes*) in the entry

835 Op. cit., p. 47, 64v., 82, 114.

836 Op. cit., p. 101.

837 For Kraków – cf.: ANK, rkps/MS 1589, p. 170, year 1397: *primo mundanti fontes[s] 1 marcam*; ANK, rkps/MS 1590, p. 49, year 1400: *…mundanti fontes vj gr.;* ANK, rkps/MS 1591, p. 61, year 1401: *…pro mundacione et reparatione fontis in fundo x gr., …eykoni iij fert. de purgatione fontium. Item de mundacione fontium ix scot., …pro mundacione fontis 1 fert., …pro purgatione fontis xvii gr. …pro mundacione fontis vi gr.…*; ANK, rkps/MS 1592, p. 67 (year 1403) and p. 157 (year 1404); ANK, rkps/MS 1595, p. 55 (formerly p. 28), year 1414: *Item viij gr. mundantibus.* About cleaning the water, including wells – Sowina 2005, p. 327 et seq. – a remark about controlling water purity together with the condition of the streets and the Market Square, also on the basis of Kraków town expenditures from 1395: *super foro et platheis ac fontibus in eisdem* (ANK, rkps/MS 1589, p. 47). About cleaning wells in Lelów and Środa – Sowina 1999, pp. 32 and 36.

Edificia Civitatis Communia (existing in the 15th century: *In communi* in 1431,[838] and *Edificatio communis* in 1487), although it included individual sums for the equipment of water storage reservoirs placed in the streets (*zamp*, *Samp*).[839] Nonetheless, from the year 1399 on, all expenses concerning the construction and later the maintenance of the Kraków water supply system were clearly singled out in the town accounts. It can be thus assumed that the disappearance of *fontes* as a separate entry in town expenses[840] evidences the decline of dug wells as public water points and the growing importance of the water supply system that was developed in the 16th century, including water storage reservoirs open to the public. If that was the case, it would mean that in the 16th century public dug wells only fulfilled a subsidiary function, and the expenses incurred in relation to their maintenance (no sums devoted to the construction of new wells were found) may have constituted a part of the expenses that were not singled out, but that included the remuneration paid to municipal officials called *circulatores*, who (as was mentioned above) had always been responsible for this type of town water reservoirs.

There exists no source data concerning either the number or the exact location of public dug wells in Kraków (not to mention the whole network). On the basis of town accounts we can try to establish their minimum number, because the only ones that were mentioned were those on which money was spent. And still, there exists the risk of an error concerning their identification due to the fact that the location of wells in the town space was described in many different ways. Only in some cases the street in which a given well was situated was stated. The location of other wells was defined in relation to local landmarks, namely public buildings or facilities, but mainly in relation to houses owned by well-known Kraków patricians. For that reason in order to reconstruct the location of Kraków public wells in the space *intra muros* **(cf. fig. 41: the insert under the band)** it was necessary to conduct prosopographic and socio-topographical studies based on the earliest preserved town accounts and records found in town councillors' and echevin books dating from the end of the 14th century.[841]

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838 ANK, rkps/MS 1596, p. 69.

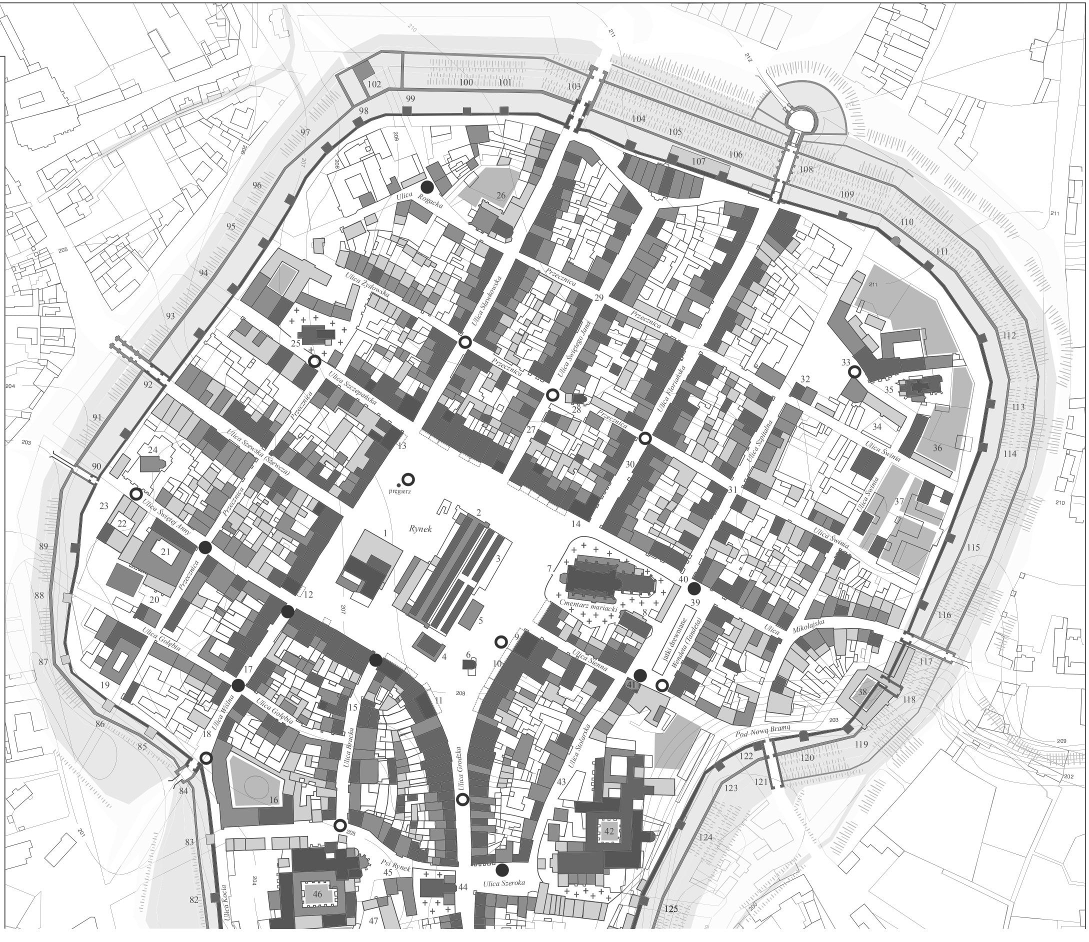
839 ANK, rkps/MS 1601, year 1530, p. 100 (87): *vas (?) ad Samp – mrc. 0 gr. 10*; p. 107: *fuder ad zamp in platea iudeorum – mrc. 0, gr. 13*.

840 Had it embraced also water storage reservoirs connected to the water supply network, it would have survived, as data connected with the maintenance of the functioning water storage reservoirs or with the construction of new ones when the network was extended in the 15th century, and especially in the 16th century, would have been recorded under this entry.

841 KsRachKraków II, 1878 and KsŁawKraków 1904.

II.4.5

ważniejsze obiekty
Significant sites
1 Ratusz, spichlerz, kabaty i wieża ratuszowa
2 Sukiennice
3 Kramy Bogate
4 Waga Wielka
5 Waga Mała
6 kościół św. Wojciecha
7 kościół NP Marii (Mariacki)
8 kościół św. Barbary i klasztor Jezuitów
9 Szara Kamienica
10 kamienica Montelupich
11 kamienica Hetmańska
12 Pałac Pod Baranami
13 Krzysztofory
14 kamienica Margrabska
15 Bursa Węgierska, dawny dom wójta Henryka
16 Pałac Biskupi
17 Bursa Ubogich
18 kościół św. Norberta i klasztor Norbertanek
19 Bursa Jerozolimska
20 Collegium Minus
21 Collegium Maius
22 Kolegium Nowodworskiego
23 Miednica
24 kościół św. Anny
25 kościół św. Szczepana i nowicjat Jezuitów oraz kaplica śś. Macieja i Mateusza
26 kościół św. Marka i klasztor zakonu Marków
27 kościół Niepokalanego Poczęcia NP Marii i klasztor Bernardynów Na Żłóbku
28 kościół św. Jana
29 kościół św. Urszuli i klasztor Bonifratrów
30 Pałac Kmitów
31 kościół św. Tomasza i klasztor Karmelitów Trzewiczkowych
32 kaplica św. Rocha i szpital Scholarów
33 kościół Św. Ducha i szpital oraz klasztor Duchaków
34 klasztor Duchaczek
35 kościół Świętego Krzyża
36 zabudowania klasztoru Benedektynek ze Staniątek
37 zabudowania klasztoru Cystersów z Mogiły
38 kościół Matki Boskiej Śnieżnej i klasztor Dominikanek Na Gródku
39 jatki rzeźnicze
40 Prałatówka
41 szkoła Panny Marii
42 kościół Świętej Trójcy i klasztor Dominikanów
43 klasztor Dominikanek i szpital Ubogich Wdów
44 kościół Wszystkich Świętych
45 domy kanoników kolegiaty Wszystkich Świętych
46 kościół i klasztor Franciszkanów
47 Pałac Ostrogskich
48 kamienica „Podelwie"
49 kościół św. Piotra
50 Pałac Tęczyńskich
51 Pałac Lanckorońskich, klasztor Bernardynek
52 dwory szlacheckie na cmentarzu Świętej Trójcy (obecnie klasztor Bernardynek)
53 kościół św. Michała i klasztor Karmelitów Bosych
54 apteka Królewska (dawny „Dom Kupiecki" Okołu)
55 Collegium Juridicum oraz domy nr 49, 51, nr 6 (dawne kramy handlowe Okołu)
56 Bursa Długosza
57 kościół śś. Piotra i Pawła, klasztor Jezuitów
58 kościół św. Andrzeja i klasztor Klarysek
59 kościół św. Marii Magdaleny
60 szpital księży emerytów „św. Marcina"



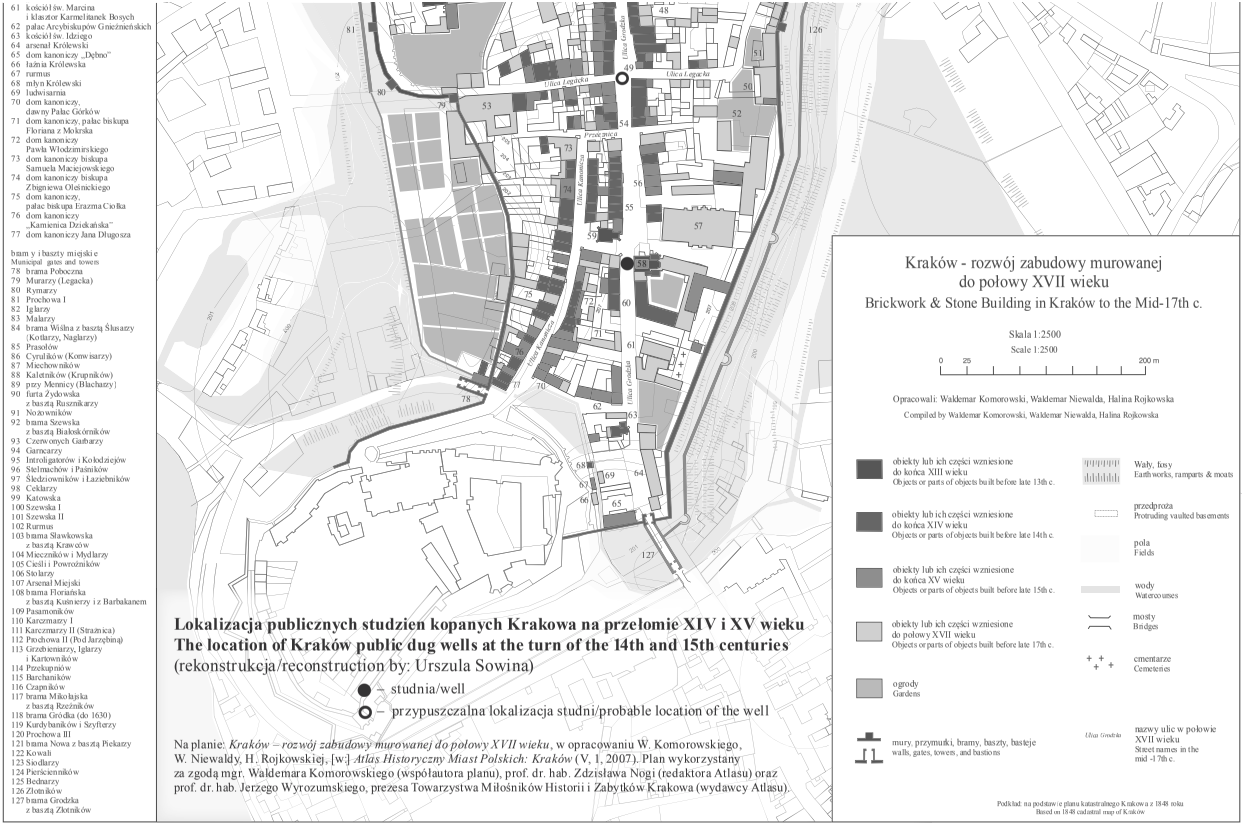


Fig. 41: The location of Kraków public dug wells at the turn of the 14th and 15th centuries (reconstruction by U. Sowina). On the town plan: "Brickwork & Stone Building in Kraków to the Mid-17th c.", compiled by W. Komorowski, W. Niewalda, H. Rojkowska, in: Atlas Historyczny Miast Polskich: Kraków (V, 1, 2007). Plan used with the consent of Mr Waldemar Komorowski, MSc (the co-author of the plan), Professor Zdzisław Noga, PhD (the editor of the Atlas) and Professor Jerzy Wyrozumski, PhD, the president of the Towarzystwo Miłośników Historii i Zabytków Krakowa (the publisher of the Atlas).

In 1390 in town accounts 4 marks and 10 groschen were recorded as payment for at least 5 wells.[842] One of them was situated in the fish market (*in foro piscium*), i.e. within the Market Square.[843] Another one was next to the parish schools (*ante Scolas beate Virginis*), in the south-western corner of the Small Market, where two streets met: Szkolna (School) Street (running from the Market Square) and Braci Kaznodziejów (Preaching Friars') Street (called from the 16th century Stolarska (Carpenters') Street[844]), near the meat stalls.[845] The location of the remaining three wells was defined in relation to the houses (or their owners) situated at the smallest distance: *ante Warschonem*,[846] *ante Goczonem*, *ante Gosil*. An attempt to identify these persons and the location of their houses brought about positive results in two cases. On the basis of records from the earliest preserved echevin books of Kraków two houses were identified: Goczo Czeyn's house was probably situated close to the Rogacka baths (next to which *Dominus* Goczo had a house until 1392[847]) and Hanusz Gossil's house was located in the Market Square.[848] No direct source mentions of the location of Marcin Warsz's house were found (he died before 14 November 1392[849]); it can only be supposed that it was near the house belonging to the Wierzynek family, standing in the Market Square, because

842 KsRachKraków II, 1878, p. 292–293 and ANK, rkps/MS 1587, p. 54: *fontes*.

843 Tyszka 2001, pp. 87, 102 and 121, footnote 347 – about the difficulties in localizing this market in the light of two records: from 1438 and 1457. The former locates the market in the Market Square – near Szewska Street. The latter describes it as being situated near the Small Scales.

844 Tomkowicz 1926, pp. 126–127.

845 ANK, SC 5, p. 107, year 1424. About the location of the Virgin Mary's Church schools – cf. also Tomkowicz 1926, pp. 49–51 and Wyrozumski 1992, p. 297; cf. also SC, 5, p. 125: *domum suam retro macella prope Scolas beate Virginis*.

846 ANK, rkps/MS 1587, p. 54: *½ marc. ad fontem ante Warschonem pro fune*.

847 Localized on the basis of mentions in: KsŁawKraków 1904, p. 173, no. 1447 (*contra monachos*), no. 1471, p. 178 (*domum suam quam inhabitat*), and p. 227, no. 1769 (*domum, ortum et horreum quondam Goczonis circa balneum Cornutorum*). Goczo Czein – town councillor in 1393 – KsRach Kraków II, 1878, p. 242 (found through the index on p. 346). He died before 28 August 1394 – cf. KsRachKraków II, 1878, p. 114.

848 Hannusz Gossil, echevin – KsŁawKraków 1904, through the index of people and places, p. 335. In the years ?–1375–1394–? he had a house in the Market Square, neighbouring with the house belonging to the Bochner family – KsŁawKraków, 1904, no. 1094, p. 128 (year 1375) and no. 1850, p. 240 (year 1394). Until the year 1394 he had a house next to another well – in Rzeźnicza (Butchers') Street, near butchers' stalls – KsŁawKraków, 1904, no. 571, p. 67.

849 KsŁawKraków 1904, p. 203, no. 1625.

Marcin's wife, Konstancja, came from this family and was a joint heir of a half of the *advocatia* of Wieliczka.[850]

Moreover, in town accounts from the same year 1390, in a separate entry, 19 marks and 26 groschen were recorded as money for a new well (*super nouo fonte*),[851] which is almost five times more than the above-mentioned sum pertaining to 5 wells. The scope of the works was extensive: from supplying oak timber, including beams, through digging the well (for 112 groschen, paid in the following installments: a threescore of groschen, a mark, 4 groschen), to building a roof above the well, paving the area around it and installing unspecified iron elements (*ferramenta*), most probably affixed to a mechanism for drawing water. Unfortunately, due to the laconic character of the mention the mechanism is difficult to recreate. However, since the roof excluded the existence of a crane, it may have been an iron wheel (pulley) hung on an iron structure (the above-mentioned *ferramenta*?) above the well, with a rope or chain running over the pulley, or a windlass-shaft, or even perhaps one of the "stronger machines" described above that were specially covered with a roof. It is worth mentioning that using one of such constructions in places of high traffic intensity, especially in large centres, was much more convenient than using a crane that took up more space. Cranes were used at public wells in smaller centres, e.g. in Środa in Greater Poland and Łowicz. In large centres cranes were probably installed in less busy places, e.g. in Wrocław, in the Ketzerberg district, as shown in B. Weiner's plan dating from 1562.[852]

In the subsequent year 1391 3 marks and 46 groschen[853] were spent on at least three wells: one of them was the above-mentioned well next to the parish schools (*fons ante scolas*), the second was a newly-dug well (*fons nouus*), and the third one was near a market hall called "szmatruz" or "smatruz" (*Schmetterhaus*, *garrulatorium*).[854] It was on the western side of the Market Square, north from the Town Hall, perpendicular in relation to Szewska Street.[855] On the basis of a

850 Sikora 2004, pp. 205–207.

851 ANK, rkps/MS 1587, p. 57; KsRachKraków II, 1878, p. 292.

852 Plan Wrocławia, 2001.

853 ANK, rkps/MS 1587, p. 128; KsRachKraków II, 1878, pp. 295–296.

854 Moreover, this time without mentioning the exact wells, 3 groschen were spent on a bucket, 7 groschen on hanging two buckets, 10 groschen on cleaning a well and 1.5 marks on ropes "ad fontes et alibi".

855 Tyszka 2001, map on p. 102 and p. 123 – its location according to a highly detailed description in echevin books (ANK, SC 6, p. 250, year 1441) of the position of bread stalls in relation to such landmarks as the Town Hall, the "szmatruz" and the Cloth

mention dating from 1438 the location of the fish market was defined as to the west of the "smartuz"; hence, it is not out of the question that the well *in foro piscium* from 1390 and the well *penes garrulatorium* from the following year was the same object. If that was the case, then an additional conclusion emerges, namely that the fish market in Kraków, at least between the years 1390 and 1438, was situated in close vicinity of the "szmatruz", on its western side, i.e. not far from the exit of Wiślna Street (into the Market Square), a street along which it was convenient to transport fish from containers and watercourses situated outside Wiślna Gate (Brama Wiślna).[856] Therefore, the well in the fish market, near the "Schmetterhaws" (*garrulatorium*), was an indispensable source of water supply mainly for fishermen and fish merchants (who needed it to keep the fish in containers with water, to wash and rinse the stalls, vessels and tools etc.), but also for merchants and craftsmen from the "smatruz" market hall.

Coming back to the town expenditures connected with the "new well" from the years 1390 and 1391, it has to be noted that there is no certainty as to whether this was one water reservoir. However, if this was the case (which is highly probable), then the piece of information from the town accounts for the year 1391 about hanging (two) buckets at the same time at this well would confirm the conclusions that have been reached on the basis of data from the year 1390 concerning the "new well", namely that this well was equipped with one of the mechanisms for lifting water from deep wells. According to S. Solski, two buckets could be used to draw water either with a windlass, or with a metal "circle" (pulley) of a diameter not smaller than an ell (so that the buckets could pass without knocking against each other), aided by a mechanism consisting of spools and a cogwheel. Bearing in mind the diameter of the "circle" (pulley), the diameter of the upper, widest part of each of the buckets had to be a bit smaller than an ell (since the radius had

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Hall, as well as the two small streets running across the Market Square. In Kraków accounts from the years 1524 and 1531 appeared rent from the "szmatruz" (ANK, rkps/MS 1600, p. 48 – Schmetterhaws, ANK, rkps/MS 1602, p. 59 – *Garrulatorium*), paid quarterly, inter alia, by leather craftsmen: *cingulatores, albicerdones, bursifices, corrigiatores, acufices*, which testifies to the fact that mainly leather stalls were present there. Cf. also Goliński 1997, p. 25 – about a better documented 14th-century "szmatruz" in Wrocław, a two-storey hall with bread, shoes and leather stalls in the ground floor and with undefined merchandise offered for sale on the first floor.

856 Cf. also Part II of the present work – about the development of fish economy on the then reclaimed suburban marshlands along the western fortifications of Kraków, including the royal privilege of 1422 granting the town *spacium loci Żabocruk*, meant to be turned into a fish pond or ponds.

to measure less than a half of an ell) in order that some space was left between the buckets and between each of the buckets and the walls of the well. Consequently, the diameter of the whole well must have been at least a bit larger than 2 ells (ca 1.2 meters).

It can be stated without a doubt that the expense dating from 1390 in the amount of ca 20 marks for a new well, disproportionately high in comparison with expenditures on other *fontes*, not only in that year, but also in the years 1391–1399,[857] constituted the minimum (+ possible expenses from the year 1391) or the total cost of the construction and equipment of a public well in Kraków at the end of the 14th century.[858] The well might have been the one referred to in a document of 1395 as the newly-built well near the wall of the Dominican Monastery from the side of the Nowa Brama (New Gate), next to St Mary's Church school,[859] which the present author identifies with a well mentioned as late as 1470 in a Kraków echevin book: *domum suam in fundo ex opposito fonte circa murum monachorum sancte Trinitatis iacentem*.[860] Therefore, it must have stood not far from the already existing well in the Small Market, in the south-eastern part of Szkolna (School)/ Sienna (Hay) Street. However, owing to the fragmentary character of the sources, this cannot be established. It is also unknown whether this well was the same well which was referred to as *fons ante Predicatores* in town accounts of 1396, for which the town paid 2 marks out of 3 marks and 6 groschen spent in that year on wells in general.[861] The word '*ante*' indicates that the latter well may have stood in front of/ opposite the western facade of the Church, namely from the side of *platea lata*; the existence of a well in that place is confirmed in later accounts, dating from 1408, 1409 and 1414.[862] These doubts can only be resolved by one of the above registers, i.e. the one pertaining to the year 1409, in which *fons in ampla platea* and *fons circa s. Trinitatem* are presented as two different objects.

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857 ANK, rkps/MS 1587–1589 and KsRachKraków II, 1878, pp. 295–324 and Kutrzeba 1900a, table III.

858 For the sake of comparison we can refer to a nearly contemporary "Report on the measuring the bricklaying works done at the end of the building campaign in 1399 while the Teutonic Castle in Bytów was erected" (Zakon Krzyżacki, 2005, p. 133). This report contains a list of tasks carried out by a hired bricklayer, including building a well, for which he asked "a spare penny", and received 40 marks.

859 KDMK I, 1879, no. 81, p. 110.

860 ANK, SC 8, p. 407 – the present author owes this mention to Przemysław Tyszka, PhD, for which she would like to express her heartfelt thanks.

861 KsRachKraków II, 1878, p. 313–314 and APKr., MS 1589, p. 111, year 1396.

862 ANK, rkps/MS 1594, pp. 35 and 96 (year 1408), pp. 107, 129, 148, 161 (year 1409) and ANK, rkps/MS 1595, p. 55 (formerly p. 28) (year 1414).

In the course of analysing subsequent expenses made towards *fontes* in the 1390s, it can be noted that in 1392 the town expenditures on wells were put down under three entries. The following sums were paid for: 1) *Fontes in circulo* – 44 groschen;[863] 2) 4 wells: *circa Gothfridum, (fontes) Goczonis et Wenckonis, apud beatam Virgine(m)* – which amounts to 1.5 marks and 4 scots in total;[864] and 3) *Super fonte leprosorum* – 1 mark and 9 scots (66 groschen in total).[865] On that basis it can be assumed that at least 4 public wells were outside the Market Square and that a separate well exclusively for lepers (in accordance with the rule: *separatio leprosorum*) was maintained for money from the town coffers. Among public wells placed outside the Market Square, apart from the well next to the parish school and the one next to Goczo's house near the Rogacka baths, also the location of the well "in front of Gotfryd's house" was identified. The person was most probably Gotfryd *Gallicus* Fattinante, an Italian merchant from Genoa (*Fattinante de Janua*), the general *supparius* in Wieliczka and Bochnia, who died before 11 July 1393. Since he owned a house on the corner of the Market Square and Wiślna Street,[866] it can assumed that the well was situated in Wiślna Street, near its exit into the Market Square. Most difficulties were connected with the attempt to identify the fourth well situated outside the Market Square, described as *fons Wenckonis*. Assuming that – like in other cases – this signified that the well was in the vicinity of a patrician's house, the present author supposes that it was Winko's (Wincko's, Wencko's) house.[867] According to Franciszek Sikora's findings, Winko was the first husband of Nawojka, a daughter of Anna née Wierzynek – whose husband was Jurg Czeyn (Wierzynkówna – Jurgowa Czeynowa).[868] Incidentally, Anna was Konstancja Warszowa's (Marcin Warsz's wife) sister.[869] Counted among wells which were situated outside the Market Square, it probably stood in Bracka Street, near its exit into the Market Square, just like the well neighbouring with Gotfryd Fattinante's house in Wiślna Street.

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863 ANK, rkps/MS 1588, p. 31.

864 ANK, rkps/MS 1588, s. 60.

865 Loc. cit. Cf. also: KsRachKraków II, 1878, pp. 299–300 and 302.

866 The identification of this person as Gotfryd Fattinante was done by the present author on the basis of: KsŁawKraków 1904, through the index of people and places (including p. 335) and mentions: no. 1260, p. 147 (30 September 1390), no. 1276, p. 149 (14 October 1390), no. 1720, p. 221 (11 July 1393), no. 1828, p. 238 (9 January 1394).

867 Ptaśnik 1914, p. 7, counts Winko among *Bergmeisters* (*magistri montium*), i.e. officials working in salt mines.

868 Sikora 2004, pp. 206–207.

869 Loc. cit.; earlier likewise: Ptaśnik 1914, p. 31.

There is no data concerning the following three years, because in accounts pertaining to 1393 no expenses towards wells were noted, accounts from the year 1394 did not survive, and in 1395 the only recorded expenses connected with wells were 0.5 mark and later 3 fertones paid to a well-digger for digging a well for the Kraków limestone quarry and lime kiln complex.[870] In the latter year town wells were mentioned in the following manner: *super foro et plateis ac fontibus in eisdem*, however, no money was spent on that occasion.[871] Between 1396 and 1399 sums assigned to *fontes* were very small. As was mentioned above, the sum spent in 1396 amounted to 3 marks and 6 groschen. Apart from the well "in front of the Dominicans" (on which 2 marks were spent), 30 groschen – and perhaps additional 24 groschen (0.5 mark) – were paid for works at the well whose location was described in two ways: *ex opposito Piczunke* and *ante piczczin*.[872] Most probably the focal point was the house owned by Jan Piczczin, the then town councillor, who had been an echevin before.[873] In May 1393 Jan Piczczin possessed a brick dwelling house in the Market Square that had been given to him several months earlier by Jerzy Arnsberg the elder's wife.[874] Due to the lack of sources it is impossible to establish whether at that time he still owned a house in Grodzka Street which he had bought in 1373 from Gotfryd (Fattinante).[875] For that reason the well *ante Piczczin* can be located as standing on an unspecified side of the Market Square, and not in Grodzka Street (which would enable us to identify it with *fons cathenatus* from 1367 as the same deep construction, since it was also equipped with a chain to draw water).

In the year 1397 5 marks and 16 scots were spent on public wells in Kraków. 4 marks and 8 scots for the well of the Rogacka baths were recorded separately. Probably works connected with digging this well were still going on at that time, since among the expenditures the remuneration of the digger was specified: he surely

870 ANK, rkps/MS 1589, p. 37.

871 ANK, rkps/MS 1589, p. 47; KsRachKraków II, 1878, p. 309. Expenses on "the Market Square and the streets" appeared in Kraków accounts either in the context of their cleaning (*mundatio foris et platearum*) – cf. op. cit., the previous mention, or in the context of equipping them, e.g. with chains in order to partition (close) them. Cleaning wells, encountered in other years under the entry *fontes*, together with expenses on their maintenance and equipment – e.g. in the year 1414 – ANK, rkps/MS 1595, p. 55 (formerly p. 28).

872 KsRachKraków II, 1878, pp. 313–314 and ANK, rkps/MS 1589, p. 111, year 1396.

873 KsŁawKraków 1904, through the index of people and places, p. 351, and KsRachKraków II, 1878, p. 254. Cf. also Starzyński 2010, pp. 248–249.

874 KsŁawKraków 1904, p. 213, no. 1668, 2 May 1393.

875 Op. cit., p. 93, no. 802 (28 January 1373), p. 97, no. 834.

received 1 ferto twice and probably also 0.5 mark, 3 fertones and again 0.5 mark.[876] In the year 1397 the only well that was defined in some way (as equipped with a wheel on which a long rope was wound) was the *fons ex opposito Zupparii*.[877] Nevertheless, it is difficult to establish its exact location, because at that time there were several *supparii* active in Kraków. In town councillors' books of 1392 a certain *Dominus Nicolaus Zuppnik* appeared,[878] who was probably the same person as the one referred to in the same way in the years 1394–1397, both in documents of the town council, and in those issued by the echevin, the only difference being that these documents bore the Latin equivalent of this name, i.e. *Nicolaus zupparius*.[879] It follows from two records in echevin books that he and his wife, Krystyna, had a house with a brewery at the corner of Żydowska (Jewish) and Wiślna (Wisła's) Streets.[880] The publisher of Kraków town councillors' books, Józef Szujski, quoting a record of 26 August 1395 where four *supparii* and citizens of Kraków appeared together, namely: Mikołaj Falkinberg, Mikołaj Kerber, Iakubek and Walenty Folcza, identified Mikołaj żupnik as Mikołaj Falkinberg, thus omitting Mikołaj Kerber.[881]

Nevertheless, the mention of the well *ex opposito zupparii* in accounts from the year 1397 may have also referred to one more *supparius* active in the period in question, namely Mikołaj Bochner, registered in the surviving town court books at least between 1390 and 1405. In 1392 he was a member of the city council, *inter alia* together with Mikołaj żupnik mentioned above.[882] In December 1393 both of them as councillors were present during the confirmation of the validity of the deceased Gotfryd Fattinante's testament,[883] whereas in 1394 they appeared as parties in a case concerning debts between Bochner's nephews and the late Gocz's

876 ANK, rkps/MS 1589, p. 147 and KsRachKraków II, 1878, p. 316. About the Kraków Rogacka baths cf. also: Part II of the present work.

877 ANK, rkps/MS 1589, p. 170.

878 KsRachKraków II, 1878, p. 79, 82 and 235 (as a town councillor).

879 KsRachKraków II, 1878, p. 114 (year 1394), 137 (year 1396), p. 166 (year 1397 – a town councillor) and KsŁawKraków 1904, p. 285, no. 2161 (6 August 1395) and p. 304, no. 2327 (18 August 1396).

880 KsŁawKraków 1904, p. 285, no. 2161 (6 August 1395) and p. 304, no. 2327 (18 August 1396).

881 KsRachKraków II, 1878, p. 130 and index on p. 348. In the years 1393 and 1394 also a *supparius* named Herman was mentioned in echevin books – KsŁawKraków 1904, p. 224 no. 1749 and p. 261 no. 2004 and index, p. 382.

882 KsRachKraków II, 1878, index on p. 242.

883 KDKK II, 1883, p. 182.

children.[884] At the end of July 1395 Mikołaj Bochner incurred debt of 221 marks of Prague groschen for half a year with another Kraków patrician Piotr Wingart.[885] In 1396 he was mentioned as *Dominus Nicolaus Bochner Supparius Salis et plumbi Theloneator et Monetarius*.[886] He remained a *supparius* of salt and lead (*Supparius salis et plumbi, Supparius, der Suppenig*) at least in 1399 and 1400.[887] In the years 1396–1399 he was also the owner of a half of the *advocatia* of Wieliczka.[888] Bearing in mind Bochner's importance, there is a high probability that the well *ex opposito zupparii* from 1397 was the same well mentioned in the following year as *fons ante Bochner*:[889] the only well on which in 1398 money from the town coffers was spent (the sum was very small: 23 scots, i.e. 46 groschen, including 10 scots for repairing the wheel). As follows from an analysis of mentions in echevin books, during the time in question Mikołaj Bochner owned three houses in the southern part of the east side of the Market Square, starting from the house on the corner of the Market Square and Szkolna Street.[890] Hence, the well "in front of Bochner" must have been located in the space within the Market Square between Szkolna and Grodzka Streets, most probably next to one of the three plots (*curiae*), looking from the direction of Szkolna Street.

The year 1399 was the last of four years of low expenditures on town wells: the total sum for that year amounted to 3.5 marks and 9 groschen (3 marks and 33 groschen) paid for a well "in front of Jurgowa Czeynowa's house in which Mr Langemichil lives" (*ad fontem ante domum Iurg czeyninne ubi habitat dominus langemichil*).[891] Therefore, the well stood undoubtedly next to the house belonging to the above-mentioned Anna Wierzynek-Czeyn in the Market Square, where her son-in-law, Michał Lang (Langmichil), lived. According to Franciszek Sikora's findings, Langmichil was the second husband of the Czeyns' daughter, Nawojka, *primo voto* Winkowa (wife of Winko/Wencko). On behalf of Nawojka, he was also

884 KsRachKraków II, 1878, p. 114. About him as a guardian of the children of his late brother Stanisław (Stano) Bochner cf. also: KsŁawKraków 1904, p. 152, no. 1300 and pp. 151–152 no. 1308 (year 1390).

885 KsRachKraków II, 1878, p. 130.

886 KsRachKraków II, 1878, p. 150.

887 KsRachKraków II, 1878, p. 192, 208 and 209.

888 Sikora 2004, pp. 206–207. About Mikołaj Bochner's fate in the early 15th century and about his bankruptcy – cf. Ptaśnik 1913, pp. 66–69.

889 ANK, rkps/MS 1589, p. 240; KsRachKraków II, 1878, pp. 320–321.

890 KsŁawKraków 1904, p. 298, no. 2275, 26 June 1396; no. 2408, 17 February 1397. Krasnowolski 2004, part I, p. 92.

891 ANK, rkps/MS 1589, p. 318.

the administrator of a quarter of the *advocatia* of Wieliczka, and in 1399 he became the owner of the other half of this *advocatia*.[892] Thanks to research conducted by the above-mentioned scholar, it is known that in 1410 Michał Lang lived in the house on the corner of Bracka (*Fratres Minores*) Street and the Market Square. This house was a legacy from his late wife.[893] Consequently, the well in question can be identified with the "well *Wenckonis*" located outside the Market Square and mentioned in town accounts from the year 1392, recognized as a well already existing at that time in Bracka Street. In that case, there would also be a consistency in the way this well was called: after the surnames of the owners of the houses and/or the people living in the houses situated in the immediate vicinity of wells.

In accounts pertaining to the year 1399, in a different place, among expenses made towards construction works at the Jewish Bath, 0.5 marks was recorded as payment for digging its well (out of 29 marks and 20 groschen spent at that time on these works).[894]

Small sums recorded at the end of the 14th century, allocated for public wells in Kraków, constituted probably only the cost of repairs of either the well shafts, or the casing, or the pieces of equipment of these reservoirs. However, in the years 1400–1403 a considerable increase in expenditures and greater investment in this domain can be observed despite the fact that construction works at the town pipe water supply were already under way at that time. Just like in the early 1390s, also at the beginning of the first decade of the 15th century new public wells were dug, which testifies to a growing need for water in the developing town.

In 1400[895] as much as 25 marks 9 scots (18 groschen) and 2 Vierchens (6 denarii, i.e. 1/3 groschen) were spent on *fontes in generali*; it was defined, however, that the expenses were connected with two wells: near the Franciscan Monastery and in Sławkowska Street: *fons apud Minores, fons in platea Slaucouiensi*. Further 25 marks and 1 groschen were spent on the well of the Rogacka baths.[896]

It follows from the entry *fontes Ciuitatis* from the year 1401[897] that the well in Sławkowska Street was a new well (*Nouus fons in plathea Slaucouiensi*). The expression *nouus fons* was used for another well whose location was also stated:

892 Sikora 2004, pp. 207–209. Earlier, in 1397, Langmichael was an echevin in Kraków (KsŁawKraków, 1904, p. 315, no. 2410), and from 1399 – a town councillor in this city (M. Starzyński, 2010, pp. 252–253).

893 Sikora 2004, p. 209.

894 ANK, rkps/MS 1589, p. 324: *super fossione fontis – ½ marc.*

895 ANK, rkps/MS 1590, p. 49 and KsRachKraków II, 1878, pp. 325 and 326.

896 ANK, rkps/MS 1590, p. 56 and KsRachKraków II, 1878, p. 325.

897 ANK, rkps/MS 1591, p. 61 and KsRachKraków II, 1878, pp. 328 and 329.

in Garncarska Street (*nouus fons in platea figulorum*). In an attempt to establish a more precise location of this reservoir, a much later mention is worth citing, namely one dating from 1476 from the Kraków echevin book, according to which a well stood at the junction of Garncarska and Wiślna Streets, next to the *Bursa pauperum* and to one of the corner houses in Wiślna Street.[898] Bearing this in mind, the mention from 1401 may have referred to the building of precisely this well. Due to the laconic character of the whole mention of the expenses recorded in that entry, only some of them can be ascribed to these two wells. Among these expenses large sums paid to a person called Eiko stand out. He was identified as a professional well-builder; we will return to him later. In 1401 the total sum of 27 marks and 21.5 scots (43 groschen) was divided between three other wells: *fons langmichil* (15 scots for a wheel), *fons plathee s. Floriani* (2 marks and 16 groschen for timber: poles – *pro asseribus*), *fons in fundo* (10 groschen for cleaning and repairs). The location of the first well was discussed above. As regards the other two, the exact location of the well in Floriańska Street was not established and the place in which the well *in fundo* stood remains unknown.

In 1402 21 marks 22 groschen and 9 denarii were assigned to six town wells:[899] *fons plathee Iudeorum, fons circa scolas, fons plathee lutifigulorum, fons Armknecht, fons carnificum, fons s. Stephani*. Ascribing five of them to streets, and some of them even to specific places in the Kraków public space does not present greater difficulties, since they had topographical designations; unfortunately, also this time the exact location of the new well (with a wheel) in Sławkowska Street was impossible to be established. As regards the *fons s. Stephani*, it can only be assumed that it was situated near St Stephen's Church. The "butchers' well" (*fons carnificum*) proved easier to locate. It was probably one of the wells earliest mentioned in the analysed sources. A record in Kraków echevin documents from 1371 provided us with the information about a corner brick dwelling house behind the meat stalls, opposite a well, in Rzeźnicza (Butchers') Street. The house was being given up by *providus Gosil,* citizen of the Moravian town of Opava[900] If he was the Hanusz Gossil in front

898 ANK, SC 8, p. 605: "Jacob Stresuch hot dy helfte des hawsis off der Weissilgassyn an der ecker bey den born kegin der bursa pauperum". This mention and several other mentions from unpublished Kraków echevin books, quoted further on in the present work, were found and later made available to the present author by Przemysław Tyszka, PhD, for which fact she would like to thank him. About the location of the Bursa Pauperum funded in 1409 by Jan Isner – cf. Włodarek 2000, p. 381 et seq.

899 KsRachKraków II, 1878, pp. 331–332; ANK, rkps/MS 1591, p. 159.

900 KsŁawKraków 1904, no. 571, p. 67 (7 June 1371): *providus Gosil de Opauie civis domum lapideam retro macella in acie in plathea Carnificum, ex oposito fontis, Johanni Swewo suisque heredibus hereditarie resignavit.*

of whose house in the Market Square (near the Bochners' house, namely probably on the side between Szkolna Street and the exit of Grodzka Street) a well stood in 1390 (cf. above), it can be assumed that he preferred having houses in close proximity to such water reservoirs. In echevin books the well near the meat stalls was mentioned also in 1394,[901] i.e. at the time coinciding with the dates of the analysed town accounts from the turn of the 14th and the 15th centuries, and in 1424, 1462 and 1471.[902] The fact that in town accounts from 1402 it was called the "butchers' well" and all the descriptions quoted above clearly indicate that it was mainly used by the representatives of this craft who lived and worked there. As regards the location of the sixth well, namely the one mentioned in town accounts of 1402 as being near the house of the patrician Georgius (Jerzy) Armknecht, the present author would point to św. Jan (St John's) Street: at least two houses in this street were the objects of transactions he entered into in the 1390s.[903]

In 1403 the overall sum paid for the *fontes civitatis* was 30 marks and 13 groschen. It embraced expenses made towards five specified wells, including wells which had not been found in earlier records: *fons ante Collegium* (0.5 mark for the diggers and probably also for that well: unknown sums for the sand and cleaning); *fons in valle* (0.5 mark for Gorner, probably a well-builder and, perhaps, 16 groschen for buckets); a well opposite All Saints' Church (*fons ex opposito Omnium Sanctorum* – 0.5 mark for a wheel), as well as those already known: the well near the School of the Virgin Mary (*fons ante scolas* – 0.5 mark for Gorner, probably a well-builder) and the (new) well in Garncarska Street (*fons in platea lutifigulorum* – a rope for that well was bought for a threescore of groschen!).[904] The well next to All Saints' Church will reappear in accounts pertaining to the year 1414.[905] The well *ante Collegium* can be located next to a large stone building on the corner or at the junction of Żydowska Street and a street later called Jagiellońska. This was the oldest building of the Jagiellonian

901 KsŁawKraków 1904, no. 2002, p. 261: *Nicolaus Belicz duo macella sua, unum versus fontem, secundum ab acie, aliud versus Scolares beate Virginis, secundum ab acie, tenens dorsum versus domum eiusdem Nicolai Belicz, Johanni Schultis de Crosna libere resignavit et promisit.*

902 ANK, SC 5, p. 107, year 1424 and mentions originally found by P. Tyszka, PhD: ANK, SC 8, p. 113 (year 1462) and op. cit., p. 451 (year 1471).

903 KsŁawKraków 1904, p. 166, no. 1386; p. 295, no. 2245; p. 296, no. 2258; p. 277, no. 2100.

904 ANK, rkps/MS 1592, p. 67: *Item ½ marc. pro rota fontis ex opposito omnium sanctorum.*

905 ANK, rkps/MS 1595, p. 55 (formerly p. 28).

University: the Collegium Maius, restored in 1400.[906] It was probably this well that appeared in 1433 in a record in echevin books as a landmark in relation to which the location of one of the houses-objects of transaction was defined: *domum suam sitam in atie, ex opposito Collegii, circa fontem*[907] Hence, in all likelihood it stood at the junction of the above-mentioned streets and was the same well as the one known from Hanna Zaremska's research, mentioned in 1392 at the occasion of describing the location of a property that was being purchased at that time by Piotr Gerhardsdorf from Anna Wierzynek-Czeyn: *in parva platea ex opposito fontis in platea Judeorum, eundo ad platea Sutorum, circa passum curiae Petri Girhardsdorff*.[908] However, it is hard to tell whether the well at the junction of Żydowska (Jewish) Street (now called św. Anny (St Anne's) Street) and the street later called Jagiellońska was the same well as the one mentioned in accounts from the year 1402 as *fons plathee Iudeorum*, because it is impossible to establish the exact location of the latter well. It might have been another well, standing in the same street, but closer to the town walls, near the oldest Kraków Jewish quarter, situated – according to H. Zaremska's studies – between the streets: Żydowska/św. Anny, a side street without a name (later called Jagiellońska), Garncarska (Potters') (Gołębia [Pigeons']) Street, and the town walls.[909] As regards the location of the *fontis in valle*, the second well mentioned in the accounts from 1403, we are left to guess: since most of the wells mentioned in town accounts were identified as situated in the centre of the town, the present author is inclined to locate the *fons in valle* at the edge between the middle terrace and the flood terrace; according to findings of Kraków researchers, the northern fortifications of the early-mediaeval Okół, including its ramparts, ran along this edge.[910] The well in question may have stood in Grodzka Street, to the north of Poselska Street.

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906 Extensively about the Collegium: Włodarek 2000, pp. 23 et seq. Loc. cit. about the purchase, precisely in 1403, of a house in Grodzka Street intended for Collegium Iuridicum. Had the well in question been situated next to the latter, this Collegium would bear an additional name – as newly built – in order to distinguish it from the existing Collegium (Maius).

907 ANK, SC 6, p. 69 (mention originally found by Przemysław Tyszka, PhD).

908 Zaremska 1999, p. 119 (quoted from: *Codex diplomaticus Studii Generalis Cracoviensis*, vol. I, Kraków 1879, no. VII) and p. 120.

909 Zaremska 1999, p. 117.

910 Rajman 2004, p. 38.

In 1404 expenses made towards unspecified public wells amounted to 6 marks and 18 groschen.[911] In 1405 15 marks 21 groschen and 11 denarii were paid for wells, only one of them being specified: the well in Wiślna Street.[912] It will later appear in accounts for the year 1414.[913] Owing to the lack of data, it is difficult to locate this well within the space of Wiślna Street and e.g. to identify it with one of the two wells known to have existed there, namely one at the exit of Wiślna Street into the Market Square (*ante Gothfridum*) or the other one at the junction of Garncarska and Wiślna Streets (which would be less probable, considering that in previous years this well was consistently called the (new) well in Garncarska Street). Moreover, it cannot be excluded that a third well stood closer to the Wiślna Gate. However, these doubts could only be removed by field studies.

Due to the change of the method of registering accounts from an "object-oriented" to a "chronological" system in the years 1407(8)–1410,[914] expenditures on wells were registered among other expenses made in a given week. Between 1408 and 1410 only four wells were specified (three of them were town wells), all of them mentioned before: one in Szeroka Street (*platea lata*; in 1408 and 1409 the total sum spent on that well amounted to 1 mark 38 groschen and 4 denarii, including 0.5 mark for its repair in spring),[915] one near the Dominican Church (*fons circa S. Trinitatem*),[916] the well at the Rogacka Baths,[917] and in 1410 the well near St Mary's Church school.[918] Other expenses made during these years in relation to unspecified wells (like in the years 1404–1405) apart from those made towards several above-mentioned ropes, included mainly payments for *faber* and for cleaning these wells.

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911 ANK, rkps/MS 1592, p. 157.

912 ANK, rkps/MS 1593, p. 69.

913 ANK, rkps/MS 1595, p. 55 (formerly p. 28) – *Item Miczkoni fossori de fonte in platea Visla iij scot. Sabbato vigilie Trinitatis.*

914 This was how S. Kutrzeba (1900a. p. 39) called them; he also noted that later the "object-oriented" system was back in use. But in the accounts from the year 1414 under the entry "fontes" a combination of both of these systems is visible.

915 ANK, rkps/MS 1594, pp. 35, 96 and 129.

916 Op. cit., p. 107.

917 Op. cit., pp. 151, 153, 156, 157 – expenses on major earthworks at that well done at the turn of October and November 1409. Also p. 161 (21 December 1409): *fabro pro fonte ad cornutos XV scot.*

918 Op. cit., p. 172 (22 February 1410): *pro reparacione fontis circa scolas S. Virginis iij fert.*

Thanks to the tabular presentation of Kraków expenditures drawn up by Stanisław Kutrzeba,[919] we can compare the town expenditures and the expenses made towards wells between 1390 and 1405 (S. Kutrzeba did not include expenditures from the years 1408–1410 in his list). During this period the following sums were paid from the town coffers for: 1) public dug wells – 170 marks 27 groschen and 8 denarii; 2) the well at the Rogacka Baths – 29 marks and 15 groschen; 3) the lepers' well – 1 mark and 18 groschen. The total sum only slightly exceeded 200 marks of Prague groschen (201 marks 12 groschen and 9 denarii). While comparing the expenses made towards wells in Kraków with the overall town expenditures in the years in question, we can note their being barely perceptible (from ca 0.05% to 1.4% yearly).

The prosopographic and socio-topographical analysis of the nearest neighbourhood of the wells leads us to more conclusions and observations of a different character. First of all, we can note that in Kraków public wells were found in front of the front houses standing within the space of the sides of the Market Square and of the streets. The same phenomenon was observed in Flemish towns, including Leuven/Louvain, but there such wells – although called "public" by authors of scientific publications – were in fact still "neighbours'" wells, as they were financed by the owners of the houses that stood in the immediate proximity of these water intakes. The situation in Kraków at the turn of the 14th and the 15th centuries seems to be equivalent to the one documented in sources from the second half of the 15th century for Brussels: at that time neighbours' wells in Brussels began to be managed and financed by the town, which accompanied its rapid development that occurred later than in Kraków.

The way in which town wells were referred to in Kraków account books from the turn of the 14th and the 15th centuries, namely as situated in front of the houses belonging to specific patricians and located in the parts of the town space that had a high or the highest value (the expressions used to describe these reservoirs were modified together with the change of the owners and/or the residents of the houses) not only underlined the importance of these reservoirs as the main public sources of water supply, but also indicated that the close proximity of a well increased the already high value of the property. It may have also survived as a reflection of the old system of neighbours' or even family and neighbours' wells whose traces we would like to find. The neighbours (or families) chose a place where the well was to stand, they organized its construction and later provided

919 Kutrzeba 1900a, table III: "Wykaz rozchodów Krakowa z lat 1390–1487 [A list of Kraków expenditures from the years 1390–1487]".

funds for its maintenance (e.g. the well or wells in front of the properties in the Market Square belonging to the Wierzynek-Czeyn-Lang family). This system dated back to the times after the town had been chartered with German law in 1257, when representatives of the oldest patrician families of Kraków began to set up their houses on the best plots marked out around the Market Square.[920] To put it another way, we can put forward a hypothesis that these wells – strong, solid constructions reaching deep strata of water suitable for drinking – as the main sources of water supply, may have been an inherent part of the programme of the organisation of space on each side of the Market Square, together with measuring the plots and developing them after 1257. Since the programme was created by the oldest settlers in the town chartered with German law who formed its first patriciate centred around the Market Square, it is not impossible that initially the wells belonged only to them as "the wealthiest". Such a situation was also found in Italian centres in the early Middle Ages. The patricians who lived around the Market Square in Kraków may have also established the so-called neighbours' wells-municipalities, known from some western European town communes. Like in many towns, also in Kraków digging wells at street junctions survived from the times of the neighbours' communities. This is clearly visible in the reconstruction of the location of these reservoirs and constitutes a repetition of the well-tried organisational models of neighbours' communities in towns (*viciniae*).

In the analysed town accounts from the turn of the 14th and the 15th centuries the above-mentioned way of describing wells was accompanied by a different method of referring to new public wells. They were defined (not in every case) according to the street in which they were dug. It can be observed that in this respect the communal organisational structure began to "cover" the former structures. In accounts from the 15th century the location of the well was stated very rarely; at the most the following elements were provided for identification: the name of the street or a near-by public building (e.g. a Church) treated as a landmark.[921] The patrician neighbours' wells-municipalities disappeared altogether. These changes, clearly visible in accounts for the year 1414, can also be associated with the declining role of public dug wells in Kraków municipal economy in relation to the growing importance of the developing town water supply network. The 16th century

920 In detail about, the earliest documented in sources, subsequent owners of houses in the Market Square from the turn of the 13th and 14th centuries until 1333 – cf. Rajman 2004, pp. 244–268.

921 Cf., inter alia, ANK, rkps/MS 1595, p. 55 (formerly p. 28) (year 1414): *Item ad fontem in ampla plathea VIII gr.…Item ad fontem ex opposito omnium Sanctorum 1 marc. xxi scot…Item Miczkoni fossori de fonte in plathea Wisla.*

witnessed the next stage of this process, namely the above-mentioned disappearance of the separate entry in town accounts entitled *fontes*.

The above-mentioned sum slightly exceeding 170 marks spent between 1390 and 1405 embraced at least 21–22 Kraków public wells (*fontes civitatis*). This was the minimum number of these reservoirs in the town, because this number referred only to the wells that were built or repaired in the period in question, which is why they were recorded in written sources. As a matter of fact, it can be close to the actual number of the Kraków wells, since in the course of this relatively long period most of them required at least some minor running repairs or supplementary equipment, and even such costs were recorded in the town accounts. Therefore, in the middle of the second decade of the 15th century, apart from the functioning water supply system, except for private wells on plots, besides wells at the Rogacka and the Żydowska baths, and aside from the lepers' well, there may have been at least 25 town dug wells. Referring to the information cited above, we can note that Kraków ranked between Strasbourg and Nuremberg in terms of the number of public wells in relation to the estimated number of inhabitants and the level of difficulty in reaching the water-bearing stratum. This would also confirm the assumption made in the present studies that Kraków belonged to the "second situation". As far as the number of public wells in Kraków in the second half of the 15th century is concerned, the lack of written sources similar to the ones from the turn of the 14th and the 15th centuries does not allow of establishing the overall, even estimated, number of such reservoirs and whether it diminished together with the development of the water supply system and (at least from the beginning of the 1440s) with building private connections to this network. It can be only stated that the minimum number of *fontes* equalled twelve, because it follows from Kraków accounts dating from 1487 that in that year ropes were bought for this number of such reservoirs.[922] It is not certain, however, whether these reservoirs were dug wells or already (or perhaps also) water storage reservoirs connected to the water supply system open to the public, unless the latter did not require ropes for drawing water.

A precise documentation of the above-mentioned Kraków public dug wells and marking them on the town map, done on the basis of both the existing and the planned archaeological studies, the latter including searching for the water reservoirs presented above,[923] would constitute an indispensable supplement and

922 ANK, rkps/MS 1597, p. 21: *Item xx gr. vor iiij borne zu leyne Item 40 gr. vor viij borne czu leyne*.

923 Marking dug wells localized by the present author on the town plan revealed e.g. an almost absolute absence of mentions of such wells in the area of the Streets: Szpitalna

a verification of the presented attempt to localise Kraków public dug wells confirmed in written sources and to estimate their number.

If we attempt to estimate the number of wells in small towns of the Crown of the Kingdom of Poland through an analysis of expenses recorded in town accounts of some of the centres, we can note that they referred to a few wells at the most (like in other small European towns). As examples of such centres we can cite Little Poland's town of Lelów and Środa in Greater Poland. In the former town in 1482 one of the wells stood *ex opposito advocati*,[924] i.e. in front of the house of the *advocatus*, which must have been an important place in the town space (even if it was only an court *advocatus* who presided over town echevins). The location of another well recorded in 1510 was typical: in the Market Square.[925] The third well was situated in front of Mr Lukan's house (*versus dominum Lucanj*).[926] One of them might have been (but did not have to be) the same well as the one mentioned in 1493 as being "done anew".[927] In 1512 materials were gathered for "wells which were to be constructed".[928] A close analysis of four agreements with contractors (cf. further in the present part) drawn up in the second decade of the 16th century revealed that the works that were done at that time consisted in repairing 4 wells, one of them standing to the south of the Town Hall, another one in Krakowska Street. As to Środa in Greater Poland, in the mid-16th century there were at least 3 public wells: one in the Market Square,[929] the above-mentioned well called Walkmyn,[930] which was located in the vicinity of the so-called Swine Market, in close proximity to a large group of private malthouses owned by the

(Hospital), św. Tomasza (St Thomas'), św. Marka (St. Mark's) and św. Krzyża (Holy Cross), which fact Professor Hanna Zaremska pointed out during a discussion on the present chapter. This state of affairs might have resulted from the fact that as early as at the end of the 13th century the *curia* of the abbot of Mogiła was situated in this area. It consisted of a stone/brick manor house, outbuildings and a garden. To the north from this *curia* were the houses of the abbess from Staniątki and of the abbots from Koprzywnica – cf. Komorowski/Krasnowolski 2009, p. 340.

924 ANK, IT 230c, pp. 6–7.

925 Op. cit., p. 294.

926 Op. cit., p. 330.

927 Op. cit., p. 90.

928 Op. cit., p. 327.

929 APP, Środa, I/73, p. 64v., year 1552; a huge stall was built next to it (*penes puteum magna constructa est penestica*) – p. 160v.

930 Loc. cit. et seq.; APP, Środa, I/30, p. 202v., year 1532: *penes fontem civilem dictum Walkmyn*.

local burghers, and a third well next to the baths.[931] It was probably from the latter well that a gutter with water was conducted to the baths.[932]

III.2.3 Dug wells as mikvehs

Dug wells, presented in the previous part of the present chapter, with their basic division into private, neighbours' and public wells, are obviously not the only type of such water reservoirs reaching the town's subsurface water-bearing strata. Jewish water reservoirs should not be overlooked. A Jewish well (*puteum Judeorum*) in Płock dating from the 13th century was the earliest-mentioned Jewish well in the Polish lands. Situated near the Dominican Monastery, it constituted an important point in the town's topography, considering the fact that the Bishop Piotr in a document of 1237 listed it as one of the elements marking out the northern border of the area included in the privilege. Therefore, it was treated in the same way as a well near the collegiate Church (*puteum Wyslaue ecclesie*) which was mentioned as another landmark.[933] Owing to the laconic character of the written source it is difficult to establish whether the *puteum Judeorum* in Płock was a well or a mikveh, namely a water reservoir used by this community for ritual immersion. In the year 1453 in Wrocław the "baden Borne" was mentioned also as a landmark in the town's Jewish district.[934] This record revealed that it was a mikveh, a reservoir dug to the water-bearing stratum, an equivalent of a *fons*: a well. This was the word (*fons*) used to describe a 15th-century mikveh in Poznań. However, this can be established only on the basis of the content of the mention which includes a detailed description of the construction of this reservoir. The mention in question was a contract to build this reservoir, preserved in 15th-century court books of Poznań, a town with a strong Jewish community.[935] On 7 March 1464[936] the representatives

931 Środa, I/73, p. 65, year 1552: *a purgacione aquę in puteo circa balneum 9 gr.*

932 Środa, I/73, p. 47.

933 ZbPłock, I, 1987, no. 9, pp. 14–17, loc. cit. literature concerning this document. The collegiate Church was funded by Dobiechna, the wife of the knight Wojsław from the renowned Powała family– Żebrowski 1973, pp. 82–83 and idem 1994, pp. 156–158.

934 The present author owes this piece of information to Professor Mateusz Goliński, who found it in: APWr., Akta m. Wrocławia, E 10, 1, p. 120, where the place of abode of one Jewish woman was described as follows: "bey deme baden borne yn der Juden gassen". The present author extends her heartfelt thanks to Professor M. Goliński.

935 More about the Jewish community in Poznań – recently: Rudzińska 2005 and Zaremska 2011, p. 244–245.

936 ARadzPozn., I, 1925, no. 1002, pp. 368–369. The contract also mentioned by Rudzińska 2005, p. 358 and Zaremska 2011, p. 378.

of that community appeared before the Poznań city council and stated that on that day Jakub the bricklayer (*providus Jacobus murasz*) entered into a contract with them to build a well (*fons*) in the way and in the form described below. This was to be a round stone and brick construction of a total height of 8 ells. The clients decided that the overground part would measure 2 ells, with the entrance, as was the custom, and the well wall itself was to be 2.5 bricks thick from top to bottom. The walls of the structure were to be lined from the inside with round steps going down from the entrance to the depth of 2 ells, with supports (*sustentatorium alias poryacze*) measuring 1.5 bricks. Below, still inside the large round wall, Jakub the bricklayer was to dig a round well of an equal depth of 4 ells in every place. The water was to flow from underground veins (literally: from rivulets – *de riwlis*) that would burst when the well was being dug. The well was to be deepened so that the water reached the depth of 4 ells. The stretch of the wall that was under water should be built of stones and its width should be equal to the width of 3 bricks. This underwater part should also be lined with steps leading down to the bottom of the structure. This underwater part of the well should be restored by being plastered with lime (*reparare seu dealbare cum cretha alias tyncowacz*).

Therefore, it was undoubtedly a mikveh, which statement can be confirmed by comparing the above description with an archaeologically documented construction of the oldest mediaeval mikveh built in Speyer in 1126[937] (fig. 42) which was a model for other mikvehs. The Speyer mikveh was also supplied by fresh groundwater.

Fig. 42: Speyer on the Rhine. The interior of a mikveh built in 1126, with water from the water-bearing stratum. Photograph: A. Janeczek.

937 Speyer, Judenhof: Mikwe. Web; cf. also Stein, Günter, Judenhof und Judenbad in Speyer am Rhein. (Grosse Baudenkmäler Heft 238), München, Berlin: Dt. Kunstverlag, 1977 (non vidi).

The example of the Poznań mikveh indicates that what is worth noting is the Biblical understanding of the identity between such a dug well and a source of "living water", namely flowing from underground streams: water veins, indispensable for the functioning of this kind of a ritual ablution reservoir. On the basis of the precisely defined depth (in ells) of the whole structure it can be assumed that the Poznań Jewish clients must have known beforehand that the "living water" would be located at a very shallow depth below the ground level (starting from 2 ells, i.e. ca 1.16 meters), although they did not exclude the possibility of deepening the well so that the depth of the water would never be less than 4 ells, i.e. ca 2.32 meters.[938] Thus, the following question arises: Was their knowledge derived from the fact that in the same place a mikveh had existed before and the contract involved merely its general reconstruction, or was their expertness a result of prior work done by dowsers?

As far as the terms of the contract entered into in Poznań in 1464 are concerned, it was worth 40 marks paid in denarii, but the clients made a stipulation that Jakub the builder (*edificator*) should supply the necessary materials, including bricks, stones and lime, whereas they undertook to deliver as much timber with poles as was needed. The agreed sum of money was deposited with Paweł the goldsmith in the Market Square; Jakub was to receive the money from Paweł in four instalments of 10 marks each on the dates indicated by the Jews, the first 10 marks were to be paid when Jakub began the works. Paweł the goldsmith vouched for Jakub, and as a consequence, in case the latter failed to finish his job within two weeks (he was not allowed to work on Jewish holidays, though), it was Paweł who should cover the cost of finishing the construction. Since the Jewish clients chose Paweł as the one who would vouch for Jakub the bricklayer, the goldsmith must have enjoyed their confidence which in turn must have resulted from their common business activities. The unnamed clients, i.e. the ones who commissioned the construction of the Poznań mikveh, were undoubtedly the elders of the Jewish community. They may have been Kofman and Boos, who performed this role at the end of June 1462.[939] Even earlier, on 18 January 1460, before the Poznań court of the town councillors, during one common hearing the course of action concerning the following issues was decided: vouching for somebody and repaying debts by Nuremberg merchants

938 This is consistent with A. Kaniecki's findings that in Poznań, situated in the second terrace of the River Warta, underground water was relatively shallow, i.e. from 2 to 5 meters deep – Kaniecki 2004, p. 585.

939 ARadzPozn., I, 1925, no. 941, p. 343.

to their creditors: Paweł the goldsmith and Kofman.[940] According to another mention in Poznań town councillors' books, at that time Paweł the goldsmith lived in the vicinity of the Poznań Jewish quarter in Żydowska Street,[941] and therefore also near the planned mikveh. Paweł's house in the Market Square stood at the exit of Żydowska Street, opposite a brick dwelling house owned by an unnamed member of the patrician Czewchner/Czeuchner family.[942] Nothing is known of any setbacks in the two-week construction works at the Poznań mikveh in the early spring of 1464. It had been probably in use when six months later, on 8 September 1464, a fire broke out in Poznań and Jews were blamed for starting it. The following description was found in the diocesan documents: "many Jews of both sexes were killed, others, willing to protect their children, hid with them in houses and cellars of Christian houses, risking being exposed to the flames; a few Jewish children were baptised, the remaining Jews were imprisoned and after several days banished from the town."[943] Neither the punishment in the form of losing the king's favour that was imposed on the burghers for the killing of Jews and sending them into exile, nor the banishment of the Jews lasted long. The former was abolished on 15 November 1465,[944] whereas at the end of 1466 Kofman was recorded again in the town councillors' books as a creditor of one Poznań female burgher.[945]

III.2.4 Well-builders

The presence of a Christian bricklayer at the building site of the Poznań mikveh turns our attention to the builders of all of the kinds of dug wells discussed above that reached the water-bearing strata. However, written sources not always provide us with information concerning these people, and if they do, it is mostly laconic.

940 ARadzPozn., I, 1925, no. 853, pp. 307–308. Only in the case of Kofman it is known that the debt was repaid with usury (16.5 times threescore of groschen borrowed, 17.5 – repaid). Earlier, Kofman performed the role of a creditor of the above-mentioned Nuremberg merchants; they put their goods in pledge with him, which he transferred to another Poznań burgher, Andrzej Fischer, for him to sell. Fischer began to repay Kofman starting from 4 marks – ARadzPozn., I, 1925, no. 845, pp. 305–306 (5 December 1459).

941 Wiesiołowski 1982, pp. 181–182.

942 ARadzPozn., I, 1925, no. 899, pp. 325–326. Cf. also Wiesiołowski J., 1982, pp. 148–149 (Czeuchner family).

943 AcCap. II, 1902, no. 1304, p. 587.

944 Rudzińska 2005, p. 360.

945 465 ARadzPozn., I, 1925, no. 1077, pp. 405–406, year 1466.

The above-mentioned contracts from Paris, Palermo, the Teutonic town of Bytów, or from Poznań, and also comparative studies concerning e.g. Bohemian towns[946] reveal that the authors of the brick, stone and lime constructions (namely wells) were bricklayers or masons (bricklayers-masons), i.e. craftsmen who also built other constructions. Notwithstanding, Wacław, the builder of a well in Kłodzko, who hollowed out the rock with great diligence, was called by the chronicler admiring his effort simply a digger: *fossor*. The same term was also used in the earliest Kraków accounts analysed above to refer to people who carried out works at various wells in that town, wells that were undoubtedly dug in a different ground than the one in Góra Zamkowa (Castle Hill) in Kłodzko. Nevertheless, in Kraków, in the same accounts, alongside *fossor*[947] also a more precise term was used: *fossor fontis*,[948] perhaps equivalent with the first one, but the latter left no doubt as to the existence of a separate task, namely building well shafts and later their maintenance, including cleaning.[949] The same accounts from Kraków provide us with the information that a *fossor fontium* also dealt with cleaning cesspits: for cleaning an undefined cesspit in 1409 a half of a mark, a considerable sum for such work, was paid from the town coffers to a well-digger.[950]

In Kraków town accounts from the turn of the 14th and 15th centuries the names of well-diggers were generally not stated. An exception was made for three of

946 Cf. Hoffmann F., 1992, p. 92.

947 The earliest this term was used in Kraków accounts was in 1390: it referred to the people working at "the new well" – ANK, rkps/MS 1587, p. 57: *Super nouo fonte – – Item 1 sexagenam fossoribus. Item 1 marc. eisdem.* Cf also: ANK, rkps/MS 1588, p. 60, year 1392: *Item pro fonte apud beatam Virginem – – pro eodem fonte fossori X gr. – –*; ANK, rkps/MS 1589, p. 318, year 1399, rkps/MS 1590, p. 49, year 1400; ANK, rkps/MS 1595, p. 55 (formerly 28), year 1414: *fossori de fonte in plathea Wisla*.

948 The earliest this term was used in Kraków accounts was in 1392: it referred to the people who worked at the construction of the *domus circa hospitale pro Curia potabilium Bisschroter* – ANK, rkps/MS 1588, p. 85: *Item fossori fontis ½ marc. – – Item fossori fontis iij fert. Item pro lignis quercinis 1 sexagena Item pro statua fontis X gr.*; Cf also ANK, rkps/MS 1589, p. 318, year 1399; ANK, rkps/MS 1592, p. 67, year 1403: *Super fonte ante scolas primis Gorner ½ marc. Item fossor fontis 1 ½ marc.*; ANK, rkps/MS 1594, p. 100, year 1409: *fossori fontium XIII scot.* and p. 102, year 1409: *fossori fontium VI gr.*

949 In 1404 a *fossor fontis* received his payment for cleaning a well – ANK, rkps/MS 1592, p. 157. In 1408 a *fossor seu mundator fontium* received 8 groschen – ANK, rkps/MS 1594, p. 48.

950 ANK, rkps/MS 1594, p. 123: *fossori foncium de purgacione cloace ½ marc.*

them: the well-digger called Gorner, who received payment several times,[951] Miczko in 1407and 1414,[952] and most of all a certain Eyko (Eiko/Eike), but only in the year 1401. It was then that in accounts pertaining to five town wells (the new well in Sławkowska Street, the well *langmichil*, the well in Floriańska Street, the well *in fundo* and the new well in Garncarska Street) only Eyko was referred to by name, as many as 16 times, when various sums were paid to him in the total amount of 9 marks without 2 groschen.[953] The sum of 0.5 mark (i.e. 24 groschen) was repeated 7 times, 1 ferto (i.e. 12 groschen) was paid once, 3 fertones were paid twice, including once for cleaning the wells (*de purgacione foncium*). At one occasion he was paid 3 florins, and on another threescore of groschen. He probably worked (on the strength of a yearly hire contract) at each of the five wells mentioned in the accounts, although the way of recording the money paid to him leaves too much doubt and thus prevents us from ascribing the sums to specific reservoirs. What can be stated with certainty, however, is that expenses made towards three of the wells, including two new ones: in Sławkowska and Garncarska Streets, and perhaps also the *langmichil* well, began with paying Eyko 0.5 mark in each of the cases. It can be supposed that he received the largest sums for his work at the new wells, including the above-mentioned notable 3 florins (even if they were paid in denarii) for the well in Sławkowska Street and the threescore of groschen for the one in Garncarska Street. In expenditures connected with wells in 1402 Eyko was not mentioned, however, besides an unnamed *fossor fontis* also an unnamed *magister* appeared, the latter being remunerated four times in a way closely resembling Eyko's income from the previous year (– – *VIII gr fossori fontis et ij gr. primo magistro super fonte St. Sthephani fecit 1 fert.* – – *magistro ½ marc.* – – *Item magistro 1 marc.* – – *iij fert. magistro* – –).[954] Possibly, Eyko and *magister* may have been the same person: hired temporarily, a "master" well-digger perhaps from another town,[955] better skilled than *fossores fontium*. This in turn would testify to a solid character of the construction of 14th-century Kraków wells.

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951 ANK, MS 1592, p. 67, year 1403: *super fonte in valle primo Gorner ½ marc.* – –, *super fonte ante scolas primis Gorner ½ marc.* – – *Item fossori fontis 1 ½ marc.* – – *Item gorner IX scot.* – – and p. 157, year 1404 – the only mention in which he was called a digger*: Item fossori gorner 1 ferto*.

952 ANK, MS 1594, p. 30: *Item Miczkoni fossori fontium VI gr.*, rkps/MS 1595, p. 55 and 218.

953 ANK, rkps/MS 1591, p. 61.

954 ANK, rkps/MS 1591, p. 159.

955 Earlier this term was used in the entry *fontes* in expenditures for the year 1390 – ANK, rkps/MS 1587, p. 54. The use of the word *magister* in reference to a well-builder

The specialisation and also the professionalization of the job of a well-builder can be evidenced by the terms used in written sources derived from the words describing wells, for instance, the above-mentioned *providus Johannes alias Hanus de Lubowla fontanus*, noted in town books of Sandomierz. While searching for such terms in written sources from other town, we can note that e.g. in the register of the expenditures of the City Council in Lelów for the years 1482–1538, in 1493 a *fontanus* was recorded who was paid 1 ferto (12 groschen) for repairing a well.[956] Since he was not referred to by name, it cannot be established whether he was the *Johannes fontanus* who was mentioned several pages further (in the same year, but still without the exact date) as the one who entered into a contract with the town councillors to build a new well for 5 marks and who was assigned two helpers for a week[957] (the time needed to build a well with the casing and necessary equipment or only to dig the well shaft?). The same mention is also a list of sums paid to him in 1493 in 12 uneven instalments calculated in groschen, fertones, scots and marks, amounting to 3 marks and 28 groschen in total. It cannot be established whether *Johannes*/Jan carried out the contract and if he did, whether he was paid the whole sum he was supposed to receive, since his name never appeared again in the register of the expenditures of the City Council. In the following year, a new council, settling the debts of the previous council, paid 1 wide groschen to "a man who helped the well-builder at the well"[958] and 4 marks to an unnamed well-builder (*pro fontano*). The latter sum was taken by his intermediary who at the same time was his creditor, who took for himself also the additional 14 groschen owed to the

was also found e.g. in building accounts of St Adalbert's Monastery in Wrocław in 1501 – cf. RachDomWroc., 1858, p. 309: *Item eadem die 1 m. magistro qui facit fontem in orto – Item laboratoribus circa fontem. – Item in vigilia annunciacionis 1 m. magistro qui fontem facit*. The present author extends her heartfelt thanks to Fr Jan A. Spież OP for making the text of the above-mentioned accounts available to her.

956 ANK, IT 230c, p. 87: *Item fontano a reformatione fontis in meliorationem dedimus fertonem*. However, no mentions exist of hiring a bricklayer who worked at that time at repairing a canal to work at the wells in Lelów – loc. cit.

957 ANK, IT 230c, p. 90: "*Regestrum fontanj. Johannem fontanum convenimus pro factionem fontis ex novo pro quinque marcarum et duobus hominibus pro adiutorio dumtaxat pro una septimana sibi concededimus". Item eidem iiij gr. dedimus/ Item eidem marcam dedimus/ Item eidem dedimus fertonem/ Item eidem dedimus xiiij scotorum/Item eidem dedimus fertonem/ Item eidem dedimus ij gr./Item eidem dedimus iiij gr./ Item eidem dedimus xiiij gr./ Item eidem fertonem dedimus/ Item eidem fertonem dedimus/ Item eidem fertonem dedimus/ Item eidem fertonem dedimus.*

958 Op. cit., p. 101: *Item dedimus latum grossum homini qui adiuuabat penes fontem fontano.*

well-builder and paid by the town councillors.[959] However, there is no certainty as to whether the case concerned *Johannes* the well-builder, since the total sum paid (7 marks and 42 groschen) was higher than the one stipulated in the contract to build the well. Yet, it might have referred to some other unregistered services performed by (*Johannes*?) the well-builder. Anyway, in short, in 1494 the town council of Lelów settled the outstanding balance with a well-builder who was absent from the town; consequently, he may have been a non-resident professional, only hired to perform this specific service which consisted in building the well. Owing to difficulties with the identification and a paucity of information concerning the people involved we can only wonder whether it was the very *Johannes fontanus*, residing in 1493 in Lelów, who in 1504 was recorded in Sandomierz as a professional from Stará Ľubovňa in the Spiš region.

In accounts from Lelów dating from the turn of the 15th and 16th centuries information about four other contracts for building public wells with various persons was preserved. Each of these contracts pertained to one such well; two of them were entered into in 1514, and the other two in 1518. The first contract from 1514 (without the exact date, but certainly from the beginning of that year)[960] can be associated with works carried out at the Town Hall between 1513 and 1514,[961] because the contract concerned a well near the Town Hall, on its southern side. The works did not consist in digging a new well, but in a complete renovation of an old one. Hence, it was most probably the well in the Market Square, recorded in Lelów written sources in 1510,[962] mentioned above in the present part. Maciej Głowa, who had earlier repaired wells in Lelów,[963] and Paweł Parzymięso were hired to perform this work for 3 marks and 6 groschen. The payment was made in instalments (however, the exact dates were not recorded), i.e. in the same way as was done in the years 1493/1494. The town councillors paid for oak timber twice: 13 scots and 2 groschen, which amounted to 28 groschen in total. They also paid 6 groschen to the workers who cut down the oak trees (*Item domini dederunt sex gross. laborantibus qui incidebant robora quercum scilicet non his laborantibus fontis cum ad eorum pecuniae seu eorum laborem non spectant*). Głowa and Parzymięso, the ones who performed the service itself, received in turn: half of a threescore

959 Op. cit., pp. 102 and 103. Also p. 108 (year 1494) – in which mention it was recorded that an unknown well-builder was paid additional 5 groschen, also through another person.

960 Op. cit., p. 329.

961 Op. cit., p. 327.

962 Op. cit., p. 294.

963 Op. cit., p. 211, year 1505: *a reformacione foncium Glowa dedimus mediam sexagenam.*

(30 groschen) and 4 times 1 ferto, i.e. 12 groschen, which amounted to a total sum of 78 groschen out of the 150 groschen stipulated in the contract. The way in which the subsequent instalments were paid is difficult to establish, since there was confusion in the town accounts that resulted from the election of a new town council and from the fact that the new council settled the old council's payments, which is testified in the subsequent pages of the register. The mention following the one including the contract, entitled *Exposita per dominos consules Anno domini 1514 ad laborem fontis circa pretorium Nouos*,[964] refers to 4 expenses: 2 groschen paid to Paweł (Parzymięso – identified by U.S.) and to Piotr Łysy for works underneath the chamber (of the Town Hall), 8 denarii for a rope for a well, a half of a mark (out of a total sum of 1 mark and 6 groschen) paid to a well-builder called Ołomuniec (*Olomunÿecz*), and a half of a mark given by the newly-elected town councillors to Paweł Parzymięso and Piotr Łysy for an unspecified purpose. Almost the entire record (apart from the last expense) is strongly crossed out, and the first and the third expenses are repeated later in an organised manner: the first one in the register of the expenditures for the year 1514, and the third one in the second contract dating from 1514 for the construction of a well in Krakowska Street. Only in the accounts of the town council for the year 1515 there is a mention of Paweł Parzymięso being paid a half of a mark *super constructionem fontis siue putei*, which amounted to the council settling the outstanding balance with him.[965]

It was with *Nicolaus Olomunÿecz de wszeborczÿcze* (originally from Olomouc in Moravia? – in Polish: Ołomuniec) that the town councillors from Lelów on 28 April 1514 entered into a contract *pro constructione putej in platea Cracoviensi*.[966] The sum stipulated in the contract was the same as in the agreement with Głowa and Parzymięso for the renovation of an old well in the Market Square, namely 3 marks and 6 groschen. Thus, it cannot be excluded that both of the contracts (in which words with synonymous meaning were used: *edificatio* and *constructio*) concerned the renovation of existing well shafts. Both of them were located in the oldest and most important places of Lelów, a town chartered with German law: one in the Market Square, the other one in Krakowska Street, i.e. in an artery running south from the corner of the Market Square, forming part of a route between Greater Poland and Little Poland along which the chartered town was established and developed. Considering that the renovated well near the Town Hall was on the same side of the Market Square as the exit of Krakowska Street, both of these

964 Op. cit., p. 330.
965 Op. cit., p. 351.
966 Op. cit., p. 332.

wells must have been situated close to one another. This and the identical sums stipulated in the contracts suggest that the construction of both of these wells was the same which may have resulted from their equal or very similar depth (reaching the same water-bearing stratum) and consequently that their construction and renovation were of a comparable level of difficulty (in the latter case their different technical condition must be taken into account).

Within the scope of the second contract dating from 1514 Nicolaus/Mikołaj Ołomuniec first received 6 groschen, and later twice 1 ferto. Subsequently, the new town council paid him a half of a mark, noting that he had received 1 mark and 6 groschen in total (the way this expense was recorded made it possible to interpret the earlier crossed-out mention). Still without stating the exact dates, the council paid Mikołaj a threescore (i.e. 60) of groschen, 6 groschen and 2 groschen, which amounted to 122 groschen out of the 150 stipulated in the contract. It was recorded in the register of the expenditures for the year 1514[967] that the town councillors met all the payments connected with the construction of the well, however, without mentioning the amount of money paid (28 groschen?)

Two contracts with Stanisław *fontarius [sic] ad laborandum* two wells in turn were preserved from the year 1518. The first one[968] was entered into on Friday after the octave of Corpus Christi (11 June) in 1518 with Stanisł aw of Pilcza to "develop" a well "behind Czyrzyna's house" for 3 marks and 1 ferto (156 groschen), out of which sum Stanisław had already received 6 groschen as a down payment. The subsequent instalments were paid in the following order: 10 groschen for the well-builder's individual needs at work – on Saturday before the Feast of John the Baptist (19 June); 13 scots (26 groschen) for works at the well (*pro labore fontis*) – on Tuesday, on the Feast of Saints Peter and Paul (29 June) and on the same day additional 6 groschen; 1 mark (48 groschen) for his work on Sunday before the Feast of St Margaret (4 July); a certain Mr Wilkowski Zÿska received 3 fertones at an unspecified time for oak timber for this well; a half of a mark without 2 groschen was paid to Stanisław the well-builder on the day of the Feast of St Margaret (10 July); finally, he received 3 fertones and 2 groschen on Wednesday on the eve of the Feast of St Mary Magdalene (21 July), which constituted the last instalment for his work as a well-builder at this well. At the end of the same year (on Wednesday after the Feast of St Thomas, i.e. on 22 December) the town council of Lelów hired Stanisław the well-builder *ad laborandum* another well, this time unspecified, for a remuneration of 1.5 marks

967 Op. cit., p. 333, year 1515.
968 Op. cit., p. 365.

(*salarium*).[969] He was paid 18 groschen immediately. The three remaining instalments were paid as late as in the middle of February 1519: on Saturday before the Feast of St Valentine Day (13 February) Stanisław received as *salarium* also 18 groschen, later 5 groschen, and on Wednesday after St Valentine's Day (17 February) he was given 12 groschen. The mention including the contract itself and the payments reveals that Stanisław was not paid 1.5 marks (i.e. 72 groschen), but 53 groschen. Another mention from the same year of an unnamed *fontanus* repairing a well might have also referred to Stanisław.[970]

Several conclusions can be drawn from the analysis of the five above-mentioned contracts (preserved in an exceptionally large number in comparison with other small towns) pertaining to public wells in Lelów. First, the remuneration of the workers under as many as three out of five contracts was identical or almost identical: in two cases it was 3 marks and 6 groschen, and in one case – 3 marks and 1 ferto. Considering the fact that in one of the contracts the service consisted in a complete renovation of an old well, and that the contract from 1493 mentioned a higher sum of 5 marks as payment for a well-builder for "making a well from the start", it can be supposed that the four remaining contracts pertained to the renovation of existing public wells. However, since certainly in three out of the above-mentioned four cases the town council hired well-builders, the constructions undergoing renovation must have been the well shafts, especially that expenses made towards devices for drawing water used above the ground were recorded separately, never in the form of contracts, but as individual mentions, like the one from 1498 according to which 7 groschen were paid to Jan the carpenter "for the pole at the well" (*a statua ad fontem*).[971]

Another conclusion is that works consisting in building a well shaft (like in 1493) or renovating existing shafts (like in 1514 and 1518) were not expensive in Lelów in comparison with wells dug elsewhere in high escarpments of different geological composition or in rock elevations. If we collate this conclusion and the above-mentioned pieces of information from Lelów written sources about well cranes we can assume that the depth of wells in this town at the turn of the 15th and 16th centuries did not exceed 6 meters. However, in order to confirm this and to find the public wells mentioned in Lelów written sources, conducting

969 Op. cit., p. 366.
970 Op. cit., p. 432 (year 1519): *fontario qui fontem reparat*.
971 ANK, IT 230c, p. 120, year 1498.

archaeological research seems necessary (excavations from the year 2006 failed to reveal any traces of the Town Hall[972]).

Despite the fact that digging wells in Lelów was not a difficult task, only one contract was entered into with local craftsmen, most probably with carpenters, judging from other commissions performed by Parzymięso (this in turn indicates that the construction of the well shaft was wooden). Professional well-builders, referred to as *fontani/fontarii*, came from outside the town and probably stayed there only temporarily, until they finished the works stipulated in the contract and commissioned by the town councillors. Other numerous mentions recording small and mostly indefinite running repairs *circa (apud) fontes* (apart from the expenses made towards ropes and buckets for wells described above) either failed to state the name the workers or stated their names and/or surnames, but without specifying their profession,[973] which was a different practice than the one used in the case of *fontani/fontarii*. Therefore, written sources from Lelów indicate that no professional well-builders digging well shafts resided permanently in this little town.

The interchangeable use of the words *fons* and *puteum* for dug wells in written sources from Polish towns resulted in calling their builders not only *fontanus* or *fontarius*, but also *putearius*. In *Słownik łaciny średniowiecznej w Polsce* [Dictionary of Mediaeval Latin in Poland] there is no such word as *fontarius*, whereas *fontanus* and *putearius* are used with a different meaning. The former was translated as: "of or from a spring, concerning a spring (*qui ad fontem pertinet*)" or: "living near a source (*qui ad fontem habitat*)" and "inexhaustible, perpetually flowing (*inexhaustus, perpetue fluens*)".[974] *Putearius* was translated as: "ditch, trench (*canalis arte factus, "przekopa studzyenna",* i.e. well trench)".[975] In the dictionary in question two equivalent source terms were given for a well-digger (in Polish: *studniarz*): *fontanista* and *fontifex*; nevertheless, the examples quoted from written

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972 Piece of information received from Mr Henryk Nowak, the secretary of the Lelów commune, and from Mr Zbigniew Bryła, member of the Lelów Historical and Cultural Society on 20 September 2007, for which the present author expresses her sincere thanks. Mr Z. Bryła also supplied the present author with the item of information that according to contemporary research, the water-bearing stratum in the Lelów escarpment is found at the depth of ca 7–8 meters.

973 E.g. ANK, IT 230c, p. 107: *dedimus Mathiam Laschek a suo labore 2 gr. aput fontem*; loc. cit: *2 gr. Chaschorek pro labore circa fontem;* op. cit., p. 141: *Albo Joanni II gr. a labore circa fontem als defanamus sibi super exactionem.*

974 SłŁacŚr., vol. IV, 1975–1977, column 288.

975 SłŁacŚr., vol. VII, no. 10 (61), 2000, column 1571.

sources were inapplicable. The first example referred to paying a *fontanista* for digging a sewage pit (*fontanistae a fossione latrinae… marcas 2*[976]); the other one certainly referred to repairing a chest of a water (storage) reservoir connected to a network of subsurface conduits open to the public; the repair was to be carried out by Michael fontifex (*Michael fontifex de Cracouia reparabit cistam… in fonte*).[977] The first example testifies to additional (but related) professional activities of a well-digger (considering the structural similarity between sewage pits and wells; both of them required periodical cleaning[978]); whereas the situation is different than stated in the dictionary in question when it comes to defining a well-digger as *fontifex*. The example referred to the renovation of an element of the water supply system, a task usually performed not by a well-digger, but by a master fountain-builder (the latter profession will be elaborated on further).The words *fontanus/ fontarius* indicate that such a person must have dealt with a natural spring, and dug wells were perceived as such springs, as was mentioned above. The word *fontifex,* derived from the words *fons* and *facere* (as stated in the above-mentioned dictionary), should be literally translated as "the one who makes sources of water", i.e. its artificial intakes, which can surely be applied to a builder of water supply systems (and their intakes, including artificial fountains). Such an interpretation

976 RachWawel 1913, p. 164.

977 Loc. cit. Cf. the text of the mention published in: CA I, 1917, no. 380, p. 121; it results from that mention that Michał *fontifex de Cracovia* was to carry out this task in the Kraków Monastery of Poor Clares/ the Order of St Clare (*in claustro s. Andree*) between 5 December 1442, when the contract was entered into, and 24 June 1443. If he failed to complete the task, he was to return 2 marks that he had received on account of the works, 2 weeks after the deadline at the latest, i.e. until 8 July 1443, under penalty of excommunication. A mention was found in CA, Suppl., 1993, no. 220, p. 104 that on 10 July the diocesan court cleared him of the charges brought against him by the gatekeeper of the monastery. However, since the charges were not specified in the mention, it is unknown whether they concerned the task entrusted to Michał *fontifex*. It is worth adding that the threat of excommunicating craftsmen for failing to carry out construction or repair works or for failing to return money to a member of the clergy or to a religious community appeared in sentences of Kraków ecclesiastical courts – cf., inter alia, CA, Suppl., 2000, no. 61, p. 43, year 1465. Cf. also CA, Suppl, 1993, no. 126, p. 74, year 1442, where in footnote no. 1 Michał *fontifex* was called "a well-builder" by the editor.

978 Cf. RachWawel 2000, p. 37: *Stanyczyk fontanistae a mundatione fontis castri* (year 1531) and footnote 51, concerning this Stańczyk (Staniczyk), a well-builder, who "in the years 1529–1531 cleaned and repaired wells and dug sewage pits at the Wawel Castle" – with a source reference to: RachWawel 1913, pp. 104, 164, 171.

finds support in the word *fex, ficis*, derived[979] from the word *artifex* (opifex). The explanation of the word *fontifex* presented above is corroborated by the fact that this word was usually used in this meaning both in Polish and in Western European written sources. This in turn testifies to a greater precision of the language of written sources than is sometimes supposed.

As far as the term *putearius* is concerned, it appeared in *Słownik staropolski* [Dictionary of Old Polish] as a Latin equivalent of the Polish word "studziennik" (well-digger, well-builder), but without any source examples.[980] Paulus de Praga came up with a definition of *putearius* in his mid-15th-century (thus rather late) encyclopaedia.[981] Its Czech equivalent being "studničník",[982] a *putearius* was a craftsman who knew how to dig wells and surround them with masterly casings (literally: masterly surround them with a wall). Having enumerated necessary tools for the work of a well-digger, such as a hoe, a narrow spade, a pike pole, a bucket and a ladder, Paulus underlined that this craftsman [before getting down to digging a well] had to acquire knowledge of underground water veins, of their properties and depth, so as not to dig incorrectly and expensively. Consequently, it follows from the definition provided by Paulus de Praga that a well-digger had to possess the technical skills of digging well shafts, but also (or rather most of all) the knowledge and the aptitude of a dowser. Yet, although written sources gathered in the course of the present research supply us with information about

979 Cf. SŁacŚr., vol. IV, 1975–1977, column 157.

980 SłStaropol, vol. VIII, 1977, p. 492.

981 BJ, Paulus de Praga, p. 188b.v.: *Putearius est artifex sciens fontes et puteos effodere et eos artificialiter obmurare cuius instrumenta per que complet suam opperatium scilicet fossorium, pala, eculeus, tina, letoria debet autem hic artifex suum sciencie expositione terre venas terre cognoscere et qualitas atque sit profunditas ne vatius fodiat profunditates expensis*. It can be observed that this Latin text instead of the most common word encountered elsewhere to denote a ladder, i.e. "scala", uses the word "letoria", formed on the basis of the German word "die Leiter" or as a borrowing from Hungarian "lajtoria" (Linde, I, 1854, p. 526, where apart from the Hungarian term, the author provided also a similar, Croatian word: "lóytra"). As far as the indispensability of a ladder for all works connected with wells is concerned, according e.g. to a mention in Lelów court books, the "jury" controlling water in the local wells were equipped with ladders and pike poles (the Latin text consistently uses the Latin word to refer to ladders) – cf. ANK, IT 230c: *Item iuratis cum conspiciebant domos hoc est aquam scalas et aculeos dedimus 3 gr*.

982 Cf. also Hoffmann F., 1992, p. 92: "studničnici", and also "studnikaři", described as specialised well-diggers in Bohemian towns; loc. cit. also about bricklayers who not only built wells, but also dug them.

well-diggers building or repairing wells, they are silent on whether well-diggers were also the ones who dowsed for water.

In written sources from Polish towns the term *putearius* has not been found; instead, the Polish word "studziennik" was used, associated by chancery scribes with the above-mentioned term *fontanus*. For example, it was recorded in documents of Kraków diocesan court under the year 1482 that Maciej Studziennik was to repair a well (*fons*) of one of the Kraków canons.[983] According to a record in the books of Kraków Town Council from the year 1533, *Mathias fontanus seu Studziennick* testified that he had received 40 marks from Mr Jan Czimmerman, i.e. a sum that Czimmerman had owed him, in keeping with a record in the books (as a form of securing the debt – U.S.) made on 2 March 1532.[984] It was probably the same Maciej Studziennik who in 1535, also before the town councillors' court, signed for the receipt of 40 groschen due from Tomasz the tailor, the guarantor of ¼ of Maciej Cholewicz's debt.[985] In Kraków town councillors' books under the year 1540 exists a mention of the late Andrzej Studziennik, who once owned a house with a garden in Kazimierz (near Kraków), near the town bleachery and the moat.[986] Earlier, at the end of the 15th century, a loan of 1 florin received by Katarzyna Studzienniczka (a well-digger's wife) from Pawłowa Studzienniczka (the wife of a well-digger called Paweł) was secured by a record in the Kraków books of the tribunal of *advocatus*.[987]

Mentions in Kraków town councillors' and echevin court books and in books of the tribunal of *advocatus* of individual well-diggers, not united in a guild, or of their wives testify to the fact that, unlike in the small town of Lelów, well-diggers lived in the Kraków agglomeration, because this agglomeration and the surrounding area offered them a wider range of possibilities than a small town. However, scarce source data does not allow of more general conclusions concerning e.g. their position in the social and professional hierarchy of the lower strata of Kraków. One can only make the following observations. A well-builder owned a property in the town space that was of a lower value than the one on which, according to a mention in written sources, a *fontifex* had his house: in Floriańska Street.[988] Moreover, a loan (secured before the tribunal of *advocatus*) between the wives of two well-diggers was comparable with e.g. a 3-florin debt of the wife of a royal physician, Jan Reguła,

983 AKMKr., Acta officialia 3, p. 283.
984 ANK, CC 435, p. 84, year 1533.
985 Op. cit., p. 602.
986 ANK, CC, 437, p. 519 (year 1540).
987 ANK, AC 92, p. 225–227, years 1494–1496.
988 ANK, SC 8, p. 570, year 1476.

registered in 1493 before the same tribunal.[989] Unfortunately, such observations cannot be satisfying due to their fortuity. What seems more important, though, is a mention of Jan Czymmerman's (one of the town's patricians[990]) 40-mark liability to Maciej Studziennik. If it was (which is highly probable) the payment due to Maciej for a well dug on Czymmerman's plot, then such a large sum – in comparison e.g. with contracts known from Lelów – suggests that the well must have been deep and difficult to build. Research conducted by Adam Chmiel revealed that in 1542 a goldsmith called Jan Czymmerman (Zimmermann the grandson) was the owner of the third plot in Grodzka Street, on its right-hand side from the Market Square and that on that plot stood a well still functioning in the first half of the 18th century, at that time equipped with a crankshaft and a rope for drawing water.[991] Assuming that Zimmermann the grandson inherited the plot from his father, we can infer that their well was situated in the same stretch of the street (and escarpment) as the other two wells identified earlier in the present chapter as deep: the *fons cathenatus* mentioned in 1367 and "(der) Schacht" mentioned between 1450 and 1503, on the border between plots belonging to goldsmiths: Zelczer and Czarny, Jan Czymmermann's (the father's in 1503) neighbours and fellow professionals, from the corner of Grodzka and Szeroka Streets. The goldsmith's high liability to the well-digger may have resulted from the fact that the well-digger built the well on credit. Thus, he must have had a considerable amount of money for this service, sufficient at least for the duration of the works, apart from the money that was necessary to maintain himself and his family. Maciej Studziennik's financial possibilities, and thus his wealth, were greater than those of itinerant well-diggers hired in

989 ANK, AC 91, p. 13. More about this cf. Sowina 2006c, p. 314.

990 On the basis of studies conducted by Zdzisław Noga on 16th-century Kraków patriciate, it can be concluded that this Jan Czymermann (Zimmermann) was a goldsmith (his father, also named Jan and also a goldsmith, died in 1502), an elder in the goldsmiths' guild, an echevin, a town councillor and an *advocatus* of the Supreme Court of German Law at Kraków Castle (*Ius supremum Magdeburgense castri Cracoviensis*), who died in 1539. His son, also Jan, followed in his grandfather's and father's professional footsteps – cf. Noga 2003, p. 353. According to A. Chmiel (1934, p. 34), Jan Zimmermann the grandson died in 1544.

991 Cf. Chmiel 1934, map before the text with houses marked on it, and p. 34, and also pp. 40 and 44, on which (respectively) quotations from inspections from the years 1734 and 1742, concerning a well on a plot formerly belonging to the Czymmermann family; the well must have been deep, judging from the structures used to draw water: 1734: "Well opposite the kitchen, with a roller and a bucket on a rope"; 1742: "In the courtyard: stone pavement, a well with a roller, cranks and a rope, a roof above the well".

Lelów, who received money from the Town Hall on a regular basis and in a much smaller amount. Nota bene, the lack of appropriate written sources from towns of the Crown of the Kingdom of Poland makes it impossible to form an opinion as to what was more profitable for well-diggers: working for a private employer, or working for the town authorities, which periodically had to account for the expenses incurred towards works which had been carried out.

The analysed source material and the lack of comparative studies prevent us from drawing any conclusions as to the differences in the financial and social status within this professional group which could result from the differences in the skills of individual well-diggers and in the work itself, and hence from the value of the work measured in money. Nevertheless, such a possibility exists.

The work of well-diggers was inexpensive in places where the water-bearing stratum was easily accessible due to its depth and to the kind of soil, namely where digging a well did not present greater difficulties. Thanks to contracts from Lelów we found out that such a situation existed *inter alia* in this town. The very nature of a well-digger's work, i.e. digging wells (irrespective whether deep or shallow), cleaning them and cleaning sewage pits, always decided the low social standing of well-diggers in the town society. They were not perceived as the ones who gave people the "source of living water".

III.3 Water supply systems

III.3.1 The importance and functions of water supply systems

While digging and using wells in towns took various organizational forms depending on the type of ownership of these reservoirs, the construction and the functioning of water supply systems that were always "organes de vie collective" as Pierre Lavedan put it,[992] belonged to the sphere of the management of mediaeval town economy. Hence, their becoming prevalent in the Middle Ages as the most perfect form of drinking water supply (just like in Antiquity) should be connected with the development of town communities, to which fact also testifies the noticeable coincidence of these two phenomena.

The construction and the enlargement of town water supply systems in mediaeval and early 16th century Europe was accompanied by a prevalent opinion

992 Lavedan 1960, p. 18. – in his opinion the "trademark" of Roman rule in towns, apart from the regularity of their layout, was the creation "d'un certain nombre d'organes de vie collective", i.e. public squares, grand secular and religious buildings, water supply systems (aqueducts) and fountains.

about the great importance of water supply systems voiced (under the influence of ancient views) in writings of that period: treatises, chronicles and descriptions of towns in various parts of Europe. For example, Giovanni Villani in a chronicle written shortly before 1348, listed the main qualities of a water supply system built on Apollo Fiesole's advice, among which was the fact that it supplied the town with the purest, healthy water in great abundance.[993] While describing the beginnings of Florence as a town of the Roman Empire, first of all Villani noted the construction of the aqueduct as one of the most important constructions built at that time (besides the town walls). Leon Battista Alberti, quoting the best known and most admired examples of artificial water supply in Antiquity (e.g. Semiramis' aqueduct), added that in his opinion Rome surpassed every other city both in terms of the size of the buildings and the art of constructing aqueducts, and as far as their capacity was concerned.[994] Jacques Le Lieur shared this opinion in his description of water supply systems in Rouen written between 1524 and 1525.[995] He cited Pliny the Elder, who expressed his conviction that the very important construction of Roman aqueducts could be compared with no other task of that kind in the whole world.[996] Further on, Le Lieur described the main Roman aqueducts,[997] including the Aqua Claudia that carried the most water to Rome, and apart from Pliny the Elder, he also referred to Suetonius and other unnamed historiographers, underlining (following the latter writers) the enormous cost of Aqua Claudia.[998] Among the unnamed writers must have been Frontinus,[999] the Water Commissioner of Roman aqueducts, the author of the following words: *Tot aquarum tam multis necessariis*

993 Villani 1991, libro primo, VII, Web.

994 Alberti 1988, p. 324.

995 Le Lieur 1911, pp. 1–2.

996 Le Lieur 1911, pp. 1–2: „Pline, en son trente sixiesme livre de la Naturelle Histore, dict que la magnifficence des cours des eaues et fontaines de Romme excédoit et surmontoit toux les plus exquis et sumptueux édifices et chozes merveilleuses du monde" (cf. Pliny the Elder, lib. 36, cap. XXIV, 123. Web).

997 Le Lieur 1911, pp. 1–2.

998 Suetonius listed the extension of the aqueduct in the first place among Claudius's particularly great accomplishments: "The public works which he completed were great and essential rather than numerous" (*Opera magna potius necessaria quam multa perfecit*) – Suetonius, Vita Divi Claudi, 20. Web. J. Le Lieur (p. 2) also quoted Suetonius and wrote that the aqueduct was being built for eleven years without interruption and that every day 30 thousand people worked at it. Cf. Suetonius, op. cit.: "…a work of great difficulty and requiring eleven years, although he had thirty thousand men at work all the time without interruption".

999 Frontinus Liber Alter, 72. Web. – about the Aqua Claudia.

molibus pyramidas videlicet otiosas compares aut cetera inertia sed fama celebrata opera Graecorum, translated by Charles E. Bennett in the following way: "With such an array of indispensable structures carrying so many waters, compare, if you will, the idle Pyramids or the useless, though famous, works of the Greeks!"[1000]

In western and southern Europe, as early as before the experience of the Black Death, besides supplying people with an abundance of drinking water, water supply systems were to serve hygienic purposes in towns, not only supplying water that would be good for drinking, but also for washing and rinsing, i.e. for cleaning the town, as Giovanni Villani wrote (*abondanza di buona acqua da bere, e per lavare la cittade*).[1001] The same two most important aims of installing water supply systems were given nearly two centuries later by J. Le Lieur: water supply systems were to supply Rouen with drinking water, clean water (*eaues doulces, l'eaue nette*), and also to contribute to keeping the town clean by being used to rinse out the pavements.[1002] Still holding up Rome as an example, he noted that authors who had described the history of that city had mentioned that before it had got "the great abundance of water and fountains" thanks to aqueducts, it had been full of filth and rubbish and its air had been polluted owing to fumes. However, since the installation of numerous aqueducts the town had been cleaned of the dirt; thanks to this fact also air had become less prone to plague.[1003] One cannot resist the impression that he quoted Frontinus, who praised Roman water installations and wrote that *ne pereuntes quidem aquae otiosae sunt: alia munditiarum facies, purior spiritus, et causae gravioris caeli quibus apud veteres urbis infamis aer fuit, sunt remotae.*[1004]

1000 Frontinus, Liber Primus, 16. Web (Latin text and English translation). Cf. also English translation by Harry B. Evans. In: Frontinus (Evans) 1997, p. 20.

1001 Villani G., 1991, libro secondo, I, Web.

1002 Le Lieur 1911, p. 57.

1003 Le Lieur 1911, p. 1: „auteurs qui ont descrit les faictz et gestes de Rommains, affermentque, en précédent et avant que avoir en la cité de Romme la grand habundance des eauz et fontaines, icelle cyté estoit fengeuse, plaine de inmundices et ordures qui la rendoient mal plaisante et fort contraire aux sens humains, et aussy, par vapeurs et exhallacions infaictes, l'air facilement susceptible de corruption estoit souvent aux habitans dangereux et pestiféré; maiz depuis, par les cours et affluence de plusieurs fontaines, ladicte cité fut purgée et nectoyée d'icelles immundices, et à ceste raison fut rendue plus salutaire et l'air moyns susceptible de corruption et moyns subgecte à pestes qu'elle n'avoit esté en précédent".

1004 Frontinus, Liber Alter, 88 and its English translation by Ch. E. Bennett: "Not even the waste water is lost; the appearance of the City is clean and altered; the air is purer; and the causes of the unwholesome atmosphere, which gave the air of the City so bad a name with the ancients, are now removed." Cf. also Frintinus (Evans) 1997, p. 38.

Jacques Le Lieur aptly presented the aims of constructing these installations and also noted that water supply systems played an important role in effective firefighting. What is more, they contributed directly to the improvement of the town's aesthetic qualities: they also served decorative purposes, which could be fully appreciated in ornamental fountains.

Monumental decorative public fountains built in important places, including the main square of the town, could also serve the local authorities to manifest their power: such a hypothesis was put forward by Chloe Deligne, a Belgian researcher, on the basis of 14th–16th-century fountains in towns of Southern Netherlands.[1005]

In European regions in which "beer civilization" flourished water supply systems were also constructed for beer production, As was established in the previous chapter, as far as town in the Polish land are concerned, this relation became easily visible in town written sources only in the 16th century and only for the 2nd stage of beer production, namely for its brewing.

III.3.2 Technological and organizational models of the construction and functioning of water supply systems

In the culture of mediaeval Latin Europe technical models of building town water supply systems, namely the art of laying conduits through which water flowed, remained the same: taken in Antiquity from the East and widely used in Greece, prevalent in Rome, and later in towns of its provinces. Described in detail by Vitruvius and Frontinus, they survived in their works that were kept, read and copied in early mediaeval monasteries.[1006] In the mid-5th century Palladius in his *De re*

1005 Deligne 2008, p. 81 et seq.

1006 E.g. according to A. Guillerme (1985, p. 188), Vitruvius' treatise was copied in monasteries in Reichenau, Murbach, Schelstadt, Cologne and Tours; it was also known in the first half of the 9th century by the head of construction works at the royal palace in Aachen. A. Guillerme also remarked that Carolingian technical literature was based – inter alia – on Roman works from the field of hydraulics and that it was highly probable that precisely these works served as an inspiration for Bishop Aldric, Charlemagne's chaplain, when ca 834 he built an aqueduct in Le Mans, described among the deeds of the Bishop as something extraordinary, "which no one had seen happen before" – cf. the full Latin text in: Gesta Aldrici Episcopi Cenomannensis, MGH Scriptores XV. 1, Hannover 1887, 2, p. 310, referred to in: Squatriti P., 1998, p. 12, footnote 9. It can be noted that this admiration resulted not only from the character of the *Gesta*, which as a rule praised the deeds of the hero, but also from the fact that such an installation was, in truth, an exceptional rarity at that time. As regards the issue whether Frontinus' work was known in the early Middle Ages, both A. Guillerme (1985, p. 188) and C. Kunderewicz (Frontinus 1961, pp. 5–6),

rustica used the above-mentioned models described by Vitruvius. In the early 14th century Pietro de Crescenzi copied the models from Palladius, and Polish readers could acquaintance themselves with them thanks to Andrzej Trzycieski's translation of Crescenzi's treatise published in 1549.

An analysis of the descriptions of the techniques of conducting water in works by Vitruvius, Palladius and Crescenzi reveals their uniform character, which, however, does not exclude some differences. Vitruvius began giving his advice as follows: "Water is conducted in three ways, either in streams by means of channels built to convey it, in leaden pipes or in earthen tubes, according to the following rules. (*Ductus autem aquae fiunt generibus tribus: rivis per canales structiles, aut fistulis plumbeis, seu tubulis fictilibus*)[1007] Palladius gave the following description: On aqueducts. Water can be led through a stone channel, lead pipes, wooden channels or pipes made of burnt clay (*XI. De aquae ductibus. Cum uero ducenda est aqua, ducitur aut forma structili aut plumbeis fistulis aut canalibus ligneis aut fictilibus tubis*).[1008] The most important difference between these fragments is the appearance of wooden conduits in Palladius' late antique text.

In the remaining part the two antique texts are convergent when they discuss the conditions of conducting water depending on the landform and when they give the dimensions of lead pipes. As far as conducting water is concerned, Vitruvius' original description presented two situations: when natural obstacles in the form of hills blocked the passage of the pipes between the source and the town walls and when the pipes, crossing a flat terrain (but always preserving the proper inclination), had to overcome depressions of the terrain. In the first case Vitruvius advised to make underground tunnels with the correct inclination inside of the hill with the channels cut in stone, or – if the hill was made of earth or gravel – to build tunnels with side walls and arches in the ground. If more than one row of such tunnels were to be constructed, the distance between them should be one *actus* (120 feet, namely ca 35,52 m).[1009] The second case, namely conducting water through depressions of the terrain by means of substructures, remained characteristic of the

independently of one another, accept P. Grimal's opinion (Frontin, Les aqueducs de la ville de Rome, Paris 1944) about the existence of an early-mediaeval manuscript in Hersfeld Abbey, earlier than the copy from the Abbey of Monte Cassino dated at ca 1130 and ascribed to Peter the Deacon.

1007 Vitruvius VIII, 6.1. (Latin text and English translation). Web.

1008 Palladius 1898, lib. IX, 11 – Latin text. Web. Cf. also (after Palladius) Crescenzi 1548, p. 16: *De aquae ductu faciendo, Cap. IX. Cum vero ducenda est aqua, ait Palladius, ducatur aut forma structili, aut plumbeis fistulis, aut cannalibus, aut fictilibus tubis.*

1009 Vitruvius VIII, 6, 3. English translation. Web. Cf. also Vademecum 1983, p. 338.

ancient overground aqueducts, known in their most spectacular form from the lands of the Roman Empire. These two ways were also presented by Palladius in his treatise,[1010] from which they were copied by Pietro de Crescenzi.[1011] When it comes to the technique of laying these channels and to their type, Vitruvius and later Palladius described lead pipes in greatest detail, because they were most commonly used in Roman aqueducts. The pipes should all measure not less than 10 feet in length (2.96 m);[1012] they had different sizes and weight, and thus various diameters. The latter, however, were given only by Sextus Julius Frontinus, a mathematician of the Alexandrian School, specialist in military engineering, water engineering and land surveying. The Water Commissioner of the Roman aqueducts, Frontinus drew up a highly detailed description of all of them ca 97 AD.[1013] According to what he wrote, the diameter of lead pipes used in Roman aqueducts ranged from a "five" to a "hundred and twenty" and equalled from 1¼ of an inch to 12 plus 1/3 plus 7/288 of an inch 548 (from 2.31 cm to ca 23 cm). Strings of lead pipes of the Roman aqueducts were interspersed with water reservoirs every 24 thousand feet (original: *actus ducentos*, i.e. 200 *actos*, namely ca 7.1 km), "because if damage be done to any part, it will not then be necessary to take the whole work to pieces, and the defective places will be more easily found. These reservoirs, however, are not to be made on a descent, nor on the venter, nor on a rise, nor, generally speaking, in valleys, but only on plains."[1014] This structure of aqueducts: pipes interspersed with control reservoirs that for practical reasons became predominant, irrespective of the material used to make the pipes, was adopted by and applied to all mediaeval (and later) town water supply systems.

In Vitruvius' description the material used to make pipes that was an alternative to lead was clay (earthen tubes). The author underlined that the cost of a ceramic pipe was lower. Ceramic pipes should be made of dense, tight, burnt clay (*tubuli crasso corio*) with the walls 2 inches thick "and tongued at one end, so that they may fit into one another. The joints are then to be coated with a mixture of quick lime and oil".[1015] In the further part of his description the author presented what was the

1010 Palladius, 1898, IX, 11 – Latin text. Web.

1011 Crescenzi 1548, pp. 16–17.

1012 Vitruvius VIII, 6, 4 – Latin text and English translation, Web. Conversion of the unit *foot* into meters after: Vademecum 1983, p. 338.

1013 Frontinus 1961 (Polish translation by C. Kunderewicz), p. 35–39; Frontinus (Evans) 1997, 24–63, pp. 23–29; Frontinus, *The Aqueducts of Rome* (English translation by Ch. E. Bennett). Web.

1014 Vitruvius VIII, 6, 7. Web.

1015 Vitruvius VIII, 6, 8 – Latin text and English translation, Web.

most difficult in an effective conducting of ceramic pipes, namely overcoming all slopes. While joining ceramic pipes that ran across a flat land did not call for the use of any connectors, as this was solved by their funnel-like shape, each sharper turn of the pipeline required such connectors. To this end were used blocks of "red stone" drilled out inside. Vitruvius also referred to making a ready clay pipeline leak-tight: "When the water is first let down from the head, ashes are put in which will stop those joints not sufficiently coated."[1016] Having thus completed the technical description of lead and clay pipelines, Vitruvius presented the prevailing opinions concerning the quality of water supplied by both of them: "Earthen pipes have these advantages, first as to the work; next, that if damaged any one can repair it. Water conducted through earthen pipes is more wholesome than that through lead; indeed that conveyed in lead must be injurious, because from it white lead is obtained, and this is said to be injurious to the human system. Hence, if what is generated from it is pernicious, there can be no doubt that itself cannot be a wholesome body. (…) water should therefore on no account be conducted in leaden pipes if we are desirous that it should be wholesome. That the flavour of that conveyed in earthen pipes is better, is shewn at our daily meals, for all those whose tables are furnished with silver vessels, nevertheless use those made of earth, from the purity of the flavour being preserved in them."[1017] This is how Palladius wrote about lead pipes: "The worst thing is to conduct water through lead pipes, because it becomes unfit to drink. When lead is washed out, white lead is formed which is highly detrimental to the health."[1018] This was repeated by Crescenzi: *Vltima ratio est plumbeis fistulis ducere quę noxias reddunt aquas. Nam cerussa plumbo creatur, quę plurimum corporibus nocet humanis.*[1019] Describing the practice that he observed, Alberti wrote that water was conducted (also) through lead or rather earthenware pipes, because physicians believed that lead caused intestinal disturbance.[1020]

1016 Vitruvius VIII, 6, 9 – English translation. Web.

1017 Vitruvius VIII, 6, 10 – English translation. Web.

1018 Palladius 1807, IX, 11, p. 256 (English translation). Web.

1019 Crescenzi 1548, p. 17.

1020 Alberti 1960, p. 283. Moreover, Alberti mentioned that copper will be equally detrimental and that copper dishes cause epilepsy, cancer as well as liver and spleen pains. A comparison of clay and lead pipes to the advantage of the former can be found also in later treatises; e.g. in the mid-17th century Bernard Palissy praised clay for its advantages and various applications and wrote, inter alia, that clay pipes, as is commonly known, are much better and healthier than lead pipes – Palissy 1989, pp. 51–52: „…on sçait bien que les eaux qui passent par les tuyaux de terre sont beaucoup meilleures et plus saines que celles qui sont conduites par canaux de plomb".

It must be noted, however, that the toxicity of lead pipes that was underlined by the above-mentioned authors of treatises, occurred only in contact with soft water, as was observed by Danuta Molenda in her description of the properties of lead.[1021] This happened due to a greater number of chemically active sodium ions that in combination with lead formed basic lead compounds, including the above-mentioned white lead (basic lead carbonate).

The technical solutions within the structure of aqueducts described by Vitruvius were also to serve managing the water that was conducted through them to towns in the Roman Empire: "When they are brought home to the walls of the city a reservoir (*castellum*) is built, with a triple cistern attached to it to receive the water. In the reservoir are three pipes of equal sizes, and so connected that when the water overflows at the extremities, it is discharged into the middle one, in which are placed pipes for the supply of the fountains, in the second those for the supply of the baths, thus affording a yearly revenue to the people; in the third, those for the supply of private houses. This is to be so managed that the water for public use may never be deficient, for that cannot be diverted if the mains from the heads are rightly constructed. I have made this division in order that the rent which is collected from private individuals who are supplied with water, may be applied by collectors to the maintenance of the aqueduct."[1022] This system of distributing water for public and private use was described more comprehensively and in greater detail by Frontinus. The solutions concerning Roman aqueducts that he presented, not only technical, but also organizational, became a model for mediaeval and later early-modern water supply systems in European towns. Frontinus' very work became, in the opinion of the author of the present study, a direct example for descriptions of water supply systems, which can be discovered in the course of the analysis of the few preserved descriptions of water supply systems of the period in question, namely from Augsburg of 1416,[1023] from Bruges of ca 1418,[1024] from Wrocław of 1499[1025] and especially from Rouen of 1524–1525.[1026]

1021 Molenda 1987, p. 72, footnote 93 and 94, with relevant literature.

1022 Vitruvius VIII, 6, 1–2 – English translation. Web. As to *castellum,* cf. also Villani 1991, libro secondo, I: *capud aque* (or Capaccia in Italian) of the ancient aqueduct in Florence.

1023 Grewe 1991a, pp. 67–68.

1024 InvBruges 1871–1885, Introduction, Bruges 1871, pp. 432–438 – undated description. The author of the present work dated it to ca 1418 on the basis of mentions found in this document of people-owners of houses, known from other dated mentions in subsequent volumes of InvBruges.

1025 Goliński 2001a, passim.

1026 Le Lieur 1911, passim.

Ancient Roman aqueducts were destroyed and fell into ruin in late antiquity. In the early Middle Ages they were built less frequently; at the beginning they were the reflection of their funders' euergetism (benefaction – *beneficium*).[1027] Apart from popes – the restorers of Roman aqueducts, including Pope Adrian I, the funders of water supply systems were mainly bishops, although sometimes also rulers, like e.g. in Salerno, where the water supply system built on the initiative of Arechis II, the Prince of Benevento (758–792), functioned for several centuries (is was certainly still in use in the mid-10th century).[1028] From the 8th century also in monasteries artificial channels started to be perceived as the most perfect method of supplying water.[1029]

The establishment and the development of water supply systems in mediaeval European towns were directly influenced not only by the legacy of the Roman Empire, but also by technical models brought in the early 8th century by the Arabs conquering southern Europe. Some of these models were the same, because the Romans and later the Arabs adopted them from the same civilizationally older territories: Greece, Syria, Egypt (the Arabs also by means of Roman science, e.g. from Vitruvius' treatise). However, while the Romans adopted and mastered the art of building gravity aqueducts (also with the use of the so-called siphons[1030]), the Arabs used and disseminated in the entire Mediterranean area the ancient Middle Eastern "norias", namely devices used for the irrigation of farmlands,[1031] and made them an integral part of town water supply systems, especially in Spain, in Andalusia and Murcia. In their basic form they were vertical wheels with buckets/containers that lifted water to a higher level and as such they were described by Vitruvius in his treatise (but with no relation to the ancient aqueducts!): "If it be necessary to raise the water to a higher level, it must be differently adjusted.

1027 Squatriti 1998, p. 13 – this author considers the opinion about the following agony of Roman aqueducts as too stereotypical and shows the funders' unflagging readiness to establish aqueducts in early mediaeval centres.

1028 More about this cf. Squatriti 1998, pp. 14–18.

1029 Op. cit., pp. 19–21.

1030 Biernacka-Lubańska M., 1959, p. 53.

1031 In literature two types of "norias" are mentioned: the "as-sania/saniya" constructions described above that raised water from deep wells and "norias de corriente" (Arab. "nâ'ûra/nac-ura") lifting water from running waters – EncArtMed., 1995, p. 101; Delpech/Girard/Robine/Roumi 1997, p. 231–238 ("la noria de courant"); González Tascón 1992, p. 43 et seq.; Córdoba de la Llave 2002, pp. 262–263; Bazzana 2005, pp. 60–61.

The wheel, in that case, applied to the axis must be of such diameter that it shall correspond with the requisite height. Round the circumference of the wheel buckets, made tight with pitch and wax, are fixed; thus when the wheel is made to revolve by means of the persons treading in it, the buckets being carried to the top full of water, as they return downwards, discharge the water they bring up into a conduit."[1032] Right after this Vitruvius provided a description of another variant of this construction, later called "Paternosterwerk" in Christian Europe, which was also known by the Arabs: "But if water is to be supplied to still higher places, a double chain of iron is made to revolve on the axis of the wheel, long enough to reach to the lower level; this is furnished with brazen buckets, each holding about a gallon [*congius*]. Then by turning the wheel, the chain also turns on the axis, and brings the buckets to the top thereof, on passing which they are inverted, and pour into the conduits the water they have raised." Further on the author described an installation disseminated later by the Arabs as "norias de corriente", that is, making use of the current of water, namely a river or a canal: "Wheels on rivers are constructed upon the same principles as those just described. Round their circumference are fixed paddles, which, when acted upon by the force of the current, drive the wheel round, receive the water in the buckets, and carry it to the top with the aid of treading; thus by the mere impulse of the stream supplying what is required."[1033] Only after these descriptions did Vitruvius present the functioning of an analogous construction to the noria, namely that of the watermill, very often quoted in literature concerning this device: "Water mills are turned on the same principle, and are in all respects similar, except that at one end of the axis they are provided with a drum-wheel, toothed and framed fast to the said axis; this being placed vertically on the edge turns round with the wheel. Corresponding with the drum-wheel a larger horizontal toothed wheel is placed, working on an axis whose upper head is in the form of a dovetail, and is inserted into the mill-stone. Thus the teeth of the drum-wheel which is made fast to the axis acting on the teeth of the horizontal wheel, produce the revolution of the mill-stones, and in the engine a suspended hopper supplying them with grain, in the same revolution the flour is produced."[1034]

1032 Vitruvius X, 4, 3 – English translation. Web.
1033 Op. cit., X, 5, 1. Web.
1034 Op. cit., X, 5, 2, Web.

The two types of noria, namely the "Paternosterwerk" and the "noria de corriente", were graphically represented in the famous work by Al-Jazari of ca 1206 *Kitáb fi ma'rifat al-hiyal al-handasiyya* (*The Book of Knowledge of Ingenious Mechanical Devices*)[1035] (fig. 43).

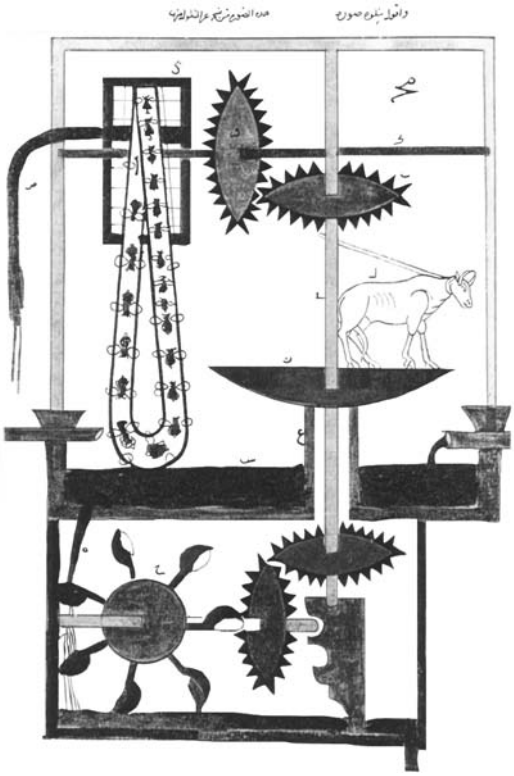

Fig. 43: Al-Jazari, "The Book of Knowledge of Ingenious Mechanical Devices" ("Kitáb fi ma'rifat al-hiyal al-handasiyya") (ca 1206). Below: a wheel with scoops ("noria"). Top: "chain pump" – a structure described by Vitruvius, called "Paternosterwerk" in Christian Europe. After: Enciclopedia dell'Arte Medievale, vol. VI, Roma 1995, p. 99.

1035 EncArtMed., 1995, p. 99. From this culture circle cf. also: Delpech/Girard/Robine/Roumi 1997, p. 230, with an illustrated example of a "noria" from Damascus, a construction with several wheels, including a paddle wheel set in motion by the force of water, being the driving force for a gear system consisting of wheels with spools; a wheel with chains wound around it to which scoops/buckets were affixed was set in motion by this gear system.

In Muslim Spain norias were used mainly to supply water to towns and to irrigate suburban gardens. One of the very famous examples of this construction is the "gran noria": "noria Albolafolia" in Córdoba on the Guadalquivir River, with clay pots attached to the paddles of the wheel (fig. 44). It was built by order of Abd ar-Rahman III to irrigate gardens.[1036] The wheel functioned until the end of 1492, when Isabella I of Castile had it stopped, because it disturbed the Queen with the noise it made, when she relaxed at the Alcázar of Córdoba.[1037] In the mid-11th century the Arab geographer Al-Idrisi in his description of Africa and Spain presented the "noria de corriente" in Toledo in a tone full of admiration for the uniqueness of the work. It was to lift water from the River Tagus as high as 90 ells, namely ca 43 meters, to the town that was situated above it.[1038] It is stated in literature that attaining such a height exceeded the technical possibilities of that time and that Al-Idrisi's account should rather be treated as his marvelling at the unequalled character of the construction.[1039] In the case of the wheel used in this noria, its diameter would have to be greater than 90 ells, because the water taken from the bottom reservoir by the buckets attached to the wheel was poured out from each of these buckets to the top reservoir when the bucket passed the highest point of the wheel and began its way down.

1036 Bazzana 2005, pp. 60–61.

1037 Val Valdivieso (del) 1994, p. 49.

1038 Cf. this fragment translated into Spanish: González Tascon 1992, p. 48: „Tiene (Toledo) sobre el Tajo un puente, de admirable fábrica, y de un solo arco; y el agua corre por debajo de él con la violencia de un torrente. En uno de sus extremos hay una noria que hace subir las aguas a 90 codos de altura; llegadas éstas a la parte superior del puente corren por cima de él en la misma dirección y entran en la ciudad". Also Bazzana 2005, p. 61, where the "90 codos" (French "coudées") were converted into 43 meters.

1039 Op. cit., p. 60, footnotes: 12 and 61.

Fig. 44: The "noria" in Córdoba, functioning between the 10th and 15th centuries. The photograph below shows its position in relation to the stone bridge on the Guadalquivir River. Photograph: U. Sowina.

As we can see, the ancient theoretical and practical knowledge about the ways of drawing water, about conducting water through conduits and about building

water supply systems survived in the two above-mentioned great civilizations: in the early mediaeval Christian civilization and in the Arab civilization. However, it was the latter civilization that knew how to make the fullest use of the entire knowledge of the past and how to combine all its elements in order to build their installations. This is particularly noticeable in the Iberian peninsula, where models brought by the Arabs met ancient models that remained in this former Roman province. Apart from the norias presented above, one can also mention the "Caños de Carmona" which were built in the 12th-century Seville in the times when this town was under the Arab rule.[1040] They constituted a combination of the earlier Roman aqueduct and the construction called "qanât", brought by the Arabs from the Middle East, that had been used there for about 2500–3000 years.[1041] The qanât consisted of horizontal underground galleries through which water flowed; water was drawn from there through wells dug to the depth of these galleries. Some of these wells, often very deep, reaching down to several dozen meters,[1042] fulfilled different functions: ventilation, control or distributional, and thus were an equivalent of the reservoirs mentioned by Vitruvius as indispensible in the structure of Roman aqueducts. The installation from Seville finished in February 1172 by an engineer called Al-Hay Yaçis consisted of 85 such wells; water that was drawn from these wells flowed in a brick aqueduct. By order of the ruler-emir it was conducted to the main square of the town from where it was further conducted to mosques, baths and private houses. On the way it also fed the town's alcázar and mills; a part of the revenues from mills was allocated for the maintenance of the "Caños de Carmona". Castilian Kings who conquered Seville in the 13th century enlarged this water supply system. At the end of the 15th century Isabella I of Castile ordered that special care should be taken of the condition of the system's lead pipes.[1043]

1040 Val Valdivieso (del) 1992, p. 17 and e 1994, p. 51.

1041 More about such constructions mentioned by Herodotus as existing in Persia during the Achaemenid rule 2500 years ago, confirmed archaeologically in that country even earlier, because ca 3000 years ago – cf. Javan et al. 2006, p. 530–540. In Andalusia they were widely used as Arab works; they were also used in a village called Ocaña near the Spanish town of Toledo in 1573–1578 – Bustamante et al. 2006, p. 509–515.

1042 E.g. galleries conducting water to Madrid (confirmed in written sources in 1399, but they might have been constructed earlier by the Arabs) reached the depth of 40 meters – Val Valdivieso (del) 1994, pp. 49–51. The use of the "qanât" construction indicated that the water intake must have been deep below the ground, so that it was not affected by periods of drought lasting sometimes for many months, characteristic of this climatic zone in which these installations were built.

1043 Val Valdivieso (del) 1994, p. 51.

The Arab rule thus left the Iberian peninsula with water wheels[1044] and the "qanât" constructions as elements of water supply systems (e.g. the above-mentioned "qanât" for Madrid) and at the same time as technical models for building any type of deep wells or mineshafts and for lifting water to a higher level not only from rivers, but also from such wells and shafts.[1045] These models were later adopted in Northern and Central Europe: in mines[1046] and in water supply systems.

The "noria de corriente" constructions became scoop wheels of the oldest water-works (*Wasserkünste*); they were easier to build because – as was already remarked – their construction was the same or similar to watermills: *molendinae*, very widespread in the period in question (which is why the norias were even sometimes called watermills, like in the description of Wrocław done by Bartholomäus/Barthel Stein in the early 16th century).

Constructions of the "Paternosterwerk" type were used in water-works that had to raise water to a greater height than could "norias de corriente" (the latter would have to have their diameter extended up to the limit of technical possibilities). Buckets on chains were also used as drainers (called "Kunst") in mediaeval deep mineshafts. They were the direct predecessors of suction and force pumps (which is why they are sometimes called "chain pumps" in literature[1047]).

1044 One of the examples of a water wheel being used in such a way was also the town of Zamora, because a "noria" was depicted in its 14th-century coat of arms – Val Valdivieso (del) 1994, p. 49.

1045 González Tascón 1992, p. 45: an example of a "noria" described in 1533, probably dating from the Middle Ages in the salt mine of Imón (Guagalajara). Apart from these constructions in the 15th century in the Christian countries of the Peninsula water supply systems were built according to Roman models, but without the overground aqueducts, e.g. a clay water supply system from the turn of the 15th and 16th centuries in the Castilian Valladolid – Val Valdivieso 1994, p. 53. Op. cit., p. 51 about pine conduits constructed a half of a century earlier conducting water to a local monastery with the permission of the ruler of Castile; these conduits ran through the town and were repaired in 1489.

1046 About scoop wheels and drainers in mines in North and Central Europe in the late Middle Ages and in the early modern period cf., inter alia: Molenda 1980, passim. Also: id. 1988, p. 70–71, where Molenda refers to Wolfgang von Stromer's findings that this system of drainage, also in the version of water collection compartments on chains of the "Paternoster" type, used in mines in Central Europe was brought from the Islamic world by Jewish technicians – Stromer 1984, p. 66. However, the latter scholar presented source evidence dating from as late as the early 14th century.

1047 Široký 2000, p. 362.

The use of "Paternosterwerk" in mines was described in detail by Georgius Agricola in his work entitled *De re metallica*, first published in Basel in 1556.[1048] Showing different variants of "Paternosterwerk", Agricola referred to Vitruvius' description of one of such devices.[1049] In contrast to Vitruvius, Agricola presented the double iron chain with buckets as moving not on a wheel, but on a shaft on which the treadmill was also set (fig. 45).[1050] Apart from the treadmill operated by people treading in it, Agricola took into consideration also the other kind of driving force of the "Paternosterwerk", namely a stream conducted to the mine to set the wheel in motion (in that case the wheel replaced the treadmill) (fig. 46).[1051] A modification of the installation described by Vitruvius and analysed above was also depicted in Peter Flotner's woodcut illustrating the oldest German translation of Vitruvius' treatise: *Vitruvius Teutsch* dating from 1548 (fig. 47).[1052]

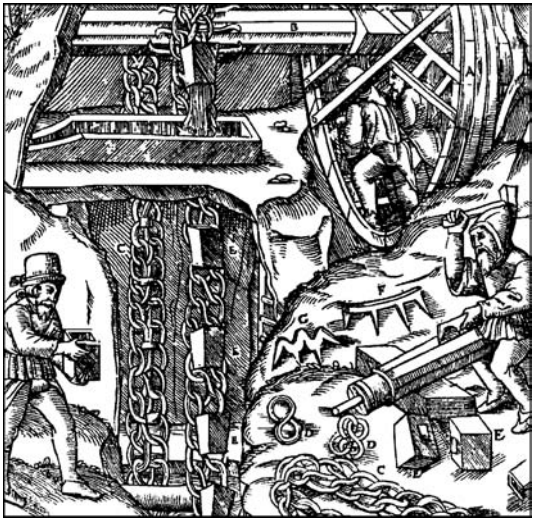

Fig. 45: A "Paternosterwerk" with chains and scoops attached to them, moving on a shaft on which a treadmill was fixed, after: Agricola 1928, p. 145.

1048 Agricola 1928, p. 144–146 and id. 2000, p. 155–160.

1049 According to Agricola (2000, p. 159) the other machine of that type, shortly described by Vitruvius, pulls out jugs of the capacity of one measure at a greater pace. Which is why it is better than the first one to pump out water from mines where a lot of water constantly flows.

1050 Agricola 1928, p. 145 and id. 2000, p. 158.

1051 Agricola 1928, p. 146 and id. 2000, p. 160.

1052 Vitruvius 1548.

Fig. 46: A "Paternosterwerk" set in motion by a wheel powered by water from a stream conducted to a mine, after: Agricola G., 1928, p. 146.

Fig. 47: A "Paternosterwerk" drawing water, set in motion by a horse mill. Woodcut by Peter Flotner, after: Walter Hermann Ryff, "Vitruvius Teutsch", Nuremberg: Johan Petreius 1548, p. 304.

III.3.3 The establishment of water supply systems in mediaeval European towns

In the process of the rapid development of towns in Christian Europe water supply systems quickly found their place. Water supply systems should be understood here as conduits conducting water to the town and distributing the water throughout the town (consequently, the term "water supply system" will not be applied to local water supply, e.g. conducting water from a nearby river to a bath, a hospital or private gardens etc.). Although not in every case written sources allow to precisely establish the time of their creation, as they often refer to works performed on already existing networks, nevertheless, we can notice that they began to be established in the 12th century and the first strong wave fell on the 13th century and pertained to economically strong centres, including the great centres of European trade.

According to Duccio Balestracci, among Italian towns south of the Alps only Florence used a Roman aqueduct established in the 1st century AD.[1053] Other towns in the period between the 12th and the 13th centuries undertook the initiative to build new aqueducts or reconstruct the old ones (Genoa: 12th-early 13th century; Siena: early 13th century; Viterbo and Perugia: mid-13th century; Orvieto: end of the 13th century).[1054] Decorative fountains were built in these towns: one of the early examples of such initiatives is the mid-13th-century fountain in the main square of Perugia (fig. 48).[1055]

1053 Balestracci 1992, p. 462.

1054 Op. cit., pp. 463–464.

1055 Loc.cit., While describing the water supply system supplying water to this fountain, Duccio Balestracci (1992, p. 464) added that the significance of this large enterprise diminished considerably when it turned out after the fountain had been finished that water spurting out of it was unsuitable for drinking. Cf. a description of a fountain: Vasari 1997. Web; and Lohrmann 1999, pp. 267–282.

Fig. 48: Perugia. A mediaeval fountain in the main square of the town. Photograph: U. Sowina.

One of the oldest mediaeval constructions in the lands of the former Roman provinces was a water supply system of Paris' Right Bank (*la Rive Droite*). At the beginning, probably still in the Merovingian times, monks from St Lawrence monastery conducted water from springs in Le Pré Saint-Gervais[1056] to the monastery and to the neighbouring St Lazarus hospital[1057] along a ca four-kilometer

1056 Gerards 1991 (1908), pp. 204 and 206; the reconstruction of the course of the water supply systems conducting water from these springs, and also from the springs in Belleville by: Lafay 1991 (Fig. 8: Aqueduc du Pré-Saint-Gervais), later reproduced in: Benoit/Rouillard 2000, p. 201.

1057 About conducting early water supply systems (in the 12th century) to hospitals in towns – Guillerme 1985, p. 190.

stretch through stone channels and clay pipes.[1058] In 1182 King Philip II Augustus purchased some of the springs from the monastery in order to conduct a water supply system[1059] to the main marketplace of Paris, namely to Les Halles (at that time it was a permanent, all-year-round market).[1060] The installation of this water supply system that undoubtedly was to serve economic purposes[1061] by contributing to a further development of Paris, was therefore no longer a reflection of euergetism of the owner of the town, but an expression of care for the common economic interest. One can ask who was the actual author of this decision signed by the highly talented but very young King (in 1182/1183 Philip was 17/18 years old[1062]), especially since it is known that the young King had a *tutor* in the person of Philip I, Count of Flanders, an ardent advocate of the economic development of towns, the man behind the successful development of Bruges, i.e. the city he made into a powerful sea port.[1063]

It was according to Roman models that another one of the earliest water supply systems in mediaeval post-Roman Europe was built – in Rouen, the capital of Normandy. The existence of a town water supply system called "Gaalor" was testified in written sources for the year 1238, and perhaps even for 1205.[1064] The principal reason for the establishment of this water supply system was conducting water to the town's main buildings and devices, as at first (that is, before

1058 Gerards 1991 (1908), p. 206.

1059 Op. cit., pp. 204 and 206.

1060 In 1183 two permanent pavilions were built which were the beginning of the Paris Les Halles – cf. Lavedan 1960, p. 55. Also Geremek 1972, p. 9, where their place in the topography of mediaeval Paris was presented, and p. 27 – their description from the first half of the 15th century.

1061 Guillerme (1985, p. 190) only mentions a smaller risk of a fire in this commercial place.

1062 When enthroned in 1180, the King was 15 years old – cf. Volkmann 1999, p. 24; in Polish literature cf.: Baszkiewicz 1978, p. 96.

1063 It was Philip of Alsace/Philip I, Count of Flanders who undertook and financed a great enterprise, namely digging a canal ca 5 kilometers long that linked the sea waters of a navigable canal called Zwyn with those of a navigable river called Roya (Reya) flowing through the town from the north to the south and establishing in 1180 a trans-shipment port in Damme – Ryckaert 1992, p. 33.

1064 Sowina 2001, p. 27–28, on the basis of a 16th-century anonymous chronicle of the town in which it was recorded that Philip II Augustus in 1205 (i.e. soon after Normandy had been definitively taken away from England) ordered to build a new castle in Rouen, next to the "fountain commonly called Gaalor" – cf. Chronique de Rouen 1900, pp. 39 and 51.

the mid-13th century) it finished its course there. One can infer from written sources that this water supply system belonged to the town from the very start. This assumption finds its confirmation in the fact that in 1257 it was the King who asked the authorities of Rouen as the owners of the water supply system to build a connection to the Franciscan monastery.[1065] The "Gaalor" was a costly installation: on its entire length of 597 fathoms (ca 1166 meters[1066]) it consisted of underground lead pipes placed in stone housings separated by containers ("cuves").[1067] The pipes were sometimes placed in two, three or even four rows.[1068] The "Gaalor" was extended in the 15th century; until the early 16th century only this system supplied Rouen with water. Its insufficient amount combined with the poor quality of water in dug wells and in small rivers flowing through the town became the reason for the establishment of two more water supply systems at the beginning of the 16th century. One of them was built on the initiative of the local Archbishop (it conducted water to his residence and to a hospital he had built), with the costs being divided between the Archbishop and the town; a part of the course was also divided into pipes belonging to the town and those belonging to the Archbishop, laid parallel side by side.[1069] The initiative of the Archbishop of Rouen was highly appreciated: it was underlined how greatly he cared for the public welfare. The Archbishop himself, having agreed to conduct water from "his" part of the water supply system to monasteries situated along the way, treated it as almsgiving ("en pure, vraye et franche osmosne").[1070]

In 13th-century London, still economically linked to Rouen, also through the elites of both of these centres, burghers with the help of the King began to build a water supply system in 1237.[1071]

One of the main centres of the Champagne fairs, namely Provins, had its own water supply system from 1273. From the beginning it belonged to the town: it was established by order of the town authorities by a hired master fountain-builder ("fontainier") who – in return for a yearly payment – conducted conduits along the streets; the conduits supplied water from nearby springs to burghers' houses.[1072]

1065 Le Lieur 1911, p. 12.
1066 Cerné 1930, p. 414: "Tableau comparatif des mesures anciennes avec celles du système décimal".
1067 Le Lieur 1911, p. 12.
1068 Op. cit., p. 17: 2 rows and 4 rows, pp. 11, 24, 57: 3 rows.
1069 Le Lieur 1911, pp. 31–33 quoted in: Sowina 2001, pp. 31–32.
1070 Le Lieur 1911, p. 39.
1071 More about this cf. Keene 2001, p. 176. Cf. also Bond 1991, p. 171.
1072 Guillerme 1985, pp. 192–193.

It is known from the oldest preserved accounts from Bruges dating from 1281 that the town authorities financed extensive works (also repairs) that were being carried out on the existing water supply system.[1073] At the end of the 13th century the above-mentioned Paris water supply system was also in use: two oldest surviving documents date to the year 1293: 1) a contract between the Paris authorities and a master fountain-builder ("fontainier") concerning the conservation of a stretch of the water supply system to the Fontaine des Innocents (Fountain of the Innocents)[1074] and 2) a document about the division of responsibility between the King and the town for the water supply system to Les Halles and to the Fountain of the Innocents.[1075] However, the Paris water supply system developed only after 1364, when water was conducted to the town through lead pipes from springs on the Belleville hill.[1076]

In towns of northern Germany from the beginning of the 1290s written sources testify to the functioning of town water supply system with water-work in the Hanseatic Town of Lübeck[1077] and from 1302 – of its second network.[1078]

Around the year 1400 a water supply system with a water-work was built in Bremen.[1079] As far as southern German towns are concerned, according to Ulf Dirlmeier and Klaus Grewe, one of the first centres in which water supply systems were constructed was the Prince-Bishopric of Basel, where in the mid-1260s the first two lines of conduits were built: to St Leonard's hospital (built in the

1073 De Rekeningen 1965, p. 36, 1 (financial year 1281/1282): *Tunc pro plumbo extrahendo de pipis post halla 7 s[ols]*, p. 72, 39 (1283/1284): *Pro opere ingenii extra [Boveriam],* p. 114, p. 115 (1284/85): *Item tunc pro circonspiciendo aqueductum versus domum Templi 28 s[ols] 1 d[enarium*], p. 160, 9 (1287/1288): *Item sabbato post Vincentii pro pipis infra hospitale sancti Johannis reficiendis 48 s[ols]*, p. 162, 35 (1287/1288): *Item pro pipa Nicolai Deinen facienda 38 lib. 11 p. 2d.,* p. 163, 5–6 (1287/1288): *Item pro pipa in Roia iuxta ingenium per Arnoldum de Bone reficienda* 8 lib. 8s. 2d., p. 163, 7 (1287/1288*): Item pro pipis supra forum Veneris et alibi reficiendis 185 lib. 15s. 4d.*, p. 165, 4 (1287/1288*): Item pro veteribus pipis infra villam per Johannem Abin reficiendis 100lb. 28 s. 4d.*, etc.

1074 Lafay 1991, p. 123.

1075 Op. cit., p. 120.

1076 Op. cit., p. 53. About the construction of water supply systems and their financing in other French towns – cf. Leguay 2002, passim.

1077 Grewe 1991a, pp. 61–62 and Grabowski/Mührenberg 1994, p. 27 – the latter authors mention that as early as in 1214 water from the River Wakenitz was conducted to the local Benedictine Monastery.

1078 Grewe 1991a, p. 63.

1079 Wijntjes 1982, p. 193.

years 1265–1266 in cooperation with the town) and to the Cathedral (built in 1266 by the Bishop, and from 1316 by the town). In 1296 there was only one water storage reservoir connected to the water network in Basel in the Cathedral Square; in 1440 there were 40 public and 22 private such reservoirs. It was only in 1455 that the water supply system came entirely under the town's control.[1080] In 1318 in Freiburg im Breisgau conduits were laid to the Town Hall. In Nuremberg the first water supply system was confirmed as existing in 1388; in 1396 a decorative fountain "Schöne Brunne" was built within its structure in the centre of the town. In the next century Nuremberg had ca 23 public water supply system reservoirs[1081] (besides 100 public dug wells functioning there at that time). Bern acquired its first water supply system in 1393, and another one in 1420. In the course of the 15th century water supply systems were built in Augsburg (1412), Zurich (1421/1430), Ulm (1426/1458), Regensburg (1449/1450) and Munich (1467/1471). In many of these centres connections were built to private reservoirs ("private Leitungsbrunnen").[1082]

Some Bohemian towns acquired water supply systems in the 14th century, but mainly in the 15th and the 16th centuries. The first gravity water supply system of the Old Town in Prague was mentioned in 1331; in 1361, i.e. during the reign of King Charles IV, water was conducted to Vyšehrad; the construction of such an installation in the New Town is dated to the mid-14th century[1083] (by order of the King the New Town was a realization of Vitruvius' model). The establishment of a water supply system in Most is dated to the year 1377.[1084] In Brno (apart from an uncertain source mention of 1354) a contract for the construction of a water supply system was drawn up in 1415 and one year later it was confirmed by King Wenceslaus IV of Bohemia. The contractor was called Prokop, a specialist from Písek, who later had shares in the water supply system (eventually, however, he

1080 Dirlmeier 1981, p. 134, Grewe 1991a, p. 56 on the basis of earlier research – cf. Huber 1955, p. 74 et seq. It is worth adding that this water supply system might have been extended – still with the participation of the bishopric – also during the Council of Basel convoked in 1431. A joint enterprise of the bishopric and the town, the water supply system was not only needed by the town which at the time was experiencing its economic heyday, but also convenient for the Council fathers who remained in Basel even after the Council had been suspended and later moved to Ferrara.

1081 Dirlmeier 1981, pp. 134–135 and Grewe 1991a, pp. 60–61.

1082 Dirlmeier 1981, p. 134.

1083 Široký 2000, p. 387; Jásek/Fiala 2004, p. 13, where the year 1348 is stated as the date of the establishment of the water supply systems both in the Old Town and in the New Town.

1084 Široký 2000, p. 382.

sold them for 10 marks); the enterprise was financed by a local patrician Václav Ház. In 1469 the water network passed to the possession of the community; it was still in use in the 16th century, to which fact testify charges for using the system made in 1508 to bath owners and in the years 1573–1619 to maltsters.[1085] In the first half of the 15th century (although it might have been in the previous century) a water supply system was built in Hradec Králové, a town suffering from the lack of water due to its being located on a hill and from the lack of water in wells. In Tábor, a town completely lacking water, a water supply system was constructed between 1492 and 1509.[1086] The whole installation consisted of the intake (namely a 53-hectare lake called "Jordan"), wooden pipes through which water was conducted in the direction of the town, and a water tower (still existing) built in the belt of the town fortifications, to which water was raised to the height of 32 meters.[1087] At the beginning the water from "Jordan" fed only the existing tank cisterns that were mainly used for firefighting purposes. The year 1567 marked the beginning of the construction of water storage reservoirs connected to a network of subsurface conduits open to the public (obviously, they were also used in the event of a fire), the first of which was erected in the Market Square.[1088] In the meantime, namely in the late 1550s, when the town was afflicted with fires, after the worst of them that swept through the city in 1559, a plan to conduct water from the River Lužnice was proposed, because – as R. Široký wrote – at the time of the greatest heat there were problems with maintaining a constant supply of water from the lake "Jordan".[1089]

The author of the present work believes that the royal privilege of 1514 for the Olomouc chapter to build a water supply system[1090] should be connected with the initiative of the Bishop of Olomouc in the years 1497–1540, Stanislaus Thurzo,[1091] the brother of Johann Thurzo Junior, the Bishop of Wrocław in the years 1506–

1085 Op. cit., pp. 379–380.

1086 Votruba et al. 1989, p. 10 – the first date appeared in a later record dating from the year 1619; a mention from the year 1509 found in the archives of the town of Kouřimi of hiring a master fountain-builder who had conducted water to Tábor ("dovedl vodu na Tábor") to build a water supply system in Kouřimi allows of a conclusion that the construction works connected with Jordan and the water supply system installations must have been finished before that year. Cf. also Široký 2000, pp. 381–382.

1087 Votruba et al. 1989, pp. 10–13.

1088 Op. cit., p. 21.

1089 Široký 2000, p. 389.

1090 Op. cit., pp. 383–384.

1091 The Bishop himself had his manor house at the castle in a nearby town of Kroměříž – cf. Baletka 1999, passim. It can be noted that the establishment of the water supply

1520. They were sons of Johann Thurzo Senior, a Kraków patrician from Levoča, a shareholder in the Olkusz mines,[1092] and thus they were well acquainted with the construction technique of draining devices used in mines. These devices served as the model for the water-work tower next to a mill belonging to the hospital in Olomouc, from which place water was conducted to the canons' residence. In 1528 the Bishops' water supply system in Olomouc was taken over by the town.[1093] The establishment of the water-work water supply system in Nymburk is generally dated at the 16th century.[1094]

The second half of the 14th century was the time when water supply system was established in Wrocław,[1095] being at that time under the Bohemian rule. Such dating of the construction implies the refutation of the former hypothesis about the existence of water supply system already in the 13th century, the main evidence of which were to be two-part conduits. In the latest literature they are interpreted as canals conducting water away from the town.[1096]

From among towns belonging to the State of the Teutonic Order, namely Elbląg, Toruń and Gdańsk, the early dating of Elbląg water supply system seems noteworthy. Its establishment was to be connected with the 1275 permission granted by the Provincial Master (*Landmeister*) of the Teutonic Order Conradus de Tierbergk (Konrad von Thierberg) senior to draw water for the needs of the town from a canal led from the River Kumiela.[1097] It is possible that this permission was connected with the programme of the organization of the State of the Teutonic Order, partly

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system was one of the first manifestations of Stanisław's Renaissance humanism, who also maintained contacts with scholars, including Conrad Celtes/Conradus Celtis.

1092 Molenda 1980, p. 520, Noga 2003, p. 213.

1093 Široký 2000, p. 384.

1094 Op. cit., p. 383.

1095 The latest findings – cf. Goliński 2001b, p. 212, where the author stated that the earliest [archaeologically] identified stretches of ceramic pipes come from that period. Cf. also Piekalski 2004, p. 12 – about "the earliest dendrochronological date from a casing of a water storage reservoir connected to a water supply system that stood in the former street called Górka Kacerska (Ketzerberg) no. 20, dated at the year 1293". According to earlier findings of this author and of C. Buśko, timber dendrochronologically dated at that year must have been reused, "because other elements of the same construction were dated at the year 1356".

1096 Buśko 1996, p. 111.

1097 Czaja/Nawrolski 1993, p. 222, quoted in: Nawrolska 2005, p. 160. However, these researchers do not provide any information (or source evidence) as to whether this water supply system actually began to function at that time, and if so, then why it failed to perform any role during the great fire in Elbląg in 1288.

based on the model of the rule of Frederick II of Sicily,[1098] in which such water installations played a particularly important economic role.[1099] One can also note that the above-mentioned privilege coincided with the formation of Elbląg's "town council system",[1100] in which generally it was the city council that was the owner of the water supply systems. Nevertheless, further studies should be conducted to determine the exact time of creation of the Elbląg water supply system, as the earliest objects (wooden troughs) considered as archaeological evidence of the existence of a water network in Elbląg are dated at the end of the 13th century.[1101] Hence, the establishment of a water supply system should rather be associated with the reconstruction of the town after the huge fire of 1288. As to Toruń, undoubtedly the oldest archaeological traces of the functioning of water supply system are dated at 1342/1343.[1102] Preserved written pieces of information concerning the functioning of a water supply system in the Main Town (*Rechtsstadt*) in Gdańsk date to the years 1379–1382.[1103]

In towns in the Polish lands the time of the establishment of water supply systems is dated at the 15th century and mainly at the 16th century.[1104] However,

1098 Zientara 1973, p. 254.

1099 Cf. Part II.4 of the present work.

1100 About this process: Czaja 1999, p. 22.

1101 Nawrolska 2005, p. 161, fig. 23. Nevertheless, wooden troughs can also be interpreted as conduits carrying wastewater (sewage, rainwater) away, as was shown by Cezary Buśko in the example of Wrocław – cf. above.

1102 Specified on the basis of dendrochronological studies, this date refers to a wooden pipe discovered in 2002 in the Old Town Market Square that formed part of a water supply system – Kola/Kotlewski 2003, pp. 25 and 28. The authors provided a reconstruction of its probable course: from the moat next to the Brama Starotoruńska (Old Toruń Gate), along Św. Ducha (Holy Ghost) Street (hence near the hospital), to the Market Square (pp. 27 et seq.). Consequently, the Grand Master's statement of 1346 on the construction of a water supply system to the hospital outside the town walls, from the side of the Vistula River, by Toruń burghers might have referred to a branch of the above-mentioned town water supply system, and not to a local way of supplying water solely for the needs of the hospital that was only called a water supply system (by Jasiński 1982, p. 54).

1103 Cf. recently: Maciakowska 2005, p. 331 et seq.; eadem 2011, pp. 106–107.

1104 Giedroyć's opinion (1906, p. 231) that "the word '*aqueductus*' as the name of devices connected with water supply systems can be encountered in Polish historical monuments as early as in the 13th century" has not been confirmed in sources to date. Too broad a meaning of this word – literally: "the way of the water" – that can also refer to any kind of artificial watercourses (like leats, channels or conduits connected with fish ponds) does not allow of a conclusion about the existence of water supply

complete sets of data concerning particular centres are extremely difficult to find. The reason for this situation is not only a fragmentary character of the sources, but also their being laconic, which can lead to a misguided interpretation and to false conclusions. The beginnings of these enterprises and later their functioning are dated on the basis of the following: 1) permissions granted by the owners of the towns to establish water supply systems; 2) accounts relating to their construction; 3) not only the presence of a master fountain-builder, but also remuneration in cash and in kind paid to him; 4) mentions of the functioning of the network or its elements; 5) charges made for using the network.

Only in the two latter cases can one be sure of the existence and functioning of a water supply system in a given centre. These two cases also testify to the fact that the town effectively acted on the royal privilege, that the construction was successfully completed and that the master fountain-builder was not only the builder, but also the conservator of the network. The fragmentary character of the surviving sources that has been mentioned above suggests that only rarely can one acquire all these pieces of information and only on the condition that one attained all the preserved kinds of sources. Otherwise, conclusions concerning the time of creation or the functioning of water supply system in a particular centre drawn on the basis of incomplete information can prove erroneous. Even more so, as there exist terminological traps that can cause our thinking to go astray. Among such traps are the words *aqueductor* and its German equivalent *Wasserführer*, as well as the word *canale*. Since the word *aqueductor* was used in reference both to water carters and to constructors of water supply systems (which is most visible in the Kraków account books of the turn of the 14th and 15th centuries[1105]) one can claim that it denoted a master fountain-builder only if the mention stated it clearly: either by calling this person a "rurmistrz" (Polish for: master fountain-builder), *Röhrenmeister*, *magister cannalium*, *cannalista*, or by describing his job, namely the construction or the conservation of the water supply system. If no such data is available, one cannot draw an unequivocal conclusion as to the establishment or the existence of a water supply system in a given town only on the basis of the word *aqueduc-*

systems if the only piece of evidence confirming this thesis would be the use of that word in written sources. Cf. also a definition by Paulus de Praga (BJ, Paulus de Praga, p. 257): *Aqueductus est ius aque ducende per alueum fundi proprium aut aliem super molendina aut piscinas aut fossata municipalia adimplenda qui ductus debet fieri sine dampno.*

1105 ANK, rkps/MS 1587–1589. These issues will be presented in greater detail further in this work.

tor, as was the case with studies concerning Bochnia (Świętosław the *aqueductor* in 1497),[1106] Poznań (Hanusz *Wasserführer* in 1398 and Stanisław *aquae ductor* in 1433[1107]), and even Sieradz (Szymon *aqueductor* in the years 1516–1521).[1108]

Another trap is the ambiguity of the words *can(n)alis* or *can(n)ale*, used mostly in the plural form, namely *can(n)ales* or *can(n)alia* respectively, to refer to water supply systems.[1109] However, these words were used also to denote all other types of artificial watercourses: not only those that conducted water to a particular destination (e.g. to a pond, brewery or garden), but also those that carried away rainwater (like gutters and drainpipes attached to the roof[1110]) and/or wastewater.[1111] In other words, they could refer to any artificial watercourses: open or closed[1112] and conducting water to a place or away from it. Conscious of the ambiguity of these terms, we must be particularly cautious when they appear in an unclear context: if not enough information is available, it may be impossible to unmistakeably interpret them.

Archaeological sources can prove enormously helpful in dealing with the above-mentioned difficulties resulting from the fragmentary character of written sources or from their being exceedingly laconic. New methods of examining archaeological finds enable a precise dating of an installation (as was done in Toruń) and defining the quality of water conducted through the conduits (as

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1106 Warcholik 1958, p. 641 and Sowina 1998b, pp. 139–141, with a polemic against this opinion.

1107 Giedroyć 1907, p. 414, quoted by: Kaniecki 2004, p. 599.

1108 Sowina 1991b, pp. 30 and 90 – Szymon *aqueductor*, the owner of a house in Mnisza Street in the years: ?–1516–1521–?. Having identified him with a high degree of probability, but too unequivocally as a master fountain-builder (before having embarked on the present research concerning water), the author put forward a supposition that the local water supply network, repaired from the year 1541 on, had been built a dozen years before, perhaps precisely under the supervision of this very Szymon *aqueductor*.

1109 Cf. inter alia: "canalia alias rury": AcCap., vol. II, 1902, p. 777.

1110 AcCap., vol. II, 1902, p. 11, year 1415: *Canalia quercina facere circumcirca turrim, ite quod de tecto turris aqua non habeat decursum ad tectum ecclesie.*

1111 Cf., inter alia, from Warsaw, from the year 1513: *[…] super canali sive decursione aquae […] de postico domus eiusdem.* – KsRadzStWarsz 1963, no. 1010, p. 294.

1112 According to a definition by Isidore of Seville, this was only a closed conduit, empty inside like reed: *Canalis ab eo quod cava sit in modum cannae* – IzydorEtym., 1911, liber XV, cap. VIII, 16. In the same place Isidore mentioned only the masculine and the feminine gender of the word in question: *sane canalem melius genere feminino quam masculino proferimus.*

was done in Prague[1113]); they can also contribute to a complete change of the opinion concerning the type of that water, e.g. not drinking water, but wastewater (as was the case in Wrocław, compare above).

Having analysed various kinds of sources, the author of the present work came to the conclusion that drawing up a list of towns that had a functioning water supply system in the 15th and 16th centuries in the Kingdom in Poland[1114] that would be complete and would raise no doubts as to its contents, would be impossible. Hence, the further part of this chapter will be devoted to a presentation of the findings that were based on the available sources and literature set against the European background.

1113 Starec 2005, p. 32: pollen analysis revealed that two-part pine troughs, dated to 1371, conducted from the Vltava River, carried very clean water that was suitable for drinking and free from any contaminants.

1114 To date, the fullest compilation including 37 towns in which water supply systems were built or were planned to be built was done by Franciszek Giedroyć between the years 1906 and 1909 (in most cases with copies of the documents, mainly royal privileges granting the right to build a water supply system). Meticulous as he was, the author did not avoid oversights and erroneous interpretation of source mentions. Cf. Giedroyć 1906, pp. 369–381: Biecz (privilege – further abbreviated as pr. – year 1464), Brześć Kujawski (pr. year 1549), Ciężkowice (pr. year 1540), Czchów (first half of the 16th century, before 1545), Drohobycz (pr. year 1544), Gdańsk (mid-16th century), Kamieniec (pr. year 1638; he overlooked a contract with a master fountain-builder dating from 1507), Nowe Miasto Korczyn (pr. year 1578), Kraków (erroneously as 1358, end of the 14th century); Giedroyć 1907, pp. 94–109 and 243–258: Kazimierz near Kraków (before 1527, pr. year 1533), Krosno (pr. year 1461), Lublin (before 1453, pr. year 1471), Lwów (years 1407–1413), Łomża (pr. year 1558), Opatów (directly after 1518), Opoczno (pr. year 1550), Pilzno (pr. year 1461, before 1487), Płock (pr. year 1498, building attempts 1509–1511, 1534 and 1537); Giedroyć 1907, pp. 411–421: Poznań (erroneously considered as a piece of evidence for the existence of water supply systems: 1398 r. – Hanusz Wasserfurer and 1433 – Stanislaus *ductor aque*; as late as 1493 – "magister canalium"), Proszowice (pr. year 1532), Przemyśl (ca 1530, pr. year 1532), Pyzdry (1539), Ryga (pr. year 1528), Sambor (before 1542?, pr. year 1542, pr. year 1589); Giedroyć F., 1908, pp. 137–139: Sandomierz (he overlooked construction accounts from the years 1531–1533; pr. year 1547, pr. year 1559, pr. year 1585); Sanok (pr. year 1510); Giedroyć 1908, pp. 282–285: Nowy Sącz (pr. year 1465, pr. year 1555), Szadek (pr. year 1541), Szydłów (pr. year 1528); Giedroyć 1908, pp. 402–405: Tczew – Derschau (pr. year 1542), Warsaw (before 1598); Giedroyć 1909, pp. 242–250 and pp. 367–372: Warta (pr. year 1556, pr. year 1562), Wieluń (pr. year 1532), Wilno (pr. year 1535), Wiślica (pr. year 1528), Włocławek (directly before 1577), Zator (pr. year 1569).

The water supply system of Kraków – the capital city of the Crown of the Kingdom in Poland – should be considered as the oldest. Kraków was a large Central European centre of crafts and international trade relations. Its water supply network was the only enterprise from the Polish lands whose establishment can surely be dated at the end of the 14th century.

Nothing is known of a privilege to build a water supply system in Kraków.[1115] Thanks to such a document – like privileges pertaining to other towns – we would be able to find out about the intentions of both the town authorities and the town's owner, namely the King, concerning the prospective place of the water supply system in the city's economic development programme.

Despite the fact that the town water supply system of Kraków were the subject of a thorough monograph written by Elżbieta Ligęza in 1971[1116] (the Wawel water supply system was not included in the book), several issues connected with these networks remain to be explained, whereas other merit further commentary or a different interpretation. The main issue that awaits resolution is the case of the alleged 14th-century water supply system in the light of the results of archaeological research carried out in 1962 in the Main Square in Kraków by Kazimierz Radwański. Radwański wrote: "in a significant number of research and installation trenches water supply system devices and possibly sewage devices were unearthed. In 14th-century levels wooden two-part water supply conduits run for hundreds of meters. Courses of conduits are interspersed with huge barrels from which water was directly drawn. (…) The sewage devices consisted of open wooden sewers and barrels performing the function of catch basins dug deep into sand ground."[1117] Leaving an informed interpretation of these finds to archaeologists, one can speculate (looking at their location on the map of the Main Square[1118]) that – according to C. Buśko's interpretation of analogous finds from Wrocław that were mentioned above – all of them might have been wooden public wastewater canals. One has to bear in mind that in Kraków existed a general obligation to build such canals. This was confirmed in a late source, namely a law passed by the city council in 1489.[1119] However, a close reading of 14th–16th century town court books reveals that much earlier there were many such canals in Kraków. They were private wastewater canals situated in the rear and/or side boundaries of the plots (namely in narrow

1115 In the absence of such privileges-permissions before the 15th century we can wonder whether this legal form was not introduced only in that century.

1116 Ligęza 1971, passim.

1117 Radwański 1964, p. 232.

1118 Op. cit., p. 230.

1119 PrzywWilkierzeKraków, 1936, no. 37, pp. 42–43.

passages between buildings or stalls[1120]) or even across the plots and leading to public canals running along streets (e.g. in Wiślna Street). Some of the canals had to be covered due to practical (connected with the topography of the land) or hygienic reasons, like *canale seu aquefluxum subterraneum* confirmed in sources in 1397 that crossed the back of the plot in the corner of the Main Square and Wiślna Street: it ran from a neighbouring plot to Wiślna Street, hence, a public wastewater canal must have been in that street.[1121] An *aqueductus* that was built in 1395 by Mikołaj Dąbrowa from his house up to the town moat (for which town councillors paid him 8 marks)[1122] must have been a public wastewater canal, and not an early water supply system led directly from the Rudawa-moat, as E. Ligęza described it.[1123] Among written sources only one piece of information dated at 1542[1124] seems to confirm the functioning of water supply system in Kraków in the 14th century. According to this material, there existed a belief that as early as 1358 King Casimir III the Great granted the right to collect a charge called *braxatura alias Rorgelt* to the town (the charge implied the existence of private connections, hence also water supply system). However, Stanisław Kutrzeba regarded linking King Casimir's privilege of 1358 with the existence of a water supply system in Kraków as erroneous and dated the establishment of such a system to the end of the 14th century.[1125] As was mentioned in the present work in the part devoted to dug wells, an analysis of the oldest preserved town accounts reveals that the basic charge on water supply network, identified by the author as "rurne" ("pipe charge"), i.e. money charged from the inhabitants for the possibility to draw water from water storage reservoirs connected to a network of subsurface conduits open to the public,[1126] appeared

1120 The existence of canals in narrow passages between buildings in the Market Square, namely between stalls near the northern side of the Kraków Cloth Hall called Sukiennice, was shown on the basis of archaeological research conducted in the Market Square in 2004 – cf. Zaitz 2006, p. 88 (a gutter in such a passage made of 2 planks from a pine tree felled "a dozen or several dozen years after 1284 and after 1340. Probably one of these planks was originally used in an earlier construction and was reused to unblock the outflow of water from that narrow passage"), p. 90 (a gutter in such a narrow passage between stalls dating from before the mid-14th century) and a map on p. 101.

1121 KsŁawKraków, 1904, no. 2410, p. 315.

1122 ANK, rkps/MS 1589, p. 18 (nlb) – accounts from the year 1395.

1123 Ligęza 1971, p. 28.

1124 KDMK, part II–IV, 1882, p. 734.

1125 Kutrzeba 1898, p. 41.

1126 In Kraków this charge amounted to 2 groschen quarterly for people who had no dug wells on their plots, and 1.5 groschen quarterly for those who owned such wells (hence, yet another kind of source of water supply than water supply systems).

only in the year 1400, which coincided with "conducting water to the town in pipes" (*aque ductura ad civitatem per cannas*),[1127] namely the ongoing construction of the Kraków pipe water supply with the water-work. Nevertheless, we can assume that the initiative to build a town water supply system with a water-work near the intake appeared earlier, at least in the mid-1380s, provided we make a connection between such a plan and the presence of Piotr Swalme in Kraków in 1385, who was referred to as "rorenmeister",[1128] i.e. undoubtedly water supply system builder. It is unlikely that he was just a "pipe master" who arrived in Kraków by chance and was expelled from the city for wounding a servant of one of the local patricians. There exist several mentions of 1391[1129] that could testify to the fact that he was a skilled professional needed by the town: according to these mentions money was to be paid for affairs connected with a certain *magister* Swalm – if we identify him as the above-mentioned Piotr. The most important was *litera securitatis domini Regis ad magistrum Swalm* which meant his right to a safe return to the town of exile.

The author of the present study is inclined to ascribe the initiative to build the installation in question to certain representatives of the ruling elite of Kraków of the period, including e.g. the above-mentioned *supparius* (who was also in charge of the town money) Godfryd Fattinante (who died in 1393),[1130] who probably experienced the benefits of water supply systems that had been functioning in Genoa, his hometown, at least from the beginning of the 13th century and in Bruges, the town from which he came to Kraków, from the late 13th century. Apart from Gotfryd, the initiators of the construction of the water supply system could come from the Kraków ruling elite of the time, in which supervisors of saltworks (*supparii*) played a prominent role. They were acquainted with mining devices,[1131] including winches and especially drainers ("Kunst"),[1132] on which was probably modelled the Kraków water-work (*Wasserkunst*), built in 1399, that raised water from the Rudawa-moat so that later a suitable inclination could be given to pipes which conducted water to the city.

Due to the lack of sources it is impossible to establish whether it was Piotr Swalme who eventually began the construction of the installation that was to conduct water from the Rudawa; if so, then it must have taken place before 1399,

1127 ANK, rkps/MS 1590, p. 46, year 1400.
1128 KsRachKraków, I, 1878, p. 65 and KsProscrKraków 2001, no. 741, p. 79.
1129 KsRachKraków, II, 1878, pp. 234–235.
1130 More about him – cf. Part III.2 of the present work: "Dug wells".
1131 Piotrowicz 1988, p. 118 and Mikołaj Serafin 2006, p. XXXI.
1132 Molenda 1980, pp. 519–525.

because according to accounts pertaining to that year, in 1399 works were well advanced, with a clear division of duties between the whole team of workers. However, at that time a new master fountain-builder headed this team, namely Martinus *magister cannarum*.[1133]

The 15th-century water supply network in Kraków did not belong to the most developed systems, which was shown in E. Ligęza's work. However, the Kraków network was consistently extended, to which fact testify the city council's permissions to build private connections to patricians' houses and the emergence in 1487 of a tax called *braxatura* paid on a gyle of beer by those who had private connections leading to their breweries.

As soon as in the year 1462 there arose such an urgent need to build a "new water-work" (*nouum aquagium*) that together with another burning need to repair a ruined town wall became the direct cause of an agreement of sale with the right to repurchase (*Wiederkauf*) for 536 florins of a 20-mark rent on the town's herring stalls to the Kraków Dominicans.[1134] Nevertheless, owing to the lack of sources it is impossible to elaborate on the building of this installation. The need for water from town water supply network was to be satisfied by the construction of a new water-work on the River Nieciecza, ordered by the King in 1521[1135] at the request of burghers who did not belong to the patriciate.

Compared with the town water supply system, the pipe water supply conducting water to the Wawel castle was established late, namely in the early 16th century, as testified in four royal documents dating from: 1502 (1), 1504 (1) and 1507 (2), referring to the remuneration of Jan *magister canalium alias rurmistrz de Dobruska (Debruska)* "for his services", and especially for conducting ("raising") water from the Rudawka to the Wawel castle *cannalibus et aliis instrumentis.*[1136] It was therefore a water-work construction. In the opinion of the author of the present study, the establishment of this installation can be associated with the coinciding Renaissance-style refurbishment of the Wawel castle that began about the year 1504.[1137] Hence, it would be one of the first tasks connected with this refurbishment.

1133 ANK, rkps/MS 1589, p. 305.

1134 KDMK, II–IV, 1882, no. 560, p. 684 (5 March 1462); this rent was repurchased by the town as soon as 15 October of the same year.

1135 Ligęza 1971, p. 32, quoted from: PrawaPrzywilejeKraków 1885, no. 17, § 23, p. 21.

1136 CA II/1, 1936, no. 26, p. 10 (quoted from: AGAD, MK 17, folio 320), no. 63, p. 23 (quoted from: MK 19, folio 122), no. 128, pp. 50–51 (quoted from: MK 22, folio 161) and no. 129, p. 51 (quoted from: MK 22, folio 162).

1137 Stępień 2002, p. 49.

The principal aim was of course supplying the royal courts of both the King and the Queen with water. Judging from a letter of 1533 from Piotr Tomicki, the Bishop of Kraków, to the Grand Marshal of the Crown, Piotr Kmita, at that time the pipe water supply conducted water not only to the castle and to the Queen's garden, but also to the Bishops' Palace.[1138] This letter and a slightly earlier one from Kmita to the Kraków councillors concerned the danger of pollution of water intakes for both the town water supply system and the Wawel system (*civitati et castro regio, tum denique orto Maiestatis reginalis et postremo curiae meae, quae omnia loca per illas vias mundam aquam recipere et copiam illius habere possent*) by the prospective construction of a house in Zwierzyniec for Marcin Myszkowski, the Castellan of Wieluń.[1139] It would surely exacerbate the existing serious problems connected with the pollution of the Rudawa, from where water was drawn to both of these systems. In his letter dated 16 June 1533 written to Piotr Kmita, the Kraków starost (and the Grand Marshal of the Crown) and to Seweryn Boner, the burgrave of the Wawel castle and the governor of the Royal domain of Kraków, King Sigismund I described the problems involving the pollution of the River Rudawa and the two pipe water supplies, namely the town and the Wawel networks, by dirty water and wastewater flowing down the gutters. The King specified that the River Rudawa was polluted and contaminated with wastewater and filth (coming) from latrines, from tanners or from all other people (perhaps this refers to craftsmen's workshops) which was why water flowing from that river to the castle water supply system was infected. It is not known how much earlier such problems (connected with bad management in the town that was plunged into social chaos) had arisen, since as early as 1531 water for the Queen was taken not from the castle water supply system, but from a well in the Canons' house,[1140] as was noted in the part devoted to dug wells. As regards other mentions of the Wawel water supply system, it is known that a record of 1530 in the Wawel building accounts in which the cost of 1 mark and 12 groschen was noted concerned this very water supply system: *lithostratho a suo labore in circuitu canalis seu cistae aqueae in primo castro*.[1141] However, it is not certain whether mentions in these Wawel building account books, e.g. dating from the year 1532, also refer to pipes that formed part

1138 Acta Tomiciana, XV, 1957, no. 465, pp. 639–640.

1139 Op. cit., no. 464, pp. 638–639.

1140 RachWawel, 2000, p. 37: *[Maii] 13. Item sabbato ante dominicam Rogationum [13 v 1531] a reformacione venae [urnae – correction U.S.] ferro ad fontem, ubi aqua hauritur pro Reginali Mte in domo canonicorum marc. – gr. 7 den. 9.*

1141 RachWawel, 2006, p. 6.

of the water supply system,[1142] because in other places in these accounts expenses connected with *canalia* (gutters for the castle) were recorded,[1143] whereas in 1530 a canal was mentioned running between the castle walls into which another canal flowed, namely one carrying wastewater away from the royal chamber.[1144] A record of 1558 from the same account books concerning 6 groschen of daily wage paid to a pavior and his helper for repairing the paving over an underground canal[1145] probably concerned a pipe water supply (and thus the situation would be similar to the one dating from 1530), although one cannot completely exclude the possibility that it concerned covered sewage canals.

As far as the beginnings and the functioning of water supply systems in other towns of the Crown of the Kingdom of Poland smaller than Kraków are concerned, judging from preambles to royal privileges or documents confirming the right to build water supply systems, they were built or were planned to be built in economically developing centres. Hence, it is not a coincidence that the most mentions of such water supply systems come from the 16th century, that is from the heyday of the development of towns in the Polish lands. At the same time, the construction of the installations was to act as a stimulus to the economic development of the towns. The town of Bochnia is a case in point. In 1519 the King granted a privilege to build a water supply system in the town to Mikołaj Cikowski, of Wojsławice the Bochnia *advocatus*, the burgrave of the Wawel castle and the Castellan of Połaniec.[1146] With the consent of the King, in 1524 Mikołaj Cikowski transferred the right *ad construenda et ducenda cannalia a ripa fluvii Raba* to the town councillors *secundum consuetudinem aliorum civitatum et praesertim civitatis Casimiriensis ad Cracoviam.*[1147] In 1533 it formed part of the "set" – as its inextricable element, together with other earlier privileges for the town (concerning *inter alia* court fees/penalties, free bread trade, local crop

1142 RachWawel, 2003, p. 10 – *canalia* were mentioned twice, when on 15 and 22 June saw producers were paid for 16 saws for cutting wood (8 groschen each) *ad canalia castri* and for 7 saws for cutting timber (3 groschen each), which amounted to 2 marks and 43 groschen in total.

1143 Undoubtedly about gutters – cf. op. cit., p. 69: about paying (on 12 October 1532) 4 groschen and 9 denarii for tarring them: *Item eadem die pro pice ad perfundenda canalia tecti marc. – gr. 4 den. 9*.

1144 RachWawel, 2006, p. 5: *lithostratis alioque brukarzom a canali inter muros incipiendo a turri campanarum usque ad canale secreti ex caminata regiae maiestatis marc. 2 gr. 40.*

1145 RachWielkorzBoner, 1974, p. 66: *licostratori restauranti licostratum super canalia pro die 1 et adiuvanti eius per die 1–6 gr.*

1146 AGAD, MK 48, folio 1044.

1147 MRPS, IV/2, 1912, no. 14079, p. 306.

measurements etc.) – comprising a royal document that introduced the division between the powers of the *advocatus* and those of the town.[1148]

In privileges granting the right to build water installations rulers often stated clearly that they were doing it in order to ameliorate the town's condition and for the public benefit. In 1508 King Sigismund I issued a privilege confirming his father's privilege of 1461[1149] granting the right to establish a water supply system in Little Poland's town of Pilzno. In its preamble, King Sigismund wrote: *ut Civitates nostras propensius in redditibus et proventibus adaugeamus Cupientes etiam oppidi nostri pilzno conditionem facere meliorem*.[1150] It is worth noting that the first indisputable mention of the beginning of the works involving the water supply system in this town comes from the year 1467: written in the oldest preserved town councillors' book of Pilzno, this mention refers to the remuneration of a master fountain-builder (*Cannalista*). He was paid 13 scots (26 groschen) *pro necessitate civitatis*.[1151] It is not impossible that some works were conducted already in 1454 and 1456, when 6 and 7 groschen respectively were spent *pro canali*,[1152] and especially in 1461, when as much as 7 florins were paid *pro labora canalium*.[1153] Extensive works on the Pilzno water supply system continued in 1488, which can be traced in town expenditures pertaining to that year.[1154] In fact, at that time the network was being built by a *cannalista* paid on a regular basis, preparing the *via ad Cannalia*, i.e. most probably a ditch in which he laid wooden pipes with metal connectors. The works being carried out at that time coincide with the excerpt from *Spominki Pilzneńskie* (*Pilzno Memoirs*) that was mentioned above, namely referring to the praise of the water supply systems and making a link, in an Aristotelian spirit, between human health and clean water.[1155] In this mention the installation is dated to 1487.[1156] The above-mentioned privilege of 1508 confirming the

1148 AGAD, MK 48, folios 1038–1049.

1149 Kiryk 1994, p. 100. Cf. also: AGAD, MK 23, folio 376: the privilege of 1508 contained the entire text of the permission with its date: *feria tercia post festum s. Trinitatis proxima anno domini Millesimo Quadringentesimo sexagesimo primo*.

1150 ANK, (Wawel), Dok.dep./Dep.doc. no. 95.

1151 ANK, (Wawel), rkps dep./Dep. MS 108, p. 64.

1152 Op. cit., pp. 14 and 20.

1153 Op. cit., p. 42. For the sake of comparison, at the beginning of 1461 the following sums were recorded (op. cit., p. 40): the town's total expenses – 230 marks and 1 ferto; income – 140 marks; in cash in the town coffers – 26 marks.

1154 Op. cit., pp. 123–135.

1155 Cf. Part I of the present work.

1156 The entire text in Latin: *De erectione canalium aquaticorum*. In: Giedroyć 1907, p. 105; also in: Spominki pilzneńskie 1961 p. 247–248; and Kowalska-Urbankowa

15th-century royal privilege for the town to have a water supply system was not connected with any impediments in their construction (e.g. with abandoning the old one and the necessity of building a new one), but with a conflict that occurred at the beginning of the 16th century between the town and the *advocatus* of Pilzno. This is evidenced by a royal document issued one week after the confirming privilege. It is a sentence in favour of the town: despite the *advocatus*' complaints concerning the destruction of his fields due to the course of the water supply system, the conduits could be laid without hindrance wherever they needed to be placed, and thus also in their current location.[1157] The King's favouring the town could stem from his will to secure the economic interests of the centre within the scope of a wider policy aimed at the development of Little Poland's towns especially exposed to being destroyed as situated near the Polish border. Such an explanation is formulated *expressis verbis* in a privilege for the town of Biecz to establish a water supply system.[1158] King Casimir IV Jagiellon granted this privilege in 1464 or 1465 (that is, almost at the same time as the one for Pilzno) and clarified that he wanted to reward the town for its services to the Monarch: "considering the location of the town of Biecz in the vicinity of the borders on which enemy attacks frequently occur and having experienced unswerving loyalty of its citizens and inhabitants", the King gave his consent to build a water supply system in Biecz and transferred the powers and the freedom of action in this respect to the town (*facultatem et libertatem damus, concedimus*). The King also permitted the town to derive income from the pipe water supply and to impose rent without hindrance and without payments to the King or to the starost.[1159] The highest ecclesiastical and state dignitaries witnessed this act, including the Bishop and the Castellan of Kraków, gathered at the Sejm in Nowe Miasto Korczyn (New Town of Korczyn), where this privilege was granted. Owing to the lack of 15th-century sources it is

1986, p. 455–456. Op. cit., p. 457 (year 1488): about letting water into a new water reservoir-chest.

1157 ANK, (Wawel), Dok.dep./Dep.doc. no. 96.

1158 The same situation occurred e.g. in Kamieniec Podolski. Feliks Kiryk (2005, p. 101) showed the establishment of a water supply system in that town as a contributing factor to the economic development of the city. His findings concerning the fact that the installation was finished perhaps as late as in the fourth decade of the 16th century (in comparison to the royal privilege issued in 1508 – op. cit., appendix on p. 103) can be supplemented by a supposition that it might have been Jan Boner who helped to complete the construction, as from 1528 the Kamieniecki indebted property was pledged with him (Ptaśnik 1905, p. 63).

1159 MatBiecz, year 1914, no. 50, p. 13, year 1464(5). Also: Giedroyć 1906, p. 369.

impossible to establish whether the construction began at that time and when the water supply system started to serve the town. It is known from the two oldest preserved Biecz account books pertaining to the years 1540–1545 and 1546–1553 that the water supply system was in use at that time: one of the permanent entries among the town's revenues were charges written down as *cannalia a civibus* and *cannalia a cerevisia* (both in the years 1546–1548).[1160] The former tax was the above-mentioned "rurne" ("pipe tax"), existing in every centre equipped with a water supply system, the latter was an equivalent of the Kraków *braxatura* defined above. At the same time we can learn from the Biecz expenditures of the period in question that the master fountain-builder (*cannalista*) was regularly paid and that ongoing works on the network were financed from the town money. The mentions of these works testify not only to running repairs, but also to the extension of the Biecz water supply system in the mid-16th century.[1161]

The King's favourable policy regarding certain towns found its reflection in a privilege to establish a water supply system in Płock granted in 1498. However, this privilege was to serve the Monarch to acquire the town's support for his political games. Płock, the town suffering from the lack of water due to its location, has the most documents concerning the attempts to establish a water supply system there in the years 1498–1537. These sources were gathered and published first by F. Giedroyć[1162] (some of them survived only in this form), and later by S.M. Szacherska.[1163] Both of them analysed the sources and showed to what extent this process was complex and difficult; moreover, it is not known whether it was successful. In the following part, the author of the present work would like to add to the above-mentioned two in-depth analyses several findings and observations she made.

The first documented step taken in the direction of the establishment of a water supply system in Płock was a privilege granted in 1498 in which the King allowed the town councillors to lay *Cannalia alias Ruri* in the town space in places where the inhabitants could draw water most comfortably. In the remaining part of the privilege a considerable difference between the text written in the *Metrica Regni Poloniae* and the text of the document given to the town can be observed. The latter text became the basis for the printed version in the *Diplomatic Code of the Duchy of Masovia* by J.T. Lubomirski, which in turn became the basis for the 1907 edition by F. Giedroyć and later for the 1987 *Collection of documents and*

1160 ANK, rkps dep./Dep. MS 25.

1161 ANK, rkps dep./Dep. MS 24 and 25.

1162 Giedroyć 1907, pp. 105–109 and pp. 243–258.

1163 ZbPłock II, 1987, passim (the relevant page numbers will be cited further on).

letters of the town of Płock by S.M. Szacherska.[1164] Hence, the text of the privilege, quoted below in full, is the first edition of its entire version, the one put down in the *Metrica Regni Poloniae*, which served as the basis for later possible confirmations and that was to be consulted in case the original document had been lost (the fragment that was missing from the document's editions and found only in the *Metrica Regni Poloniae* is marked in bold font):

In nomine Domini amen. Nos Iohannes Albertus Dei gratia rex Poloniae nec non terrarum – – significamus tenore Quomodo volentes civitatis nostre plocensis conditionem facere meliorem, sub qua tempore nostri regiminis uberiora sui accipiat incrementa, Consulibus Ciuitatis prefate plocensis plenam et omnimodam dedimus et concessimus facultatem damusque et concedimus per presentes Cannalia alias Ruri in loco Ciuili, qui ipsis commodior videbitur edificandi erigendi et construendi, ad eadem que aquam vndecunque poterint voluerint conuertendi et adducendi, atque Censum de Cannalibus eidem soluendum limittandj et statuendj temporibus duraturum. ***Subea condicione que omnes conpensas quascunque in construendis edificandisque Cannalibus prefatis Consules ipsi fecerunt debemus et tenebimur integre et ex toto ipsis soluere et reponere Interim vero quo solucionem ipsam non fecerimus damus Consulibus prefatis plenariam proprietatem Censum predictum de Cannalibus eisdem sit ut prefertur per eos limitatum prouenientem recipiendi tollendi manualiterque et in effectu leuandi atque seruandj et conuertendj pro Ciuitatis eiusdem Plocensis reformacione Tandiu donec per nos aut Successores nostros legittimos pro impensis predictis quas in Cannalium eorundem constructionem fecerint plenarie et integraliter satissaciemus Quaquindem satisfactione impensarum earundem per nos vel nostros Successores legittimos ipsis Consulibus facta possessio et vsusfructus Census supradicti de Cannalibus prefatis prouenientibus ad nos et nostros successores legittimos reuertetur pleno Iure*** *harum quibus est Actum Cracouie feria quinta festi ascensionis domini anno eiusdem millesimo quadringentesimo nonagesimo octauo. Regni vero nostri sexto presentibus reuerendis in Christo patribus dominis Andrea Roza archiepiscopo leopoliensi et Joanne Lubransskj electo confirmato plocensi Necnon Magnificis et Generosis Spithkone de Iaroslaw Cracouiensi Johanne de Tarnow Lublinensi palatinis Nicolao de Curozwank˙ castellano Siradiensi Et alys dignitariis et officialibus quampluribus. Datum per manus venerabilis Vincencij de Przeramb Regni nostri vicecancelarii, sincere nobis dilecti. Relacio eiusdem Venerabilis Vincencij de Przeramb Regni Polonie vicecancelarii.*[1165]

The difference between the texts concerned the financing of the water supply system. While in the document given to the town the King only granted the

1164 ZbPłock II, 1987, no. 270, pp. 8–9 (tekst), na p. 8 opis oryginału wydania, informacje o wydaniach, regestrach i literaturze. Cf. also: Giedroyć 1907, p. 243 and id. 1909, p. 380, footnote 77: indication of the basis for this edition: *Kodeks dyplomatyczny księstwa Mazowieckiego*. Warszawa 1863, p. 317, no. CCLXVIII.

1165 AGAD, MK, 16, folio 201.

council the charges that would be made for the water supply system **after** it had been initiated, in the other text, written in the *Metrica Regni Poloniae*, the King (also on behalf of his successors) undertook to finance the construction of the installation. Therefore, all expenses incurred by the Płock town council to build the water supply system were to be reimbursed from the royal treasury. Only in case this did not happen, the councillors were allowed to take over the charges and spend the money on repair works in the town; the councillors were to be in charge of the money until the King or his successors reimbursed the whole cost of the construction. This financial solution is the only one found among all privileges concerning the establishment of water supply systems in towns of the Crown of the Kingdom of Poland. In the present author's opinion, its unique character resulted from the will of the King to gain favour of Płock, the town that had only recently been incorporated into the Crown, especially in the situation of a conflict with Konrad III the Red (Rudy), the Prince of Czersk and Warsaw.[1166] Let us recall that it was on 7 August 1498 that the King issued a document in which he abolished the Toruń staple right, which also served the best interests of Płock.[1167] The pledge to finance the construction of the water supply system in Płock given on 24 May 1498 agrees with the time when, according to M.S. Szacherska, from the beginning of that year Jan Olbracht (John Albert) paid more attention to this very town, which also found its reflection in the appointment of a new starost.[1168]

The pledge in question was never fulfilled (neither was the execution of the order to abolish the Toruń staple right); it remained a dead law in the *Metrica Regni Poloniae*. The witnesses to the signature of this act also did not stand up for the fulfilment of this pledge at that time, namely two successive Bishops of Płock: Jan Lubrański and Wincenty Przerembski (at least the latter must have known about this pledge, as it was recorded in his files as Vice-Chancellor in the *Metrica Regni Poloniae*), even though conducting water also to the Cathedral was in their direct interest. In the light of the above, one can wonder whether the town, having only the abridged version of the privilege, knew about the royal pledge (it is not impossible that the preserved document was written and delivered later, when the conflict with Prince Konrad ended); in any case, the fact is that at that time the town

1166 More about this conflict cf. Papée 2006, pp. 90–97 and p. 97 footnote 216: "[Płock] owed its first water supply system also to the support of this King [Jan Olbracht/John Albert – comment U.S.]".

1167 ZbPłock II, 1987, no. 271, pp. 9–11; before on that subject: Szacherska 1973, pp. 113, 124–125.

1168 Szacherska 1973, p. 111.

did not start to build the intended installation. In the next royal privilege granting the right to establish a water supply system in Płock, issued on 1 August 1509, after a fire that had ravaged the town in the spring of that year, King Sigismund I pointed to the legacy of Michał Prażmowski, the provost of Płock, who died on 14 March 1507,[1169] in the amount of 200 times threescore groschen, i.e. 250 marks, as the source of financing the installation that was to conduct water to the castle, to the town and to the chapter.[1170] For that reason the town was not the addressee of this privilege, neither were its authorities, but the persons who administered the legacy, namely the executors of Prażmowski's testament, first of all Bishop Erazm Ciołek. It was to Ciołek, and not to the town, that the King gave a mill on the River Brzeźnica; the Monarch intended the mill to be demolished and a water-work to be constructed in its place. The town was involved in participating in the cost of the investment only through the obligation to make a yearly payment of 10 times threescore of groschen (600 groschen, namely 12.5 marks) to fund the altar in the Płock Cathedral. In front of this altar weekly masses would be held with special prayers for Prażmowski's soul and for the souls of his relatives. On 12 February 1511[1171] the King granted the authorities of Płock a formal permission to perpetually remunerate the altarist at the altar in the Płock Cathedral in the amount of the above-mentioned 10 times threescore of groschen yearly; the altar was erected by Erazm Ciołek and the executors of Prażmowski's testament. The document indicates that it was they who made the town participate financially in the planned (and therefore still unrealized) installation. It was a form of a reimbursement of the expenses incurred in relation to the construction of the water supply system from Prażmowski's legacy: if it had not been left as a legacy, the money would have

1169 Szacherska 1973, p. 43, footnote 1 to no. 295 – citing: Żebrowski 1984–1985, pp. 381–382: "Michał Prażmowski entitled to the coat of arms 'Belina', son of Piotr, the castellan of Lviv; bachelor of arts, doctor of decrees, canon of St Michael's Collegiate Church 1463 and of the Płock Cathedral 1469, archdeacon of Płock 1482, Peter's Pence collector in Poland from 1494, canon of Gniezno 1498, Kraków, Warsaw, provost of Płock 1500". This biographical entry contains information about Prażmowski's visits to Rome: first between 1473 and 1479 he continued his law studies there, and later – from 1491 to 1497 – he stayed at the Papal Court of Pope Alexander VI Borgia, where he worked at the Papal Chancery. Having won Pope Alexander's favour, "in 1496 he became an acolyte and a member of the Papal Household, and in 1497 – a collector of Peter's Pence in the Gniezno Province, a papal legate and a collector of all income of the Apostolic Camera in the Kingdom of Poland".

1170 ZbPłock II, 1987, no. 295, pp. 42–43.

1171 Op. cit., no. 300, pp. 48–49.

gone to the Płock Cathedral. The role of Michał Prażmowski, the Papal legate, and that of Erazm Ciołek, the Bishop of Płock, in the planned enterprise concerning the construction of a water supply system in Płock can be compared – keeping the comparison in proportion – with the role of the Papal legate and Archbishop of Rouen Georges d'Amboise, however, with the difference that the latter managed to fulfil his task.[1172] While visiting the papal court, Ciołek and Prażmowski had the opportunity to see the Trevi Fountain in Rome; the fountain was fed with water from the only ancient aqueduct functioning at that time called Aqua Vergine (*Aqua Virgo*), restored in 1453 by Pope Nicholas V. It is worth noting that the Primate Jan Łaski, a great antagonist of the Bishop Erazm Ciołek, did not manage to establish a water supply system in his town of Łowicz; in order to bring the town back to life after a great fire of 1525, the Primate only instructed the town to build a well from which water could be drawn.[1173] And yet Łowicz enjoyed much more favourable conditions to establish a water supply system than Płock did.

It is impossible to assess to what extent the attempt to establish a water supply system in Płock made in the years 1509–1511 by the clergy of the local Cathedral headed by the Bishop progressed beyond the preliminary arrangements concerning the legal, financial and technical aspects of the installation. The documentation dating from the 1530s referring to the next attempt to build a water supply system shows that among the indicated (and dutifully collected) sources of its financing was no legacy of Michał Prażmowski. If we assume that the legacy had been spent as intended, it may have been spent on *cannalia antiqua, quae sunt subtus terram*, i.e. on pipes that had been mentioned in 1534[1174] as "old" and situated underground; they constitute the only source (from the whole documentation that has been preserved to the present day) that the construction of the water supply system in Płock actually had ever been started and carried on.

The following constitute the evidence of the attempt to establish a water supply system in Płock: 1) a contract between the town authorities and Mikołaj Łuszczek, a master fountain-builder from Bochnia, dating from 1534, concerning

1172 In 1500 Georges d'Amboise contributed to the establishment of the Carville water supply system – Le Lieur 1911, p. 2 et seq.

1173 StatutyŁowicz, 1998, p. 23. Cf. also Tafiłowski 2007, p. 399, where the author mentions building "new wells" in the streets as one of the manifestations of the care J. Łaski devoted to rebuilding the town after this fire (cf. loc. cit. about issuing firefighting regulations at that time, including regulations concerning the equipment and the way of protecting houses, as well as regarding the exemption of the burnt-down town from customs duties in 1526).

1174 ZbPłock II, 1987, no. 393, p. 168.

the construction of an *aqueductum perfectum completum* (including a "mill" and a tower called a "rurhaus") for 800 florins,[1175] 2) the terms of an agreement of 1534 concerning a loan given by Jan Alansee for the construction of a water supply system,[1176] 3) the fact that the King once again gave to the town a still existing mill on the River Brzeźnica (with the view to establishing a water-work/ *Wasserkunst* there) also in the year 1534,[1177] 4) the terms of a settlement reached between the town and Jan Alansee in 1537 concerning the building of the water supply system.[1178] In the opinion of the present author, this attempt should certainly be associated with the pursuit of comfort of the Płock grain merchants who were becoming more and more wealthy and who constituted a clearly separated town elite, especially after the introduction of favourable regulations of 1527 and 1537 concerning free transport of goods on the River Vistula.[1179] Their good financial standing resulted in their higher material needs and in their will to improve their living conditions, including the elimination of the greatest difficulty, namely the lack of water. However, this did not translate into such financial possibilities of the town that would allow the city to build the water supply system at its own expense. Hence, apart from collecting the funds from last will legacies, the town needed to borrow money from Jan Alansee, the burgomaster of Płock, apothecary and aromatist (also of the Polish Queen Bona Sforza); the town committed itself to pay him back the sum from future revenues from charges made for using the network and to grant him the right to fish in a pond of the water-work.[1180]

The practice of paying back the money that the investor had lent to the town to build a water supply system by giving him future water network charges was used also in other centres, e.g. in Lublin and in Little Poland's small town of Czchów. The former case was described in literature: it is known that the investors in Lublin were the very masters fountain-builders, who in subsequent years became the owners, and later the co-owners of the water supply network.[1181] As to Czchów, in 1548 in the town court book a man named Tomasz, a helper of the supervisor of Bochnia

1175 Op. cit., no. 393, pp. 166–169.
1176 Op. cit., no. 394, pp. 169–172.
1177 Op. cit., no. 395, pp. 172–173.
1178 Op. cit., no. 420, pp. 210–218.
1179 Szacherska 1973, pp. 125–126.
1180 Cf. Szacherska 1973, pp. 144–148: a detailed description of the events from the years 1534–1538 which – according to that researcher – led to the launch of the system.
1181 Hoczyk-Siwkowa 1997, pp. 175 et seq., with a list of earlier literature.

saltworks,[1182] was called "the first author" of the town water supply system.[1183] Four years earlier Tomasz had made a payment of 500 florins for the *Canalia alias rury*; he started to take his money back in the following way: the councillors and all the inhabitants of the town were to pay him 4 groschen for a gyle of beer. Moreover, every citizen (*civis*) was to pay quarterly one groschen and the inhabitants (*inquilini*) were to pay half a groschen until the entire sum of 500 florins had not been repaid. He also suggested that for each gyle of beer after the sum had been repaid, a half of a groshen should be paid to the town to its benefit and a half of a groshen to him.[1184] Every year Tomasz rented the water supply system for 30 florins a year and for its running repairs. The person who rented the water supply system was usually one of the town councillors, just as in other centres was the case with such devices and town revenues as the scales, the bridge charge and the charge for laying one's products for sale; all of them were also rented by members of the town council. The town probably repaid the whole sum to Tomasz before 1555, because in that year the water supply network was rented by the town councillors to Tomasz Wróbel, a town councillor, for the same amount of money, i.e. for 30 florins a year.[1185]

The financing of water supply systems was an enormously important issue that decided about their establishment in a given centre. Polish towns, despite their good condition, were not always able to finance the enterprise on their own. It is worth mentioning that e.g. the maintenance (and probably also the construction) of a water supply system in Sieradz was financed by the local starosty,[1186] the construction of a water supply system in Sandomierz (to the town and to the castle) in the years 1530–1537 cost 2006 florins and 4 Vierchen paid from the royal treasury and from the coffer belonging to Jakub, a vice-custos of Sandomierz; the money was successively paid to the scribe of the Sandomierz bourgh for the master fountain-builder with whom a contract was made.[1187]

1182 About the administrative structure of the saltworks – Piotrowicz 1988, p. 115.

1183 ANK, AD 514, p. 198, year 1548.

1184 Op. cit., p. 166. This division of income was confirmed by the King in 1545, who added that after Tomasz's death his part of the income should be spent either according to his last will, or on pious purposes. The other half of the income should be devoted to the repairs of the water network – AGAD, MK 70, folio 180v., printed in: Giedroyć 1906, p. 375.

1185 ANK, AD 514, p. 283.

1186 Sowina 1991b, pp. 30–31.

1187 More about this cf. Sowina 1998b, pp. 143 et seq. and eadem 1998c, pp. 211 also in detail about the water supply system in Sandomierz and its builders.

Nevertheless, financial or technical problems (the latter will be discussed further) were not the only obstacles to the construction and later in the functioning of water supply systems. Sometimes their efficient functioning on a daily basis, indispensible for an uninterrupted functioning of devices and crafts that were dependent on water, hinged on the weather. A group of records found in 16th-century town files of Nowy Sącz that pertain to the earliest charges made for the use of the local water supply system for two financial years 1558–1559 and 1559–1560 can serve to illustrate this point.[1188] Interruptions to the functioning of the water supply system were recorded and a smaller revenue from its use was explained. 56 weekly payments to the town coffers were registered for the use of the system in the period between Saturday before St Valentine's Day (12 February) 1558 and Saturday before the Laetare Sunday (4 March) 1559. During this period interruptions in the water supply were noted 6 times:[1189] once because the water supply system was breached: *aquae ductus ruptus erat* (12 February), twice because the water would not flow to the town: *aqua ad civitatem non fluxit/fluebat* (1 October and 12 November 1558), twice because it would not flow for four days: *(eo ex) per quattuor dies aqua ad Civitatem non stillavit* (28 May and 29 October 1558), once because it did not flow for three days: *quia ad civitatem aqua per tres dies non stillavit* (15 October). As we can see, autumnal interruptions happening in October/November were predominant. However, neither of the six above-mentioned interruptions entailed a total loss of the town revenue from the water supply network, only it was smaller (it amounted to 52 marks and 15 groschen for the period in question[1190]). The situation was worse in the financial year 1559–1560 from 11 March 1559 to 20 April 1560 comprising 60 weekly payments.[1191] Just like in 1558, one day before Pentecost of 1559 (13 May) a decreased revenue was noted because *aqua ad Civitatem non stillavit*. No disturbances in the functioning of the water supply system were noted in the summer months until 2 September. This time the reason was revealed: the lack of water in the water supply system was a result of a drought. From that day until Christmas of 1559 only once 5 groschen were paid (23 September), another 5 groschen were paid on 30 December, and 15 groschen were paid on Epiphany of 1560. However, mostly no revenue was noted (*nil percepimus/canalia*

1188 ANK, AD 149, pp. 25–27: *Regestrum proventuum civilium*.

1189 ANK, AD 149, pp. 25–27.

1190 For the sake of comparison*: the aqualium civitate Siradie* charged by the Sieradz starosty in 1541 amounted to 133 florins and 26 groschen (83 marks and 32 groschen), and in 1543 – 139 florins and 15 groschen (87 marks and 9 groschen): *Cannalium seu aqualium alias rurnego Civitatis Siradiensis* – Sowina 1991b, p. 31.

1191 ANK, AD 149, pp. 73–75.

non erant); sometimes a reason was given: "water did not flow to the town" because e.g. until Saturday, 20 January, everything was icebound (*sabato ipso die Fabiani et Sebastiani canalia non erant aqua propter magnum gelum non stillavit*). The water supply network was out of use until the end of that financial year, namely until 20 April. The revenue from the water supply system for this whole period amounted to 26 marks, 27 groschen and 9 denarii), i.e. about a half less than in the previous financial year. This long period – lasting for over seven months – when the network was not used found its reflection in the town accounts: there appeared a group of 16 records about paying money from the town coffers for carting water. Between 23 September 1559 and the Holy Saturday, 13 April 1560, 19 marks and 19 groschen were spent on carting water.[1192] Only after the election of new authorities the town began to record water network charges from 11 May 1560, this time no interruptions in the water supply were mentioned. Such a situation lasted at least until 21 January 1562.[1193]

III.3.4 The structure of water supply systems

As was mentioned above, the type of source texts that in each case show the same structure of water supply systems to the fullest extent is their description. Based on experience, they constitute the best evidence of the actual functioning of a network in a given centre and show the role this water supply system performed in the topography of the city, in its society and in its economy. Although there survived just a few such descriptions for the above-mentioned towns, yet they form a model according to which the structure of water supply systems in other centres can be recreated.

Apart from the description of the water supply system in Rouen and besides the description of the water supply system in Bruges and in Augsburg, we should mention once more such a description pertaining to Wrocław, because to date it is the only known text from the Polish lands, published and discussed by Mateusz Goliński.[1194] Dated by the publisher to the year 1499, it presents the Wrocław water supply network in the vicinity of the Dominican Monastery and Kacerska Górka. M. Goliński's comparison of this description and the results of thorough archaeological studies revealed a considerable correspondence between both of these sources. This correspondence and numerous references in the text itself to specific places in the town's topography next to which the network ran (e.g. "windows of

1192 ANK, AD 149, p. 107: *A ductura aquae solutio incipitur*.
1193 ANK, AD 149, pp. 109–110, 138–139.
1194 Goliński 2001a, passim; the source text: pp. 117–121.

the mangle", "nuns' little rooms" or houses belonging to burghers mentioned by name) constitute irrefutable evidence that this description was done by personal observation, namely probably after inspections of the water supply system (like the ones in Bruges and Rouen). The most important inspection of the Wrocław water network was conducted ca 1477–1480 (it was then that the earliest version was created, which was later updated ca 1499[1195]). These conclusions and the description itself, very similar to the other above-mentioned two (particularly to the Flemish one – due to its laconic simplicity), allow of a supposition that such descriptions were done (according to a similar pattern resulting from the same rules of building water supply systems in these centres) in other towns also later, as evidenced by two descriptions of the Toruń water supply network dating from 1706 and 1735.[1196]

III.3.4.1 Water intakes for water supply systems

Since the fundamental task of the water supply system was to supply drinking water, i.e. water safe to consume, the intake had to be found or chosen in such a way as to ensure that it supplied an abundance of water of the best quality: "abondanza di buona acqua da bere", as Villani phrased it, or – according to Alberti – the best, suitable for drinking. For that reason sometimes the intakes were far away from the town or they were such that drawing water from them involved serious technical difficulties. Like in Greek, but especially Roman antiquity, mediaeval European towns used spring water, rivers or their artificial branches, which confirmed the high opinion about water drawn from these types of reservoirs, expressed in treatises and encyclopaedias. Also town moats served as intakes for water supply systems.

Spring water intakes

Gravity water supply systems, namely such in which water flowed down a slope from the intake, could use springs, i.e. water coming (flowing) from under the ground and water flowing to natural or man-made reservoirs.

The best described examples of such a solution are the water supply intakes in the Norman town of Rouen. The 13th-century water supply system called "Gaalor" issued from the intake of the same name ("la sourse de la fontaine") to which neighbouring waters flowed.[1197] It was a vaulted place carved into the rock, ca 10 feet high (ca 3.25 m), ca 10–12 feet wide (3.25–3.90 m) in which a "very old"

1195 Op. cit., p. 107.
1196 Kola/Kotlewski 2003, pp. 13–14 et seq.
1197 Le Lieur 1911, p. 7.

painting of the Virgin Mary was placed. It was situated at the foot of a hill in the suburb called Bouvereul, ca 87 fathoms away (i.e. ca 170 m)[1198] from Philip II Augustus' castle and the north-western part of the town fortifications, whose part the castle formed.[1199] Also the two other water supply systems built in the early 16th century in this town had their intakes in the suburbs. Both of them were brick/stone cisterns located in private gardens. What we know about the first one is that it was 2.75 km away from the town walls and that it had the Archbishop's and the town's coats of arms sculpted at the entrance (they were partners in this project).[1200] The other one collected spring water flowing from the nearby hill called Sestet.[1201] Very similar forms of intakes were found in Belleville (the intake for the Paris water supply system)[1202] and intakes of water supply systems in Italian towns. The latter intakes were also decorated with Marian images[1203] (as was the case with "Gaalor" water system), which most probably bore relation with the double symbolic reference: water-mother and clean spring water corresponding to virginity.[1204] Laying a water supply system from a spring intake situated outside the town (even outside the suburbs, due to the pollution of town and suburban waters connected with the growing number of inhabitants) was also confirmed for London in 1237.[1205]

Written sources concerning Polish towns very rarely provide information about spring intakes of water supply systems; only sporadically do they mention the way they looked and describe their owners' decisions as to their use for the above-mentioned purposes. When in 1464 the decision was reached to build a water supply system in Little Poland's town of Biecz, water was to flow to the network "from all places in the fields and in the mountains",[1206] which meant that the

1198 1 fathom = 6 feet = 1.95 m – cf. Cerné, 1930, p. 414: "Tableau comparatif des mesures anciennes avec celles du système décimal". While describing the course of water supply networks, J. Le Lieur consistently provided the length of individual stretches which he later often added together.

1199 Le Lieur 1911, p. 7.

1200 Op. cit., p. 29.

1201 Op. cit., p. 48.

1202 Lafay 1991.

1203 Nessi 1971, p. 118.

1204 More about such symbolism cf. e.g. Santo Tomás Pérez 1998, p. 16.

1205 Keene 2001, pp. 174–175.

1206 MatBiecz 1914, no. 50, p. 13, years: 1464/1465. Despite the fact that water collected in this way may have also been derived from rain or melted snow, however, for the water supply system to be fed with water without any disturbances, the system must have been based on water acquired from intakes that were always working.

Biecz water supply system had its source in springs from which streams flowed that were situated outside of town. More information can be gained from a privilege issued in 1534 by Jan, the Bishop of Poznań, that concerned Kościan,[1207] the Greater Poland's second largest town of to Poznań.[1208] The document described the following situation: the burgomaster and the town council, having to deal with the lack of water, bought "certain places" on six meadows (*in sex pratis illorum certa loca*) that belonged to six peasants from a village called Kiełczewo: Stefan Marcisz, Tomasz Gąsior, Maciej Schurek, Maciej Almanus, Albert Pietro and Tomasz Halas. The village belonged to the Bishop and was situated outside the north border of the town. The purchase was made in order to obtain (and dig out) "streams of waters", as had been done in some other places. From there water was to be lead through pipes all the way to the town for the benefit of the town and of the public. As the master of the waters, the Bishop confirmed this state of affairs and gave the Kościan burghers for ever the above-mentioned waters from the meadows that the peasants had sold them. At the same time, the Bishop imposed a duty on the town to pay *ex pretorio* six groschen of a yearly rent due on St. Martin's Day to each of the peasants who would incur any losses in connection with the fact that pipes ran through their fields or that buildings necessary for the functioning of the water supply system were located there.[1209] The exactness of the description of the difficult conditions concerning the land and the ownership relations pertaining to the establishment (and later the functioning) of the water installation in Kościan shows that the choice of this specific spring water (in Kiełczewo, and earlier in some other places, whose location was not stated) was the town councillors' conscious and well thought-out decision taken against the choice of the River Obra that flowed in direct proximity to the town (to the east and north-east of the town). What is more, judging from the reconstruction of the town plan for the 15th and the 16th centuries done by K. Górska-Gołaska,[1210] Obra must have separated the town from the meadows in the village of Kiełczewo, and thus also from the sources of the Kościan water supply system. However, this was not marked in the plan. In the light of the situation presented in the Bishop's document of 1534 one can consider K. Górska-Gołaska's suggestion that "perhaps water from the muddy Obra was unsuitable for drinking."[1211] However, the enigmatic character of her findings concerning also the early modern history of the Kościan water supply system makes us doubtful

1207 APP, Kościan document I/10.
1208 Górska-Gołaska 1994, p. 225.
1209 Op. cit., p. 228, where the document was understood differently.
1210 Op. cit., p. 230.
1211 Op. cit., p. 228.

about it, especially so because in 1791 a "machine supplying the town with water" was marked on the Obra River on the town plan.[1212] It was probably a water-work (*Wasserkunst*) that drew water from the river.[1213]

In the 16th century far-away springs, and not a nearby river, became the intake of a water supply system of Pyzdry, a town in Greater Poland. In a royal privilege issued in 1539 it was decided that the intake be a *piscinula* formed of spring streams on a hill in the royal village of Dłusko situated near the town.[1214] The River Warta, on which the town was situated, was not mentioned.

Another document showing that water supply system was conducted from springs was a privilege of 1569 in which the Lubin abbot together with the friars of his monastery, as the owners of a Greater Poland's town of Krzywiń, granted the burghers a spring ("szdroÿ") located in the town fields on the Jezioro Wielkie (Grand Lake) forever. Like the privilege pertaining to Kościan, it also confirmed an existing situation, in this case, however, the spring had been prepared and water had been flowing through the fields belonging to the town and to the hospital through pipes in a sufficient amount; all this had been done at the expense of the burghers, namely the abbot's and the monastery's subjects.[1215]

1212 Loc. cit.

1213 This might have been the same type of a "machine" as the one described two years earlier, namely in 1789, in a Warsaw newspaper entitled "Dziennik Handlowy i Ekonomiczny [Trade and Economic Daily]" as being designed by Antoni Melchior Lewandowski, an echevin from Gniezno, who called himself "a mechanic and a poet" – cf. Balcerzak E., 1968, p. 70 and footnote 126. Judging from a description cited there, it was a water-work (*Wasserkunst*) of the "Paternosterwerk" type, not only used in the Middle Ages and in the modern era in mines and water supply systems, but also described in detail in relevant 16th–18th-century technical literature, including works by G. Agricola and S. Solski. According to E. Balcerzak it was presented in Warsaw at that time to the King as a great novelty. This only shows, in the opinion of the author of the present work, the ignorance of the journalist and of the people surrounding the King, as well as the fraudulence of the "author" of the design, if this was the word he used to describe himself. Let us also recall the same type of a "water machine" that functioned ca 1756 in Prince Hieronim Radziwiłł's Lithuanian estates, described in his diary by the Prince, who was one of the greatest magnates in the Polish-Lithuanian Commonwealth. – Radziwiłł 1999, p. 81. A. Zamoyski, the author of a foreword to H. Radziwiłł's works, made the following remark concerning the above description: "an architect […] hired by […] Hieronim's father, marvelled at a similar mechanism in Versailles in 1700; it might have been him who brought plans of this device to Poland" – op. cit., p. 85, footnote 11.

1214 Giedroyć 1907, p. 416, quoted after: AGAD, MK 58, folio 226v.

1215 APP, Krzywiń – document I/10.

The abbot appreciated the burghers' large contribution and acceded to the pleas of the town authorities and granted them forever the charges for brewing beer "as long as the spring and the pipes continue to exist."

The best presented spring intakes of water supply systems are the ones of Toruń, but only for the 2nd half of the 17th century. Nevertheless, these documents, namely a report of the local master fountain-builder (dating from 1683) and especially 17th-century plans showing the location of the water supply network[1216] reveal marked similarities to the description and drawings of the above-mentioned water supply system of Rouen. Both in Rouen and in Toruń the installations consisted of reservoirs located in suburban fields: for Toruń they were in Bielany and Mokre, away from the town's pollution. Especially four reservoirs in Bielany supplied water that was "nice, clear and healthy," "as a crystal". In the above-mentioned report a more detailed description of one of the reservoirs was preserved: it was built of "strong oak poles, the bottom was paved with field stones, and covered with oak poles."[1217]

The fact that water for water supply systems was taken from springs testifies to the belief shared by those who built them that spring water would suffice. Hence, the choice of the particular springs was a conscious decision taken at the stage of planning the investment. This choice must have been preceded by a field study and a proper evaluation of the efficiency of the spring. The example of Rouen shows that there was more than enough water in springs and that its surplus had to be drained from the network.[1218] The same was probably true for the Toruń springs: a more than sufficient amount of water taken from there made it possible to build a branch leading to the dyeworks,[1219] whereas in the town chronicles an opinion prevailed that "water was sufficient not only for wells (found everywhere across the two towns), but also for pumps in private houses to the benefit of the burghers."[1220] If we decide to believe this, then the information concerning the shortage of water in the Nowe Miasto (New Town) of Toruń (and thus also concerning the use of rainwater cisterns there in the early 18th century)[1221] will testify to a bad functioning of the local water supply system or even to its

1216 The text of the report translated into Polish – Piskorska 1931, p. 307. Plans published in fragments in: Kola/Kotlewski 2003, pp. 16, 17, 45 et seq.

1217 Piskorska 1931, p. 307. Discussed in great detail in: Kola/Kotlewski 2003, pp. 45 et seq.

1218 Le Lieur 1911, p. 11.

1219 Piskorska 1931, p. 307.

1220 Op. cit., p. 304.

1221 Kola/Kotlewski 2003, p. 10, footnote 4.

complete failure, but not to a small efficiency of the sources from which water was or could be drawn for the water supply network.

Water-works (Wasserkünste)

According to Klaus Grewe, the author of a synthesis of the technique of conducting water (water supply and drainage) in the Middle Ages, the "era of the water-works" ("Zeitalter der Wasserkunst") in "the German-speaking space" began in 1293/1294 with the construction of a water-work on the River Wakenitz in Lűbeck.[1222] A scoop/bucket wheel was used to lift water taken from the River Wakenitz. This wheel was run by a waterwheel powered by water from that river[1223] (fig. 49). In 1302, together with another water supply system, a second water-work was built; it had a reservoir for the purification of water.

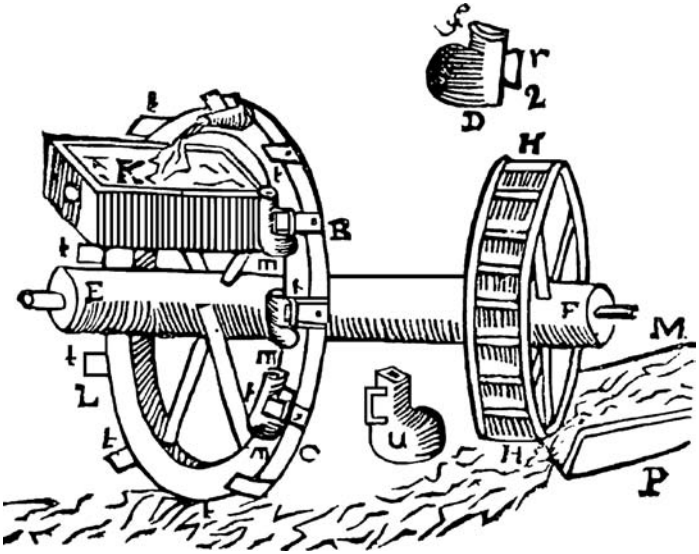

Fig. 49: The simplest water-work: a wheel with scoops on its circumference, set in motion by a waterwheel, after: Solski 1959 (1690), p. 327, fig. 194.

1222 Grewe 1991a, pp. 55 and 62. However, this author makes a stipulation that wherever there was no need to build them, the whole installation functioned solely on the basis of gravitation. About the water-work in Lűbeck cf. also: Grabowski/Mührenberg 1994, p. 27.

1223 Grewe 1991a, pp. 62–63.

In literature one can come across the opinion that the first water-work in Lűbeck was the oldest water-work with a scoop/bucket wheel in Europe.[1224] Nevertheless, one has to bear in mind that norias had been performing this role in the Iberian peninsula, at least in Córdoba and Toledo. Perhaps even in Christian Europe of that time the Lűbeck water-work was not the oldest one. During the research conducted prior to writing the present work, the author found the following mention in 13th-century accounts of another powerful Hanseatic city, namely Bruges, pertaining to the financial year of 1283/1284: *pro opere ingenii extra [Boveriam] – 10½ lib*.[1225] On the basis of that mention we can assume that the local water-work with a scoop/bucket wheel was at least being built at that time. The scoop/bucket wheel raised water from the town pond to which neighbouring waters were conducted from the south and the east.[1226] The pond was filled in 1386 during the construction of the town fortifications; later water was taken from the town moat,[1227] still with the use of the wheel whose unusual size caught the attention of a Dutch lawyer, Hadrianus Marius, in the mid-16th century. While enumerating the advantages of Bruges, a town whose greatness surpassed that of every other town, he listed "a huge wheel on the fortifications thanks to which water flows in abundance".[1228] W.C. Wijntjes quoted Guiccardini's description of this wheel dating from the late 16th century, according to which it was an instrument equipped with lots of scoops, located in the water house (*waterhuis*) and powered by a horse mill.[1229] As has been stated before, earlier, namely in the years 1512–1515, the size of the water-work wheel in Wrocław drawing water from the Odra River near the Brama Młyńska (Mill's Gate) filled Bartholomeus Stenus with admiration.[1230] The construction that he saw had been built in the 2nd half or in the

1224 Wijntjes 1982, p. 193.
1225 De Rekeningen 1965, p. 72.
1226 InvBruges, IV, 1871–1885, p. 293, entry: "Moerbuise".
1227 Op. cit., p. 177 and Historische Stedenatlas, 1991, p. 171: Waterhuis (Oud): "noria of waterscheprad".
1228 All the advantages of Bruges he mentioned were as follows: "ses églises d'une maîtrise habile, ses palais publics, aux armoiries dorées ses demeures privées, parées avec non moins d'argent et de la fierté. Un chef-d'œuvre inimaginable: mille ponts d'une pierre choisie avec soin – certains disent que Bruges leur doit son nom – et l'enorme roue sur ses remparts, qui fait affluer les eaux en abondance" – in a French translation from a Dutch original, in: Vermeersch 1992, p. 15.
1229 Wijntjes 1982, p. 193.
1230 Stein 1995, p. 115.

end of the 15th century in the place of an earlier water-work.[1231] According to K. Grewe,[1232] after the next fundamental refurbishment in 1538, it had a scoop/bucket wheel of ca 48 feet in diameter, namely ca 15 meters, with 160 wooden scoops/buckets. It raised water to ca 28 feet (i.e. to 14 ells – compared with the alleged 90 ells in Toledo), i.e. ca 8.15 meters, and supplied ca 500 litres water per minute at the most. However, according to data quoted by W.C. Wijntjes, the scoop/bucket wheel in Bremen built ca 1400, with very similar dimensions (ca 14.5 meters in diameter, it raised water to ca 8 meters),[1233] supplied more water, because one turn of the wheel gave 1 m^3 (1000 litres) water; the number of turns – provided there was a favourable level of water in the River Weser – amounted to 51 per hour,[1234] and thus 0.85 per minute, supplying ca 0.85 m^3 (850 litres) water every minute.

It has not been established how high water from the Oława River was lifted by the oldest water-work in Wrocław, in the Ketzerberg district, namely what was the diameter of its scoop/bucket wheel called "Wasserade", thanks to which from the mid-14th century a water supply system functioned in this part of the town. A piece of information concerning its much later reconstruction (in 1597) that included supplying it with four pumps that raised water 40 feet high,[1235] i.e. ca 11.7 m, can serve as a clue in terms of the altitude to which water was lifted by this water-work. Not much is known about the third Wrocław water-work wheel called sometimes in literature "Mathiaskunst",[1236] built on the Odra River between 1529 and 1539,[1237] marked on Weiner's town plan of 1562 as "Wasserkunst" near the little Isle of St Matthias.[1238] It is worth noting that despite the construction of this

1231 Goliński 1997, p. 79, quoted by: Piekalski 2004, p. 13 – stated the year 1479, whereas K. Grewe (1991a, p. 65) – 1497.

1232 Grewe 1991a, p. 65.

1233 The ratio of the height to which water was raised to the diameter of the scoop/bucket wheel in both of these cases (namely Bremen and Wrocław) was very similar and equalled 0.55 and 0.58 respectively.

1234 Wijntjes 1982, p. 193.

1235 Piekalski 2004, p. 13.

1236 Grewe 1991a, p. 65 and Hoffmann A. 2005, p. 92.

1237 This piece of information provided by: Grewe 1991a, p. 65, whereas Goliński 1997, p. 137 quoted by Piekalski 2004, p. 14 cite an item of source information concerning the beginning of construction works on a waterwheel and a master fountain-builder's house there in 1529.

1238 Grewe 1991a, p. 65 informs that in the second half of the 19th century four piston pumps installed there raised water to ca 11 meters, supplying 900 litres water per minute. Since the number of pumps and the height seem remarkably similar (in spite

water-work, in the same time, namely in 1538, the "Great Kunst" was modernised to such an extent that it was practically built anew.

Apart from wheels with scoops/buckets on their circumference as well as constructions of the "Paternosterwerk" type, still built for mines,[1239] in the 15th century suction and force pumps started to be used in water-works. The first pump of this kind was to be used in 1463 in Lűbeck.[1240] Elżbieta Ligęza came across a mention of a pump in the town water-work in Kraków in the town accounts pertaining to the year 1531.[1241] Radek Široký supposes that the use of such pumps was planned in the project dating from the mid-16th century concerning the water supply to the town of Tabor from the River Lužnice[1242] (fig. 50).

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of the difference in time) to these parameters of the water-work (*Wasserkunst*) in Ketzerberg after its reconstruction at the end of the 16th century, we can either assume that in both of these places of drawing water existed the same natural conditions and the same performance of the pumps, or suspect a confusion of information. What should be noted is the mutual ignorance of German and Polish researchers of each others' studies on Wrocław water-works.

1239 A drainer used in a mine was mentioned in a document issued by King Alexander in 1504 in which the monarch permitted – on certain conditions – one Kraków burgher called Jan Coczwara to build at his own expense *opus instrumentarum quorundam, alias kunszt appellatorum, aquarum de fodinis educendarum* – CA II/1, 1936, no. 66, p. 24.

1240 Grewe 1991a, p. 63; Grabowski/Mührenberg 1994, p. 30.

1241 Ligęza 1971, p. 51 with reference to: ANK, rkps/MS 1602, folio 75, in which the expense of 24 groschen on hides for a pump (*cutes ad pompa*) was recorded.

1242 Široký 2000, p. 362.

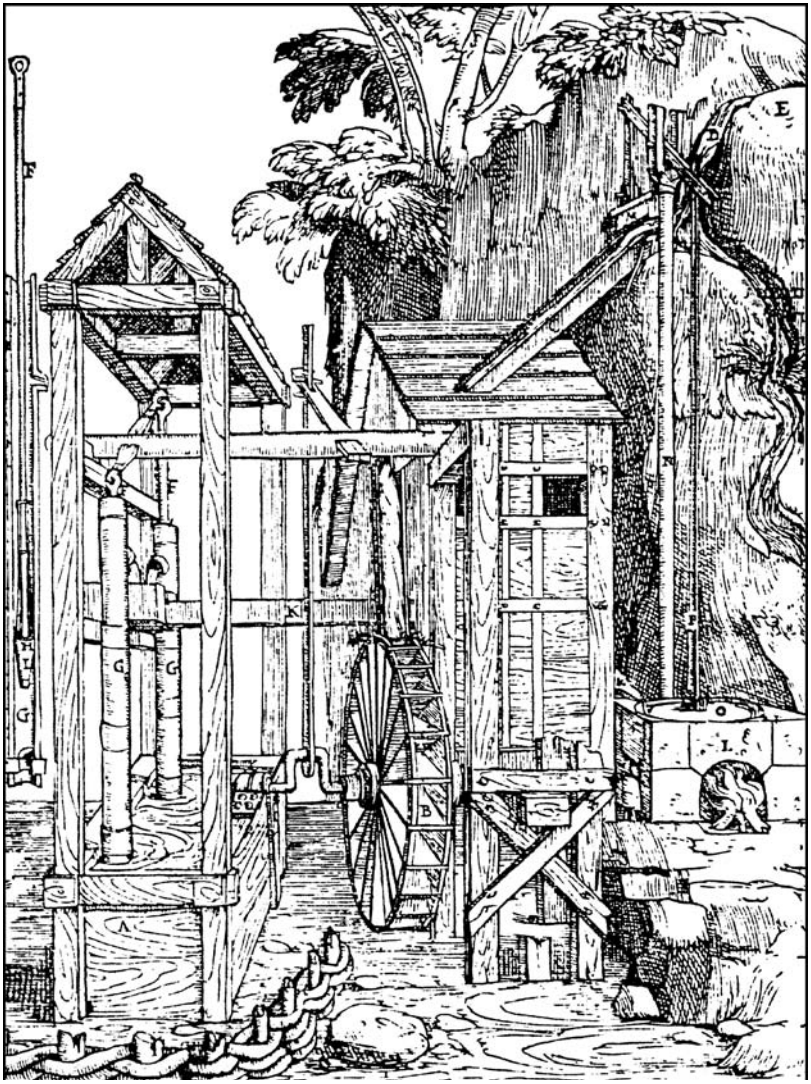

Fig. 50: A structure for lifting water: piston pumps set in motion by a waterwheel. Woodcut dating from 1553, after: Prignitz 1986, p. 15.

The devices that lifted water poured it into an upper reservoir (fig. 51) from which it was further carried in one of two possible ways, depending on the landform. The first way consisted in conducting it though conduits to the town along a

slope, i.e. gravitationally.[1243] The second method consisted in making the water flow down from the reservoir though a vertical pipe and only later in conducting it under pressure through conduits to the town.[1244] The first method necessitated conducting pipes from the reservoir on the ground; in the second method pipes could be conducted underground from the beginning. The devices were protected in buildings that by their nature had the shape of a tower. As is shown in the example of Augsburg[1245] and udoubtedly also Bruges, water-work rooms could be situated in small towers within the structure of the town fortifications. According to archaeological research on the remains of the water-work in Vilnius, conducted by W.K. Griszyn, the water-work tower to which the waterwheel was fitted, stood ca 50 m away from the town fortifications, on a water reservoir dug specially for that purpose.[1246] We can learn from royal accounts that in the year 1547 from the royal treasury was paid *pro facienda fossa inter piscinas in Wieschupi et pro restauratione ibidem seu perfectionem ex 3 piscinis in unam et pro effosione 3 piscinarum Vilnae circa fluvium Vilna, ac ductione Canalium ex rivum circa murum Vilnens.*[1247] A fragment of a woodcut by Elias Diebel of 1552 represents two water towers in Lűbeck connected with the two local water supply systems: *Brauwasserkunst* and *Kaufleutewasserkunst* (fig. 52); this piece also testifies to the reconstruction of the water-works in Lűbeck that took place between the time of their establishment and the mid-16th century. The water towers on the Vltava River in Prague (fig. 53) were and still are a characteristic and autonomous element of the townscape. The recently published documentation concerning the largest of these towers, called Šitkovská vodárna, created for the New Town in 1495 (fig. 54 and 55), shows that it consisted of a mill with a waterwheel and of a tower in which water was raised (after the 1588–1591 reconstruction surely with the use of pumps).[1248] This two-part structure of this water intake must have resembled the one built in 1514 in Olomouc in order to draw water for the local chapter headed by Stanisław Thurzo (see above). It may have been similar also to the construction in Tábor from the turn of the 15th and the 16th centuries (a plan dating from

1243 Solski 1959 (1690), pp. 331–332.
1244 Hoffmann A. 2005, p. 89.
1245 Wijntjes 1982, p. 192; Grewe 1991a, p. 68.
1246 Griszin 1989, p. 87.
1247 AGAD, ASK, Rachunki królewskie/Royal accounts 140, folio 184v.
1248 It was built in a place where mills had been functioning from the year 1178; later they were managed by the authorities of the Prague New Town; before the mid-15th century they were bought by Jan Šitek – cf. Jásek/Fiala 2004, p. 13 et seq.; also Jásek 2004, pp. 125–130.

the mid-16th century envisaged the construction of two towers and an iron or lead pipeline conducted in the rock).[1249] Let us draw our attention to water-work water intakes of the Lublin water supply system built from 1506 and of the Płock water supply system as results from the scope of the works that were stipulated in the contract with a master fountain-builder in 1534. The analysis of the following constructions: in Olomouc, Prague, Lublin and Płock, lead the present author to the conclusion that all of them were built according to the same technical model, identified as surely used in the 16th century. Two buildings represented by A. Hogenberg in the Lublin panorama of 1617 (see fig. 9) are undoubtedly counterparts of these devices, as they form part of a water-work installation of the local water supply system: *officina aquaeductus et canalium sursum aquam premens* and *turris ubi aqua in Civitate artificiose deducitur*.[1250] The same seems true for the Płock installation: according to the above-mentioned stipulation dating from 1534, it was to include the same type of rooms: *turris dicta rurhaus ac…domicula in qua fabricabitur kunsth, ubi in defectu aliquo aque in Brzeźnicza torrente volvetur rotha equo…*.[1251] The description of the Lublin device, which constitutes the sum of the results of historical, archaeological and technical research,[1252] is also an attempt to reconstruct the local intake functioning in this shape certainly in the 1550s,[1253] and according to Lublin researchers as soon as 1510.[1254] Water conducted through a ditch from the Canal of the River Bystrzyca was to be pumped (raised with the use of a suction and force pump with two pistons) through a vertical pipe placed in a tower up to a reservoir from which it later flowed down to the town's water supply network.[1255] The efficiency of this device was calculated by Z.T. Mazurek at ca 3.96 m^3/hour,[1256] which amounts to 3960 litres/hour, i.e. ca 66 litres/minute. This is surprisingly little in comparison with the figures quoted above concerning

1249 Široký 2000, p. 389.

1250 Lublin, 1997, pp. 10–11.

1251 ZbPłock II, 1987, no. 393, pp. 167–168.

1252 Hoczyk-Siwkowa 1997, passim (with illustrations).

1253 Dated by the present author on the basis of source data quoted by S. Hoczyk-Siwkowa (1997, p. 172), mainly on the basis of the earliest mention cited there, from the year 1556, about paying "Stanisław the cooper 40 thalers for his work on a wooden chest that was later carried by four men up the tower".

1254 Hoczyk-Siwkowa 1997, p. 168.

1255 Op. cit., p. 170 – illustration: "Schemat technologiczny wodociągu lubelskiego [Technological schema of the Lublin water supply system]", after: Mazurek 1986a, illustration after p. 100. The structure of the whole 16th-century water supply system in Lublin was described in detail by Z.T. Mazurek (1986b, pp. 39–57).

1256 Mazurek 1986b, p. 50.

the efficiency of scoop/bucket wheels in Bremen and in Wrocław (850 and 500 litres/minute respectively), without the use of a suction and force pump.

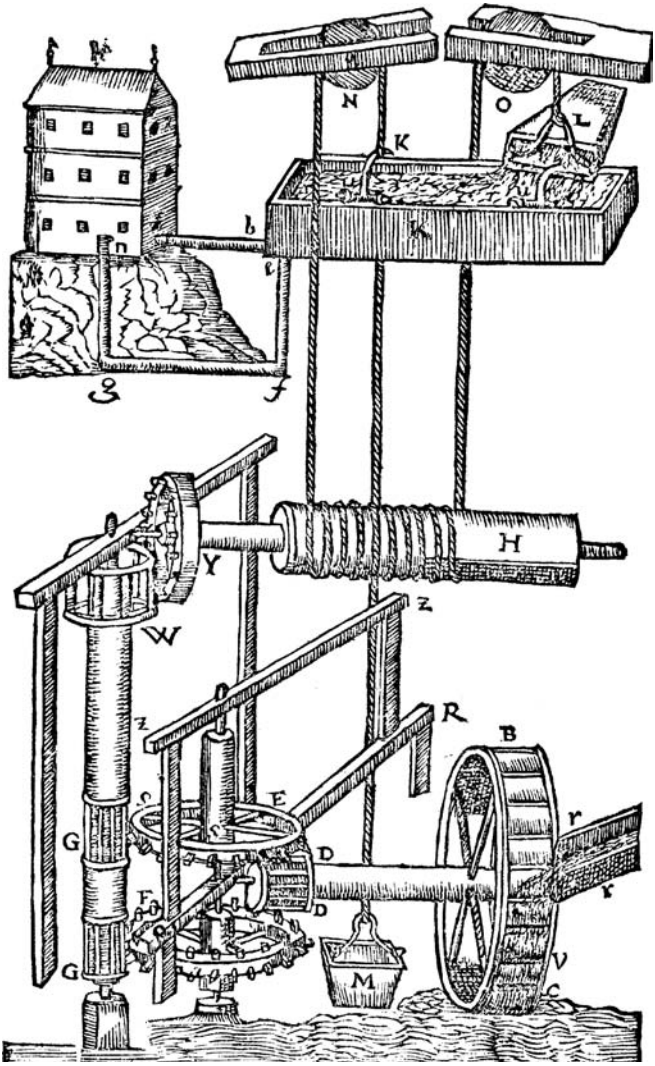

Fig. 51: An example of the structure of a water-work raising water, after: Solski 1959 (1690), p. 332, fig. 196.

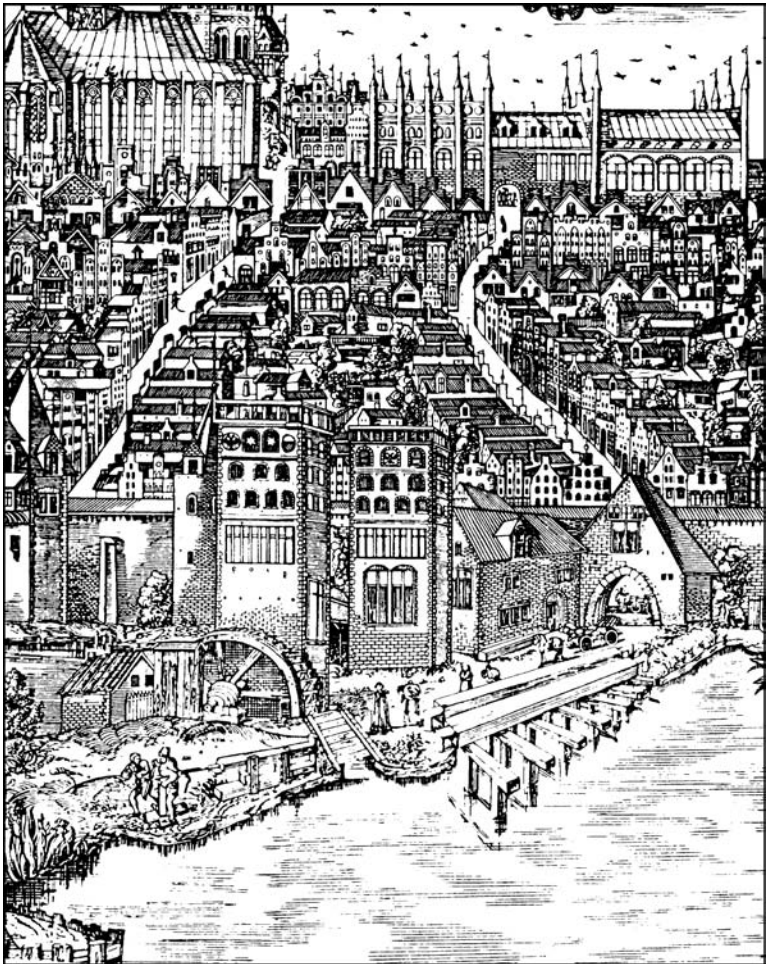

Fig. 52: Lűbeck. A fragment of a woodcut by Elias Diebel dating from 1552, with a wheel next to one of the two water towers for the networks: Brauwasserkunst and Kaufleutewasserkunst. On the bank of the River Wakenitz a master fountain-builder with his helper manually drill a wooden pipe, after: Grabowski/Mührenberg 1994, p. 28.

Fig. 53: Prague. A water tower in the Old Town on the Vltava River, with the Charles Bridge in the background. Photograph: U. Sowina.

Fig. 54: Prague. The Šitkovská vodárna (water tower) with mills on the Vltava River, 1562, after: Jásek/Fiala 2004, p. 17.

Fig. 55: Prague. The Šitkovská vodárna (water tower) in the New Town. Photograph: U. Sowina.

The construction of the Płock water-work, identified above as having (intended to have) the same devices, namely a "mill" and a tower (*turris, rurhaus dicta)*, was to begin with building the "mill" in the ravine of the River Brzeźnica. We can learn about it from a royal privilege of 1509.[1257] In this document, issued for the Bishop Erazm Ciołek, King Sigismund I decided to allocate a pond (*piscina*) and a royal grain mill on the River Brzeźnica near a village called Powsin for the needs of a planned water supply network. This grain mill was to be demolished so that in its place another mill could be built that would serve the needs of this water supply

1257 ZbPłock II, 1987, no. 295, p. 44.

system. The necessity to demolish this grain mill (and not any other), even though it supplied an abundance of foodstuffs to the castle (the starost's residence) and served not only the town, but also the whole area, tells us that this particular place was considered as the only one that was the best to build a water intake for the network. The King as the owner of the river could have chosen any other place; he was hindered neither by the existing pond, nor by the fact that the river fed at least two more mills.[1258] The need of a complete demolition of one watermill only to build another watermill in the same place, undoubtedly a water-work lifting water, could mean that not only the inner devices to grind grain had to be taken apart, but also the water and driving devices required at least a reconstruction. Bishop Erazm Ciołek obtained a royal privilege to build three new ponds (*piscinae*): the first was to be constructed near the new mill/water-work that would lift water from this pond to the water supply system; the other two were to be built on a higher place[1259] in order to help the first one so that an abundance of water would collect there and the water supply system would never experience its lack. The ponds were to be constructed in such a way as to cause no harm to mills located below. Serving as intakes (reservoirs) for the water supply systems, they were stocked with fish,[1260] since according to the same royal privilege, the King allowed Bishop Erazm Ciołek who managed the whole enterprise to catch fish in these ponds without any restrictions, until the King or his successors arrived in the castle: in this case the whole catch was to be sent to the castle for the King. However, even then it was allowed to draw water from these ponds for the needs of the water supply system.[1261] The

1258 Cf. Part II of the present work.

1259 About this ability to build multi-level ponds and pools in Poland as early as in the 1250s in order to raise the level of water used by watermills – cf. Dembińska 1973, p. 106–107.

1260 Apart from the indubitable economic interest, stocking ponds with fish may have been connected with the above-mentioned opinion – presented in Palladius's agricultural treatise, later repeated by Crescenzi and Alberti, and of course in the 16th-century Polish translation of Crescenzi's treatise – that letting fish into the pond so that they caused constant movement of the water purified it.

1261 ZbPłock II, 1987, no. 295, p. 44.: *Harum autem piscinarum usum prefatus dominus episcopus modernus liberum habebit in piscibus expiscandis tamdiu, quamdiu castrum in potestate nostra seu successorum nostrorum non fuerit. Cum autem in potestate nostra castrum fuerit, usus piscium totus pro nobis, aqua libera in piscinis pro ductu manente, reservatus permaneat.* In the light of this document the opinion expressed in R. Široký's work (2000, p. 389) that drawing water for the needs of the water supply system from the lake called "Jordan" in Tábor was in conflict with repeated attempts to breed fish in it, does not seem correct.

large number of instructions included in this privilege and concerning the technical details of the construction of the water intake for the Płock water supply system indicate that this document was drawn up in cooperation with constructors of water devices thanks to whom mills could function (here we can see the similarity between the job of a miller and that of a master fountain-builder). In the event of a surplus of water in the water supply network, which would remain after the water had been conducted to the castle and to the town, the King allowed the Bishop in this privilege to use this surplus for his own needs, however, without detriment to the King. Hence, one can come to the conclusion that at that time no one foresaw of any difficulties that could hinder the realisation of the whole investment, namely conducting water from the ravine of the river Brzeźnica, through the suburb, to the town and to the cathedral (i.e. along a stretch ca 3 km long), including technical and financial difficulties connected with the very water intake. The water was to flow from this particular place on the river to the town; to this end it was necessary to raise it from the ravine up the escarpment, which meant lifting it ca 40 meters high.[1262] The cost of this enterprise was to be augmented by an indemnity for the mill that was to be demolished. The indemnity amounted to 60 bushels (in Polish: nom. sing.: korzec) of rye a year that the King ordered to be supplied by the Bishop to the castle for the benefit of the starost. This quantity of rye corresponded to the value of ca 35 marks.[1263] Nevertheless, it is known that the construction of the Płock water-work intake was certainly not realised until 1534; it was that year that the King, four months after having concluded a contract with a master fountain-builder concerning the construction of a water supply system (anew), once again granted his mill on the River Brzeźnica to establish a water-work there (without detriment to other mills), this time, however, he gave it to the town, but without the need to pay the above-mentioned 60 bushels i.e. a last (*…ab uno lasto aut sexaginta coretis siliginis…*). And yet, in return, the town at its own expense was to conduct water to the square in front of the cathedral and to build a water (storage) reservoir connected to a network of subsurface conduits open to the public in front of the castle. As far as the granted mill is concerned, the document included an explanation that Bishop Andrzej (Krzycki) together with the whole chapter waived his right to this mill that had been given to his predecessor for all his successors.[1264]

The water-work mentioned in the contract with the master fountain-builder was to raise water to the height comparable to the one reached by the devices used

1262 Żebrowski 1973, p. 63 and PłockMapaTopogr., 1997.
1263 Chmielewski 1962, p. 117.
1264 ZbPłock II, 1987, no. 395, pp. 172–173.

in Tábor (32 meters), or maybe even greater; hence, considering the size of the escarpment, the construction of the "Paternosterwerk" was chosen (the builder came from the mining town of Bochnia), referred to in the contract as "Kunst". It was to be driven by the force of the waterwheel in the "mill". The difficulties of Płock with the supply of water are testified by the fact that even though a water intake had been chosen, the stipulation was made that in case of a water shortage, the "Kunst" was to be powered by a horse mill. Thus, it is highly probable that this water-work was like the one depicted in the above-mentioned woodcut by Peter Flötner from the oldest German translation of Vitruvius' treatise dating from 1548.[1265] Nevertheless, in the contract with the master fountain-builder pertaining to the construction of the Płock installation no mention was made of an auxiliary pump; the latter, however, had been confirmed in written sources three years earlier for the Kraków town water-work.

The construction of the Wawel water-work (built from the beginning of the 16th century) must have functioned according to the model described above. Written sources reveal that it was situated on the stretch of the Rudawa River that flowed around the Wawel castle in the vicinity of St Giles' Church. In 1590 a brick dwelling house on the corner of Kanonicza (Canons') Street was described as *domus lapideae atialis sub Arce in platea Canonicorum e regione rorhaus castrensis sitae dominorum a Gorki dictam*.[1266] The water-work was therefore built near the Wawel escarpment 25-meter high. It does not mean, however, that it had to raise water to this height, which can be testified by the following mention dating from 1575: "lead pipes that go into the castle hill from the water-work".[1267] Hence, the lead pipeline, conducted vertically from the water-work, went through the rock in the Wawel hill at an unknown altitude without reaching the top of the escarpment (just like in the 16th-century plan for the town of Tábor). Therefore, the place to which the water-work lifted the water could only be an existing well shaft. Assuming that at the beginning the water network supplied water only to the castle, a shaft that might have been suitable for that purpose was a well situated within the main complex of the castle, namely in the cellar under the Deputies' Staircase. In the year 1533 – as has been established above – the water supply network reached not only the castle, but also the Queen's garden (and the Bishop's palace), hence, before that date the installation must have been expanded. It might have been done after Queen Bona Sforza's garden had been established on the Wawel

1265 Vitruvius 1548.

1266 KsPrzyjKraków, 1994, no. 1204, p. 130.

1267 Mention found by Danuta Molenda during her archival research into the use of lead, quoted from her work: Molenda 1987, p. 73.

terrace, where a reservoir (*fons*) was placed, as the following mention should be translated: *…hortuli ante fontem castri erecti…*[1268] The author of the present book leaves an archaeological verification of the above findings to the researchers of the Wawel Hill.

The Kraków town water-work dating from the turn of the 14th and the 15th centuries obviously did not have to raise water from the Rudawa River to the same height as the Wawel installation, the later being a century younger. As has been established by Elżbieta Ligęza,[1269] the town water-work was a scoop/bucket construction. It is not known, however, whether they were affixed to the wheel, or rather to chains,[1270] like in the case of a "Paternosterwerk". This construction was set in motion with the use of a transmission mechanism called "Kamrat": it was a cogwheel (gear), for the first time mentioned in town accounts in 1401.[1271] This whole installation was powered by an overshot waterwheel,[1272] which implied the necessity to swell up the waters of the Rudawa River. For the needs of the water supply network the water was purified at the intake: in 1402 two and a half groschen were spent on *super mundacione fossati Rudawa*.[1273] At least until the year 1533 the so-called division did not exist. It was perhaps a causeway, dividing the Rudawa River into three branches, one of which led to the water-work – which on the basis of sources dating from the 17th century E. Ligęza described as also pertaining to an earlier period.[1274] It is from the year 1533 that the above-cited correspondence of the King and Piotr Tomicki, the Bishop of Kraków, with Piotr Kmita and Seweryn Boner, and of Piotr Kmita with the Kraków town councillors concerning the pollution of the Rudawa River to the detriment of both of the water-works. Nevertheless, the fact that the River Rudawka "is divided into three branches" was mentioned as late as during the 1564 inspection of the estates of the Royal domain under the

1268 RachWawel, 1913, pp. 260, 272 and 276, first quoted by Pianowski/Firlet 2002, p. 13 and footnote 4. As was mentioned earlier, another water reservoir – *cista aquae* (with a canal conducting water to it) was situated *in primo castro* – which was translated by the editor of the text (RachWawel, 2006, p. 6 and footnote 7) as the "lower castle".

1269 Ligęza 1971, pp. 43–54.

1270 According to E. Ligęza (1971, p. 51).

1271 ANK, rkps/MS 1591, p. 60 (year 1401): "kamprat". Cf. also in accounts pertaining the year 1518: twice: "vor kamp rad in das rörhaus mr. 3, gr. 0" (ANK, rkps/MS 1598, p. 263) and 1533: "Grzebień ad rotham mr. 2, gr. 0" (ANK, rkps/MS 1603, p. 174).

1272 ANK, rkps/MS 1598, p. 263 (year 1518), under the entry: *ad Curiam Rormagistri Empta* the purchase of, inter alia, "korzeczniki" (overshot waterwheels) was recorded twice.

1273 ANK, rkps/MS 1591, p. 158.

1274 Ligęza 1971, p. 50.

management of the governors of Kraków, on the occasion of listing mills working on this river.[1275]

One of the most frequently repeated expenses incurred while building the water-work were those connected with the purchase of scoops/buckets. Eventually, copper jugs were chosen to perform the role of the scoops, perhaps following some initial trials involving the use of leather and wooden scoops.[1276] Copper scoops were mentioned in accounts of 1402, when over 3.5 marks were spent *pro cupreis cant(ha)ris*.[1277] Under "Ad Rorhawsz necessaria" in the town accounts pertaining to the year 1533, the following expense was noted: 15 marks and 2.5 groschen (namely 722.5 groschen) were paid to Szymon Sikora, a coppersmith, for making 80 copper jugs, for which the town gave him 26 stones and 20 pounds of copper,[1278] i.e. 5 centners and 13.5 pounds.[1279] The price of copper amounting that year to 150 groschen for a centner,[1280] the cost of the material was ca 765 groschen, namely 15 marks and 45 groschen. Therefore, the labour cost of one scoop was 9 groschen and 0.5 denarii and the cost of the material was 9 groschen and 10 denarii. In total, a copper scoop-jug cost 18 groschen and 10.5 denarii. The whole batch of 80 scoops cost 1487.5 denarii, namely 30 marks and 47.5 groschen, i.e. 31 marks without a half of a groschen. Not knowing the technical specifications of the scoop mechanism of the Kraków water-work it is difficult to tell whether this batch formed the total number of scoops functioning simultaneously (in that case their number would be reduced by a half in comparison with 160 scoops in the Wrocław water-work dating from 1538).

Coming back to the early water-work devices used in Kraków, built at the beginning of the 15th century, we have to mention the "water house": *aqueductorium*, namely a *Rurhaus* built in 1408 by a master fountain-builder in cooperation with a blacksmith.[1281] Together with the wheels of the water-work, it formed a similar construction as the one mentioned above, i.e. the Wrocław two-part structure of the water-work intake raising water from the River Oława to Ketzerberg, known from a 15th-century description. The Wrocław structure consisted of a "mill" (*Wasserade*)

1275 LustrWojKr., part I, 1962, p. 13 (cf. also Part II.4 of the present work).
1276 ANK, rkps/MS 1589, p. 309, year 1399: – – *pro cantris ligneis* – – *Item XVIII gr. pro coreo ad cantra* – – *Item paranti cannas de coreo* – –. Cf also Ligęza 1971, p. 44.
1277 ANK, rkps/MS 1591, p. 158.
1278 ANK, rkps/MS 1603, p. 174.
1279 Conversion according to data in: Pelc 1935, p. 38*.
1280 Op. cit., p. 167.
1281 ANK, rkps/MS 1594, p. 75.

and a "pipe house" (*Rorhaws*). Later, the word "Rorhaws/Rorhaus" was always used in Kraków accounts for the whole set of the water-work devices.

As was mentioned above, in 1521 the King decreed the construction of a new water-work. Unfortunately, accounts from the years 1521 and 1522 did not survive to the present day. However, accounts pertaining to the following year, 1523, reveal that extensive works on the new Rorhaus were being carried out. The total sum spent that year amounted to 251 marks and 31.5 groschen.[1282] The scope of the works and the sum spent indicate that the works were much advanced. However, according to E. Ligęza, in 1524 the works were suspended and they were taken up only in 1541. She based her opinion concerning suspending the works in 1524 on the fact that throughout several years following that date only small sums of money paid to caretakers were put down, always in a separate entry entitled *Rorhaus in Nieciecza* (7 groschen weekly).[1283] In accounts from the year 1524 the only mention in this respect pertains to the purchase of stone from the royal quarries: *ad noui Rorhawss 7 polstoskj*.[1284] In accounts from the year 1530 (accounts from the years 1525–1529 are missing) the only entry in the separate title *Rorhaus in Niecziecza* records the total payment of 15 marks and 8 groschen made to the caretakers and workers.[1285] However, in 1531 expenses incurred in relation to the *rorhaus in Nyeciecza* were noted in an entry called *Ad Rorhaus necessaria* that was always present in accounts from other years. In that year two new pipes were purchased for the water-work in question: a lead "30" and a copper "100" (which will be discussed in greater detail in the section concerning conduits), for the sum of ca 20 marks.[1286] In the same year the separate entry *Rorhaus in Nyeczecza* was empty, but an entry entitled *Rorhaus in Istula* (with the word "Nyeczecza" written above it) contained – as in the previous and subsequent years, in one or both of these entries – only 7-groschen payments made to the caretakers.[1287] Therefore, the above empty entries did not necessarily mean that works were not conducted on the water-work installation on the Nieciecza, as the expenses were noted in total for the two water-works in the entry entitled *Ad rorhaus necessaria*.

1282 ANK, rkps/MS 1599, pp. 129–130.
1283 Ligęza 1971, pp. 32–33.
1284 ANK, rkps/MS 1600, p. 112, entry: *saxifragium in monte*.
1285 ANK, rkps/MS 1601, p. 66.
1286 ANK, rkps/MS 1602, p. 75.
1287 ANK, rkps/MS 1602, pp. 159 and 158 respectively (descending page numbering in the book of accounts).

The new water-work was also noted in an income list of 1542 as a cardinal point in relation to which the location of a pond and a hammer in Błonie on the Nieciecza was defined (*Piscina et Hammer in Blonye super fluuio Nyeczecza circa nouum Rorhauz*).[1288] It performed the same role in 1551 for the location of an estate: *penes fluvium Nieciecza ab una in Szwyerzynyecz et civitatis aquilegium alias Rorchausz extra moenia civitatis cracoviensis*.[1289] However, the oldest Kraków water-work, called sometimes *Rorhaus antiquus*, functioning from the beginning of the 15th century, stood in the space between the outer and inner town walls, near the Sławkowska Gate.[1290]

Archimedes' screw in Poznań?

While enumerating types of intakes and the ways in which water was drawn from them to water supply systems, we have to mention an opinion commonly found in Polish literature[1291] according to which the so-called Archimedes' screw (namely a helix described by Vitruvius in his treatise[1292]) was used in the Poznań water supply system. The following mention from the town accounts from the year 1493 was to serve as evidence: *pro cocleari ad cannalia 3½ fert.* Passed on in this form by Franciszek Giedroyć with an additional explanation that "*coclea, cocleariu*s = helix, screw, machine v. screw used for drawing water",[1293] this mention entered scientific circles as the only example of such a technical solution used for water supply systems known from the Polish towns. This opinion requires fundamental corrections. First of all, in Poznań town accounts published by Adolf Warschauer the following mention appeared under the date 21 December 1494: *Cuprifabro pro cocleari ad cannalia 3½ fert*. Another one was under the date 22 January 1497: *Pro cocleari ad cannalia 3½ fert*.[1294] Secondly, among objects listed in the testament of Jan, a royal master fountain-builder from Kraków, drawn up in 1545 and found by the present author, were five augers for drilling pipes (*terebra canalium*) and two *terebra rotunda instar cochlearis sed in fine dentata que vulgo Swydry lysczasti*

1288 KDMK, part II–IV, 1882, p. 748 (year 1542).
1289 ANK, CC 442, p. 730.
1290 Cf. inter alia: ANK, ALonhCrac.), pp. 536–537 (year 1574).
1291 Kalinowski/Keckowa 1978, pp. 382–383. Kaniecki 2004, p. 600 (cf. this work for more about Poznań water supply systems in the 15th–18th centuries – pp. 597–645).
1292 Vitruvius X, 6.1. Web: "There is a machine, on the principle of the screw, which raises water with considerable power, but not so high as the wheel." Its detailed description follows.
1293 Giedroyć 1907, p. 412.
1294 Stadtbuch von Posen, 1892, pp. 389 and 432.

kensze vocant,[1295] which can be translated as "round augers resembling a spoon, but ending with teeth, commonly called thinner leaf augers." A comparison of all of these mentions reveals that the ones pertaining to Poznań concerned round augers used to drill water supply pipes that cost 3.5 fertones (42 groschen) each. In all the above quotations the word used was the neuter word *coclear*, *-aris* denoting mainly a spoon, and not the word *cochlea*, *-ae* denoting a helix (F. Giedroyć equated the two terms). Consequently, the objects described were spoon augers, similar to the ones represented in one of the illustrations from G. Agricola's treatise *De re metallica* of 1556 (fig. 56)[1296] and also in a work by Salomon de Caus *Les raisons des forces mouvantes* dating from ca 1615 (fig. 57).[1297] Spoon augers were used to drill wooden pipes utilized also in mining. One of such augers together with the whole structure that used to set it in motion – just as in S. Caus' illustration – is exhibited in a regional open-air museum of folk architecture in Bardejovské Kúpele as a device dating from 1734 (fig. 58).[1298] It is known that in Poznań such augers were made by a *cuprifaber*, which could be translated as "a coppersmith", whose basic technique was cold and hot forging. The main products made by these craftsmen were all kinds of copper and iron vessels, including those that were widely used such as cauldrons and pans (and also water-work scoops, e.g. in Kraków); for that reason they were called cauldron-makers, and in late-mediaeval sources they were referred to as coopersmiths.[1299]

1295 ANK, LT 772, p. 389.

1296 Agricola 1928, p. 148.

1297 Cf. Hoffmann A. 2000b, p. 109.

1298 The present author would like to express her heartfelt thanks to Professor Bogumiła Szurowa, PhD, from the Institute of Archaeology and Ethnology of the Polish Academy of Sciences for providing her with this piece of information together with photographs of the installation taken by her.

1299 Sztetyłło 1978, p. 88.

Fig. 56: Horizontal manual drilling of a pipe, mid-16th century. P – a spoon auger with a twisted point; Q – a wider spoon auger, after: Agricola 1928, p. 148.

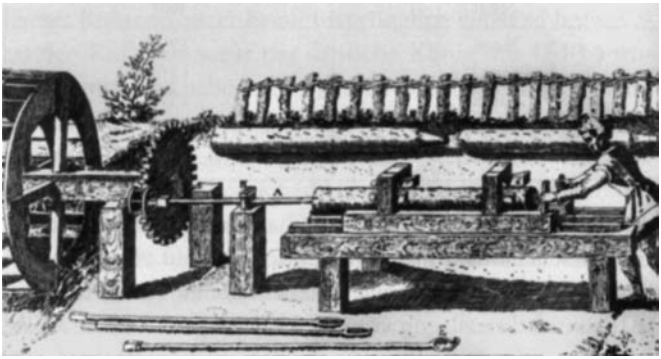

Fig. 57: A device with a waterwheel for drilling wooden water supply pipes with a spoon auger, from a work by Salomon de Caus (1615), after: Hoffmann A. 2000b, p. 109.

Fig. 58: A device dating from 1734 with a waterwheel for drilling wooden water supply pipes with a spoon auger. Bardejovské Kúpele (Slovakia), open-air museum. Photograph: B. Szurowa.

III.3.4.2 Water supply system conduits

The following types of conduits were used: metal, mainly lead (rarely copper or iron), ceramic, wooden and stone (the latter will not be discussed in the present work, as they were not used in the Polish lands).[1300] The choice of material

1300 Grewe 1991a, p. 38 – stone pipes in mediaeval walls of the Mildenburg castle in Miltenberg near Frankfurt. Le Lieur 1911, p. 61 – in the Yonville water supply system

depended chiefly on its accessibility, on financial possibilities and on the technical models. Ceramic or lead pipes were used in places where ancient technical models survived or in places to which these models were transferred. The method of laying ceramic or lead pipes to form water supply networks was predominantly taken over by mediaeval monasteries and also by towns located or established in the lands of the former Roman Empire and its provinces, including the large cloth centres of the northern France and Flanders. If such pipes were laid in other places (e.g. in Wrocław), it proves that these techniques were transferred either by the builders or by the users. The choice of these pipes: the cheaper ceramic or the more expensive lead, depended on financial possibilities of the given centre.

Metal pipes

Lead pipes were used in 13th-century water supply systems in Rouen,[1301] London[1302] and Bruges[1303] and in the 14th-century Paris network.[1304] Historical, archaeological and architectural research revealed that lead pipes were also used to conduct water to the most splendid patrician house in France in the mid-15th century, namely to Jaques Le Coeur's house in Bourges. Le Coeur was a famous financier and banker to King Philip the Good. The pipes conducted water – both cold and hot – to Jacques' private baths and to other chambers.[1305]

As far as the opinion about lead being harmful is concerned, it was commonly known, but not always shared. For example, in 1520 at the request of the town council of Nuremberg, the local physicians issued a statement that they did not consider lead pipes to be harmful for public health.[1306] Hence, water conducted through the water supply system in Nuremberg must have been hard, since there

in Rouen, built from 1510; several years after the construction works had begun, stone conduits were considered as too expensive and it was decided that ceramic (clay) pipes should be laid. Laying 1 fathom (1.95 m) of the latter in the Old Market Square cost 35 solidi ca the year 1518.

1301 Le Lieur 1911, p. 12.

1302 Wijntjes 1982, p. 197: also about the fact that they had been used earlier in the English Abbey in Canterbury, in the years 1151–1167. Cf. also Grewe 1991b, pp. 229–236 and Bond 1991, pp. 161 and 172.

1303 De Rekeningen, 1965, 36,1 (year 1281/82): *Tunc pro plumbo extrahendo de pipis post hallam 7 s.* and op. cit., 342,8 (year 1292). According to J.-P. Sosson also ceramic pipes were laid in Bruges.

1304 Benoit 1985, pp. 344–345.

1305 Gouedo-Thomas 1995, p. 133.

1306 Wijntjes 1982, p. 197.

was no danger of the toxic white lead being formed. In 1412 in Augsburg the builders attempted to replace wooden pipes with metal pipes, namely iron or ceramic. Wooden pipes were said to have poor durability,[1307] which entailed the need to replace them frequently. However, not much later the town returned to using wooden pipes. In general, in southern German towns (from where the technique may have been transferred to the Polish lands), according to U. Dirlmeier's research,[1308] metal pipes, often lead pipes, were laid near water intakes and as branches leading to private houses; in the public water supply networks on large distances wooden pipes were used. This may have resulted from considerable differences in the cost that obviously depended on the length of the stretch of pipes that were being laid.

Danuta Molenda carried out an archival research concerning the use of lead to make pipes for water supply systems in towns in the Polish lands. Her conclusion was that lead pipes were used only rarely "usually as auxiliary joints near reservoirs or water-works."[1309] Therefore, the rule observed by U. Dirlmeier for southern German towns applies to this case (with the considerable predominance of wooden pipes). However, source data quoted by D. Molenda better shows the very important role that lead pipes performed near water-works. Apart from a piece of information found in a dormitory of a 15th-century Dominican monastery concerning lead from damaged pipes (or gutters) (*plumbum quod habemus de canalibus in dormitorio destructis*), the researcher quotes fragments from 16th-century Kraków documents, including a mention from Kraków accounts from the year 1531 of 11 centners (i.e. 550 kg) of lead for *nova cannalia plumbea ad rurhaus* and a mention from the year 1575: "lead pipes that go into the castle hill from the water-work."[1310]

The role of the latter mention was described above when discussing the Wawel castle water-work. For the purposes of this study the present author analysed the former mention: it was found that it concerned 13 new pipes made for the town water-work on the Nieciecza. All of them were the so-called "30",[1311] i.e. their inner diameter was ca 11.43 cm (the ancient inch equalled 1.85 cm).[1312] The lead for their production was taken from "hooks" acquired by the town, namely

1307 Dirlmeier 1981, p. 138.
1308 Op. cit., p. 137.
1309 Molenda 1987, p. 74.
1310 Op. cit., p. 73.
1311 ANK, rkps/MS 1602, p. 75.
1312 Frontinus (Evans) 1994, p. 27: "The *tricenaria* or 30-pipe : diameter, 6 digits plus 1/6 plus 4/288 [6.1806 digits]; circumference, 19 digits plus 5/12 [19.4166 digits]; capacity, 24 *quinariae* plus 5/12 plus 5/288 [24.4340 *quinariae*].

from fragments-cuttings from pieces of lead.[1313] Each of these pipes weighed ca 0.85 centner (ca 42.31 kg). The price of lead used to make one pipe was ca 51–57 groschen (the price of 1 centner of lead in Kraków in 1527 varied between 60 and 67 groschen[1314]). As we can see, the weight of such a pipe was 2.79 times smaller than the weight of the ancient "thirty digits (*tricenariæ*)" that – according to Vitruvius – should weigh 360 pounds,[1315] i.e. ca 117.88 kg. Assuming that their inner diameter and wall thickness were the same, we can come to the conclusion that lead pipes mentioned in Kraków accounts of 1531 were 2.79 times shorter than the ancient "30" (the latter were ca 10 feet long, i.e. 2.96 m) and measured ca 1.06 m. According to André Guillerme,[1316] the length of lead pipes used in towns of northern France between the 10th and the 13th centuries did not exceed 2 meters.

Coming back to the mention from the Kraków town accounts of 1531, it has to be added that a payment was made at the same time to Piotr the coopersmith (*cantrifusor*) for producing one pipe "100" from ca 3 centners of copper. The copper was bought from Jorge Hegel for 3 florins and 22.5 groschen for a centner.[1317] Consequently, this copper pipe made in 1531 for the water-work on the Nieciecza measured ca 21 cm in the inner diameter[1318] and weighed 3 centners, namely ca 150 kg. The material used to produce it cost 7 marks and 1.5 groschen (337.5 groschen). The price of one centner of copper was 112.5 groschen,[1319] and the labour

1313 The "hooks" were formed while pieces (lumps) of lead supplied from lead smelters were weighed on town scales and when their weight in centners was established before they were sold. "Hooks" were used as payment in kind for the town, for its churches or for the rulers – Molenda 1987, p. 20.

1314 Op. cit., p. 23.

1315 Vitruvius, VIII, 6, 4 – English translation. Web. Conversion into kilograms according to: Vademecum 1983, p. 344, where 1 pound = 0.32745 kg.

1316 Guillerme 1985, p. 191.

1317 ANK, rkps/MS 1602, p. 75.

1318 Frontinus (Evans) 1994, p. 28 : The *centenaria or 100-pipe : diameter,* 11 digits plus ¼ plus 9/288 [11.2813 digits]; circumference, 35 digits plus 5/12 plus 1/24 [35.4583 digits]; capacity, 81 quinariae plus 5/12 plus 10/288 [81.4514 *quinariae*]. (2) After being altered by the watermen it had a diameter of 12 digits and capacity of 92 *quinariae* plus 1/12 plus 1/24 plus 10/288 [92.1597 *quinariae*].

1319 J. Pelc (1935, p. 167) stated the following prices for a centner of copper for the years closest to 1531, i.e.: 1526 – 104 groschen (on the basis of one mention) and 1533 – 150 groschen (on the basis of two mentions). D. Molenda (1987, p. 23) stated the price for a centner of copper for the year 1525 – 150–180 groschen, and then for the year 1550 – 180–300 groschen.

cost was 11 marks. The total cost was 18 marks and 1.5 groschen. However, the length of this copper pipe is unknown.

As far as lead pipes are concerned, in the case of Płock it is impossible to establish how much lead was used to produce them from the 50 centners (ca 2.5 tons) that in 1534 were allocated *pro fusione cannarum et etiam kunsth*.[1320] If we apply the Kraków price of lead known for the year 1527 and mentioned above (60–67 groschen a centner), we can calculate that the cost of the material would amount to ca 3000–3350 groschen, i.e. ca 100–112 florins or 62.5–70 marks. However, judging from the mention, the pipes were to be cast. This technique (as opposed to the one known in antiquity of folding a sheet of lead) was probably used at that time also in Kraków. Casting pipes may have taken place in a bell-foundry, situated near Sławkowska (Sławków) gate, in the same area where the oldest Kraków water-work stood.

Ceramic pipes

A technical legacy of the antiquity, ceramic pipes in mediaeval towns of Central Europe were mentioned in sources either very rarely (like in the case of Augsburg: for a very short time, as was mentioned above)[1321] or never (like in the case of Bohemian and Moravian towns).[1322] Hence, the more valuable (especially that it has been documented both archaeologically and historically) seems the example of the ceramic pipe water supply discovered in Wrocław at the turn of the 1980s and 1990s by local archaeologists in the vicinity of Dominikański Square and Kacerska Górka[1323] (fig. 59, 60, 61). It was established that it had functioned from the second half of the 14th century. The pipes were 34–36 cm long and measured 8–12 cm in diameter. They were fitted one into the other and the join was sealed with raw clay.[1324] In some stretches the water supply system had more than one row of pipes (two or three); according to the archaeologists who discovered this

1320 ZbPłock, vol. II, 1987, no. 393, p. 168.

1321 Ehlers 1936, p. 21. Cf. also: Goll 1992, p. 274 and Oexle 1992, p. 373–374, where the rarity of occurrence of ceramic pipes, confirmed archaeologically only in monasteries, was underlined.

1322 Široký 2000, p. 368.

1323 The results of archaeological research together with an extensive graphic and photographic documentation published in several articles cited below [in:] Silesia Antiqua, vol. 35, 1993. Cf. also Wachowski 1995, p. 144 and Buśko 1995, pp. 93–95, also about (p. 95) archaeologically discovered remains of ceramic water supply systems in other Silesian towns, namely in Legnica, Polkowice and Głogów.

1324 Buśko/Piekalski 1993, p. 155; Dwojak 1993, p. 278 et seq.; Piekalski 2004, p. 16.

network, this solution allowed a greater flow of water and the continuity of its supply in times of repairs.[1325] It is difficult to comment on the first part of this opinion without knowing anything about the amount of the "granted water" that was allowed to flow in the town water supply system of Wrocław. Nevertheless, the second part of this opinion is very convincing, bearing in mind the necessity of repairs of ceramic water supply systems that often broke down due to a greater permeability (and thus also leaking) of ceramic pipes in comparison with wooden pipes. The above-mentioned description of this water supply system from the end of the 15th century enabled M. Goliński to identify the excavated stretch with the initial course of the network: from the distribution station in the "pipe house" and further on under the Oława River (*vntir dem wasser der Ole*).[1326] It formed part of the Wrocław water supply system; judging from the above-mentioned description and from the excavations, in the late 15th century this network must have been rather extensive. It conducted water mainly to special reservoirs open to the public (in the source text each of such reservoirs is called a "Somp"), although there were also numerous pipes branching off to private plots.[1327] Mateusz Goliński noted that it resulted from the description that at the end of the 15th century the Wrocław water supply system also included wooden pipes connected with metal joints, which fact probably testified to an ongoing replacement of ceramic pipes with wooden ones.

1325 Dwojak 1993, p. 296.
1326 Goliński 2001a, pp. 109 and 118.
1327 Op. cit., p. 117 and description – p. 123.

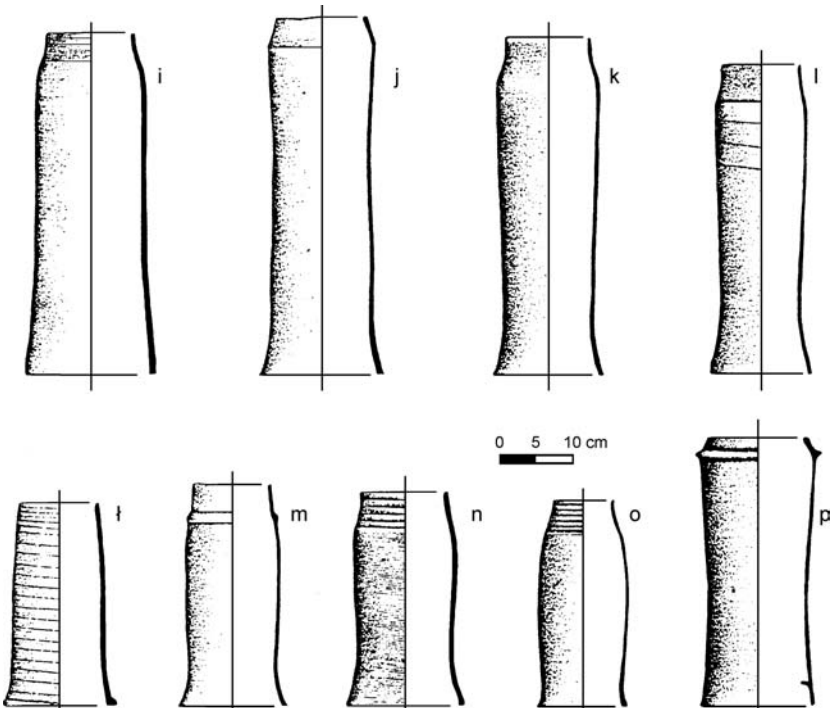

Fig. 59: Ceramic pipes from Wrocław excavations, after: Dwojak 1993, p. 294.

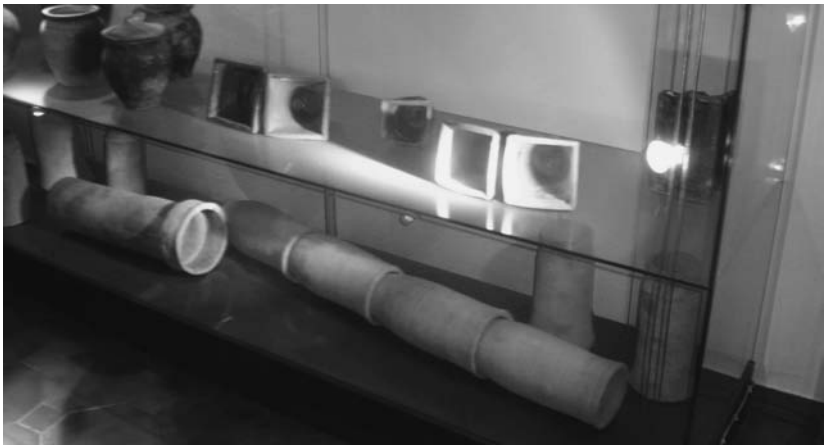

Fig. 60: Ceramic pipes from the Wrocław water supply system. Collection of the Archaeological Museum in Wrocław. Photograph: U. Sowina.

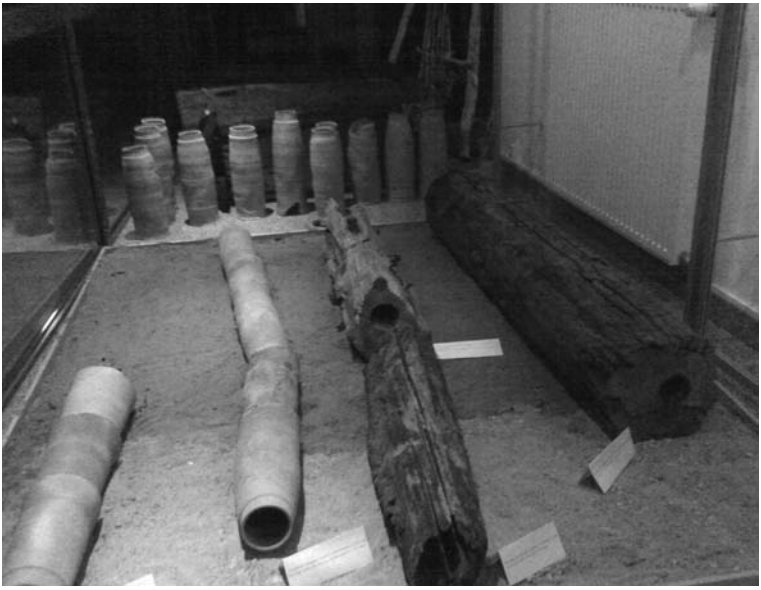

Fig. 61: Ceramic and wooden pipes from Wrocław water supply networks. Collection of the Institute of Archaeology of the University of Wrocław. Photograph: U. Sowina.

The ceramic pipe water supply that conducted water from the Oława River was the first installation of that kind to be discovered in Wrocław. Research carried out in subsequent years lead archaeologists to the conclusion that in mediaeval Wrocław ceramic water supply pipes were the most popular and that in the light of the sources known to date, wooden pipes appeared in Wrocław in the second half of the 15th century at the earliest[1328] (fig. 61).

The opinion about the use of the two above-mentioned kinds of conduits (also connected with a different intake than the one on the Oława River) at the beginning of the early modern period finds its confirmation in the following fragment of a description of Wrocław by Bartholomäus/Barthel Stein: *Sed ante molam hanc rota maxima aquaria, que arte mira totam in urbem per fistulas et ligneos tubos aquam fundit*.[1329] The author made a clear distinction between *fistulae* – pipes and wooden conduits; besides, he erroneously used the masculine gender instead of the feminine: *ligneas tubas*. Considering the fact that ceramic pipes were funnel-shaped (which is why they could be fitted one into the other), we would rather

1328 Piekalski 2004, pp. 14 and 16.
1329 Stein 1995, p. 115.

describe them using the word *tuba*;[1330] longer than ceramic pipes and straight (which is why they had to be connected with joints) drilled out tree trunks were referred to in sources as *can(n)alia*, but also *fistulae*.[1331] Consequently, the expression used by Stein would be more appropriate (because it would reflect the actual shape of the pipes) if it read: *per tubas et ligneas fistulas.* Thus phrased, the whole fragment would leave no doubt as to the fact that "water raised with the help of an impressive huge waterwheel was distributed all over the town by means of funnels and wooden pipes." This would be consistent with the 19th-century German translation of this text by Hermann Markgraf: "Noch vor dieser Mühle steht das große Wasserrad, das mit bewundernswerther Kunst das Wasser durch Trichter und hölzene Röhren in die ganze Stadt leitet".[1332]

The uniqueness of the use of the ceramic pipe water supply in Wrocław from the mid-14th century consisted in its long-term smooth running in spite of the careless and chaotic character of the 15th-century repairs.[1333] It can be fully appreciated against the background of other centres from the same part of Europe, e.g. the *tubae figulinae* established in 1407 in Lviv were rather short-lived.[1334] The present author is inclined to ascribe this uniqueness to the fact that perhaps it were the so-called Walloon weavers who brought the technique of laying ceramic pipes that formed a water supply system to Wrocław[1335] (the tentative character of this statement results from the lack of direct written sources confirming this thesis). Ceramic pipes were the first ones confirmed in sources as present in Ketzerberg,

1330 This was the only word used to refer to such ceramic conduits by: Vitruvius (*tubulis fictilibus*), Palladius (*fictilibus tubis*) and the same repeated by Crescenzi (*fictilibus tubis*) – cf. earlier in this part.

1331 In order to refer to wooden conduits Palladius used the expression: "*canalibus ligneis*", whereas Crescenzi – "*cannalibus*". All the three authors used the word "*fistulae*" for lead pipes: Vitruvius – "*fistulis plumbeis*", Palladius – "*plumbeis fistulis*", and after him the same Crescenzi – cf. earlier in this part. In mediaeval sources the term "*fistulae*" was also used to define drilled wooden pipes.

1332 Stein 1995, p. 79. Here Hermann Markgraf showed his knowledge of the structure of the Wrocław conduits, derived at least from the 15th-century description of the Oława water supply system. About the fact that he knew this source – cf. Goliński 2001a, p. 106.

1333 Dwojak 1993, pp. 286 et seq.

1334 Giedroyć 1907, p. 100. Charewiczowa 1934, p. 14.

1335 This opinion – cf. Sowina 2005a, pp. 313–314, where the author also showed the constructional similarities between the Wrocław network and the networks found in northern France and in the lands of Flanders (considering that the technique used to build such water supply systems remained unaltered from antiquity).

the late-mediaeval cluster of Walloon weavers (confirmed in sources as early as 1422).[1336] While the technical model was one of the models taken over from antiquity and used in the weavers' native lands, the material chosen in Wrocław was cheaper than lead pipes (this could be one of the factors testifying e.g. to different financial possibilities of Wrocław and Rouen or Bruges).

Wooden pipes

In literature, there is a general consensus of opinion about the fact that in Central Europe wooden pipes were clearly predominant. Written sources only rarely provide us with information concerning the kind of wood from which pipes were made; hence, archaeological findings prove more useful, though even they can be incomplete in this respect. The more archaeological studies conducted methodically in mediaeval towns and the more thorough publications of their findings, the greater the chance of being able, in the future, to elaborate on the frequency in which certain types of trees were used to make water supply installations. For the time being, we can use examples quoted from archaeological studies that have been best documented. Research conducted in Bohemian and Moravian towns revealed that pine pipes were used (either with the bark – as in the New Town in Prague, or with the bark removed – as in Jičín), as well as pipes made of oak, fir, larch and spruce.[1337] Archaeological studies carried out in Wrocław showed that the pipe water supply near the north side of the Market Square included also elm pipes; they were dendrochronologically dated to "after 1490".[1338] Pine pipes were used in a water supply system (independent from the town network) established in 1531 and conducting water from a nearby village called Nowa Wieś to the Wrocław Fish Market.[1339]

The findings of research on the Toruń water supply systems show that these networks were built of pine and spruce (even there the type of wood used for the pipes was identified only for two sites).[1340]

Research carried out in Kraków by Kazimierz Radwański showed that drilled pipes from the turn of the 14th and the 15th centuries were made of pine trunks.[1341] However, in town accounts pertaining to the year 1399 only oak wood was mentioned (if at all), but considering the extensiveness of the works at that time it

1336 Zientara 1981b, pp. 128, 130 and 150; and Goliński 1997, pp. 187 et seq.
1337 Široký 2000, p. 366.
1338 Piekalski 2004, p. 16.
1339 Goliński 1997, p. 30.
1340 Kola/Kotlewski 2003, pp. 70 et seq.
1341 Radwański 1964, p. 232.

is not known whether this wood was to be used to make pipes, especially that entries about expenses made for the pipes do not include the information what type of wood was used to make them.[1342] It is not out of the question that only oak was listed among construction materials as the most valued type of wood.

In Little Poland's town of Krosno pipes were made of pine.[1343] The same type of wood was also confirmed in Lublin.[1344] As far as pipes made of other types of conifers, the presence of spruce pipes was documented e.g. in Kościan in Greater Poland (such pipes were excavated there in 1908),[1345] whereas larch pipes were confirmed in Nowy Sącz in Little Poland (a larch pipe was found there at the end of the 19th century and its outstanding hardness was noted[1346]). However, it is not know in either of the cases whether these pipes came from the oldest, i.e. 16th-century water supply systems of these towns or from their later networks.

Moving on to the sizes of wooden pipes: they were of various length. The ones found in Bohemian and Moravian towns were from 2 to 4 meters long.[1347] Pipes from Kraków measured 2 meters in length.[1348] The only entire wooden pipe excavated from the Toruń water supply system was 4.9 meters long (fragments of pipes measuring ca 4 meters were also discovered).[1349] Pine pipes in Krosno (possibly dating from the 15th century) reached almost 7 meters.[1350] The only wooden pipe excavated from the Old Town in Płock made of an unspecified type of wood, exhibited in the local museum, currently measures 5.63 meters in length; however, cut straight at one end, and with the other end jagged, it can be assumed to have been shortened, e.g. during an improperly performed excavation.[1351] It has not been dated. Considering the lack of other such finds in the Płock area and bearing in mind the conclusion reached on that basis by archaeologists that the construction of a water supply system in this town had never been accomplished, we can speculate that it might be one of the "old pipes" mentioned as being in the ground

1342 Cf., inter alia ANK, rkps/MS 1589, p. 305: *Item pro lignis ad cannalia aque de Rudawa 1 ½ marc. VIII gr.*

1343 Muzyczuk/Gancarski 2003, p. 33.

1344 Hoczyk-Siwkowa 1997, p. 165.

1345 Górska-Gołaska 1994, p. 228.

1346 Giedroyć 1908, p. 284.

1347 Široký 2000, p. 366.

1348 Ligęza 1971, p. 29.

1349 Kola/Kotlewski 2003, p. 70.

1350 Muzyczuk/Gancarski 2003, p. 33.

1351 Oral information given to the present author by Mr Krzysztof Matusiak from the Masovian Museum in Płock on the basis of a description from the Museum's catalogue to whom the author would like to extend her heartfelt thanks.

in a contract with a master fountain-builder drawn up in 1534 (most probably they were placed underground in the course of the 1509–1511 construction works). At the end of this short review of wooden pipes we can mention a pipe dated to the 16th century, found in the Sieradz Market Square in 1961–1962, also made of an unspecified type of wood, that measured 5.2 meters in length.[1352]

The above examples show that wooden pipes were either short (one tree trunk served to make two or three pipes of that kind[1353]) or decidedly longer, from 5 to 7 meters long.

As far as the diameters of these pipes are concerned, pipes found in Bohemian and Moravian towns measured 15–60 cm in outer diameter (of the whole trunk) and from 4 to 10 cm in inner diameter (of the inner opening);[1354] the pipes from Kraków measured ca 25 cm and ca 10 cm respectively;[1355] the ones from Toruń: 26–40 cm[1356] and 8–13 cm; the ones from Krosno: ca 30 cm and 7–8 cm;[1357] the ones from Lublin: 29–32 cm and 6.5–8.8 cm;[1358] the pipe found in Płock: 20–25 cm and 7.5 cm; the pipes excavated in Sieradz in Dominikańska and Warszawska Streets (in the Middle Ages the streets were called Mnisza (Monk) and Błotna (Muddy) respectively): ca 25 cm and 6–8 cm. The most general – and the most obvious – conclusion that can be drawn from this review is that irrespective of the technical similarity between the installations, the different diameters of the openings testify to a various amount of water that could flow through them. One mention (quoted before in the present work) indicates that the diameter of a water supply conduit (a pipe or its reducer) was, above all, the measurement of the granted water. The mention comes from the royal privilege granting the right to conduct water from the River Prądnik to ponds in a manor farm in a village also called Prądnik issued

1352 The present author owes this and the following items of information concerning the size and the appearance of pipes and connectors from Sieradz to Mr Piotr Kurowicz from the Museum in Sieradz, to whom she extends her heartfelt thanks.

1353 Široký 2000, p. 366.

1354 Loc. Cit.

1355 Ligęza 1971, p. 29.

1356 These are diameters of annular pipes, provided here for the sake of comparison with pipes from other towns; besides annular pipes, also rectangular pipes 22–36 cm high and 30–40 cm wide were used in Toruń – cf. Kola/Kotlewski 2003, p. 70.

1357 Muzyczuk/Gancarski 2003, p. 33.

1358 Hoczyk-Siwkowa 1997, p. 165: the diameter of a pine pipe (30 and 6.5 cm respectively) found in the backyard of a plot at 16, Grodzka Street, near a barrel-water storage reservoir. Hence, both the pipe and the reservoir formed part of a private connection. For a list of the diameters of all of the discovered pipes from the Lublin water supply system – cf. Mazurek 1986b, p. 54.

on 31 October 1532 to the royal physician Piotr Wedelicjusz and his wife Katarzyna Hanuszlangowa. What was granted on the strength of this privilege was "the same measurement [of water] and [diameter] of the auger as the one drawn from the Rudawa River to the town water supply system in Kraków."[1359] The content of this mention is unique, the more so, as no other privilege to establish water supply systems in towns in the Polish lands contains information concerning the amount of water that was granted to a given centre. And yet, such a measurement existed: it was probably established as a customary measurement transferred among organisational models of installing mediaeval water supply systems, taken over from the rules of water distribution set out in antiquity (this can be also evidenced by the use of a one-inch module for private connections in the 13th century in Rouen[1360] and in the 15th century in Kraków[1361]). This found its material expression in the fact that the above-mentioned measurement was observed, as shown in the example of the very similar diameters of wooden pipes installed in various centres and (perhaps) those of ceramic pipes, considering that in the 15th-century water supply system of Wrocław their diameter was 8–12 cm.[1362] The differences arose probably from the fact that some of the pipes belonged to the public network, whereas some of them formed part of private connections. And yet, the diameter of a pipe from a public water supply system of one centre could be the same as the diameter of a pipe from a private connection in another town. This point can be illustrated by the example of pipes in Sieradz (in the Market Square) and in Lublin (in a private plot). Consequently, we can draw the following conclusion: the scope of the enterprise in Sieradz was more modest (a smaller amount of water) than the one in Lublin; this was directly proportional to the economic differences between these two centres (the demand for water was greater in Lublin than in Sieradz).

Wooden pipes were drilled out using spoon augers like the ones from Kraków or Poznań, mentioned while discussing the supposed Poznań Archimedes' screw. Judging from numero us instances of similar inner diameters of the pipes, we can assume that the turning spoon must have had similar or the same diameter. This, however, did not exclude the possibility of using augers of different shapes and

1359 MRPS IV/2, 1912, no. 16591, p. 429 and AGAD, MK 48, p. 269: *in quantitate illius moduli et Terebri quo ad cannalia seu aque ductum communem Civitatis nostre Cracoviensis…*

1360 In 1257 in Rouen King Louis IX received from the local town council permission to build a connection to the Franciscan Monastery that measured in diameter 1 digit (*plenum pollicem in rotundum*) – Le Lieur 1911, p. 12.

1361 KDMK II–IV, 1882, no. 443, pp. 573–574 and 578.

1362 Piekalski 2004, p. 16.

length, depending in the length of the pipes. This was the reason behind different prices of augers found in written sources. The auger used in Poznań were bought at the end of the 15th century for 3.5 fertones, i.e. for 42 groschen (for Poznań pipes of unknown length); there also exist records pertaining to Kazimierz near Kraków: from the year 1557 when a blacksmith was paid "for a long auger 8 groschen, for a second one leaf-shaped 8 groschen, for a second straight 3 groschen";[1363] and from the year 1561, when 9 groschen were paid for "3 augers that drill pipes".[1364] Among the latter expenses made for the *domus cannalium* also 1 florin and 22 groschen (namely 52 groschen) were noted for a large fluted Austrian auger.[1365]

We can read about the prices of drilling single pipes in e.g. Jan Boner's accounts of the Royal Domain under the management of the governors of Kraków: on 2 April 1558 2 groschen were paid for drilling a wooden pipe in Wawel,[1366] and that on 28 May, also in Wawel, the same price was set for *a terebratione alias wierczenia roborum super canalia*.[1367] However, it is impossible to establish whether the pipes were 2-meter long, like the ones laid in the town. The same applies to the unspecified pipes from Kazimierz near Kraków: we can read about drilling them in Kazimierz accounts pertaining to the year 1561; one florin (i.e. 30 groschen) was paid twice "for drilling 12 pipes", which amounted to 2 groschen and 9 denarii per pipe (only once the cost of this service was 2 groschen).[1368] Mentions like the one from Sieradz from the year 1541 about paying 19 groschen for drilling an unknown number of pipes (*a disposicione seu terebracione alias viuercenya Canalium*)[1369] do not provide us with information how much was paid for drilling long pipes.

According to Czech research pipes were drilled by a master fountain-builder aided by one or two assistants.[1370] The opinion that this task was performed by more than one person found its confirmation in a mention from accounts of the town of Kazimierz near Kraków from the year 1557 of paying 17 groschen and 9 denarii to the assistants of the master fountain-builder "for drilling pipes".[1371] This task (done either by hand or with the help of an auger fitted to a water-powered wheel that rotated it) is well represented in iconographical and ethnographical

1363 ANK, K. 505, p. 647.
1364 ANK, K. 509, p. 46.
1365 Op. cit., p. 44.
1366 RachWielkorzBoner, 1974, p. 65.
1367 Op. cit., p. 66.
1368 ANK, K. 509, p. 54 and 55.
1369 AGAD, ASK LVI, p. 2, vol. II, folio 62 v.
1370 Široký 2000, p. 366.
1371 ANK, K. 505, p. 647.

sources quoted above in the section devoted to spoon augers. They also show that pipes were drilled in the open air, as depicted e.g. in the illustration from Lűbeck of 1552.[1372] Furthermore, according to a contract entered into in 1534 in Płock with a master fountain-builder called Mikołaj Łuszczek, Mikołaj and his assistants could choose the most convenient place in which they would drill pipes, and the town council undertook to provide roofing that would protect the workers from the rain.[1373]

Kraków accounts show that in the years 1517–1538 the price of one ready (i.e. drilled out) pipe meant as a replacement used in connections to private plots was 12 groschen.[1374] The same price was paid for every pipe that was replaced in the Dominican connection (in total there were five of them bought in 1518, 1523 and 1524).[1375]

Wooden pipes had to be wet when placed in the ground (soaked, they were more leak-tight); consequently, water reservoirs were needed in the process of their preparation. For this purpose existing ponds were used or new ones were built. We can mention a fish pond in Písek, called "Vrtačky" (Drills),[1376] and "Rurne Stawy" (Pipe Ponds) in Little Poland's town of Pilzno in 1599.[1377] Let us point to the difficulties that must have been experienced in such towns as Płock, Kamieniec or Sandomierz which suffered from the lack of water for everyday needs, not to mention digging water reservoirs for soaking pipes. Performing this task in ponds or watercourses situated down low near water-works (these were the only places with water) entailed the need to pull every pipe back up to the place where it was to be laid in the water supply system. This might have been one of the reasons for which the construction of water supply systems in these towns was not brought to fruition (unless another method was applied, namely the one described by O. Strumieński in relation to building water installations for ponds, which consisted in pouring water into the ditch in which wooden pipes were placed.[1378] However, in that case water would have to be carried or carted there in large quantities).

1372 Grabowski/Mührenberg 1994, p. 28.
1373 ZbPłock II, 1987, no. 393, p. 168.
1374 Cf. the entry *Vendicio cannalium de Rorhaws* in these accounts from various years, analysed in greater detail further in the present work.
1375 ANK, rkps/MS 1598, p. 155 (year 1518), rkps/MS 1599, p. 24 (year 1523) and rkps/MS 1600, p. 22 (year 1524).
1376 Široký 2000, p. 366.
1377 ANK, (Wawel), rkps dep./Dep. MS no. 109, p. 372v.: "Arenda Rurnÿch Stawow".
1378 Strumieński 1605, pp. 36–38.

Czech studies revealed that pipes were placed in the ground at a depth equivalent to the modern meter. This was done according to theoretical assumptions of the period, in which the depth was specified at between 3 and 5 feet (ca 0.9–1.5 meters).[1379] It should be expected that for towns north of the Carpathians this depth was near 5 feet due to the fact that pipes could freeze in a ditch that was too shallow. Archaeological data that is available refers only to the present-day street level. Wooden pipes were excavated in Toruń at the depth between 0.83 and 1.6 meters, whereas pipes in Sieradz were found 2–3 meters below today's level of the Dominikańska and Warszawska Streets that lead away from the Market Square. A fragment from a contract with a master fountain-builder hired in 1578 to build a pipe water supply that would conduct water to the ducal court in Szczecin provides us with a helpful piece of information: the pipes were to be placed at least 3 ells[1380] (6 feet) deep, i.e. ca 1.74 meters into the ground.

Kraków town accounts of 1404 testify to the fact that wooden pipes forming part of water supply systems, laid several years before (4–5), were cleaned,[1381] and it is generally agreed in literature that such pipes were replaced at intervals.[1382] Consequently, it can happen that pipes belonging to a water supply system that was built earlier and functioned for several centuries, like the one in Kraków, will be younger than the network itself, which obviously makes them lose their value in terms of a dating element.

The next stage of the works took place in the ditch; having been laid there, the soaked pipes were connected and the joints were sealed.

Wooden pipes were joined using metal (mostly iron, but also lead) connectors called in written sources *buxae*, in Polish *buksy*[1383] or *puszki*[1384] (cans). This was

1379 Široký 2000, p. 366.

1380 Podralski 1982, p. 195.

1381 ANK, rkps/MS 1592, p. 156 – in an entry concerning the work at the water supply system (*Ratio aqueducture*): *Item vj gr. de mundacione cannalium.*

1382 Wijntjes (1982, p. 197) made a general statement that every several decades; Široký (2000, p. 366) stated that they lay in the ground for 4–5 years, 40–50 years at the most.

1383 Solski 1959 (1690), p. 417.

1384 E.g. in Kraków accounts from the years 1523 and 1524 – ANK, rkps/MS 1599, p. 24 and rkps/MS 1600, p. 22.

the most widespread method, used in German,[1385] Bohemian[1386] and Polish[1387] towns.

As far as the price of such connectors is concerned, Mateusz Goliński quotes 4 groschen for one "can" ("Buchse"), i.e. connector, used to join wooden pipes in the 15th-century ceramic and wooden pipe water supply in Wrocław.[1388] In Kraków in the 16th century, according to town accounts from the years 1523 and 1524, one pipe used for connections cost 12 groschen, whereas the price of one connector-can used together with the above pipes, was 3 groschen.[1389] The same price for one connector was set by Mateusz Czech, a blacksmith (*faber*) and weapon-maker, in his last will and testament, written in the Kraków *Liber Testamentorum* on the first Saturday after the Visitation in 1532[1390] (i.e. on 6 July). He stated, *inter alia*, that one of the Kraków town carpenters failed to pay him (which fact the testator had already reported to the town councillors) for 16 iron "buchse" (cans) worth 3 groschen each. In 1533 in the town of Kazimierz near Kraków also 3 groschen were paid for one "can". The price concerned new connectors (*Buxe nove 20 per gr. 3, fl. 2*); at the same time, the total sum of 10.5 groschen was paid for 7 unspecified connectors.[1391] In 1541 in Sieradz a blacksmith was paid 20 groschen for making 8 such connectors for pipes near the water box in the Market Square[1392] (hence, there must have been at least 8–9 pipes in a row; the pipes must have been like the one mentioned above, also found in that place. Consequently, this course must have measured not less than between 56 and 63 meters in length, considering only the total length of the pipes). Therefore, the price of one connector used in this stretch of the public pipe water supply amounted to 2.5 groschen, i.e. only a half of a groschen less than nine years earlier in Kraków. Excavations conducted in Sieradz revealed that in the town water supply system iron connectors were used; they were 11 cm long and their inner opening measured 8 cm in diameter, which equalled the maximum diameter of the pipes used in Sieradz. When in

1385 E.g. a lead connector from excavations in Lűbeck – Grabowski/Mührenberg 1994, photograph on p. 34.
1386 Široký 2000, p. 366.
1387 Inter alia: Muzyczuk/Gancarski 2003, p. 33 – excavations in Krosno confirmed that pipes were joined using iron "buksy" (connectors). About connectors in Toruń – Kola/Kotlewski 2003, p. 74.
1388 Goliński 2001a, p. 117 and description on p. 123.
1389 ANK, rkps/MS 1599, p. 24 and MS 1600, p. 22.
1390 ANK, LT 772, pp. 256–257.
1391 ANK, K. 505, p. 475.
1392 AGAD, ASK LVI, p. 2, vol. II, folio 62 v.

1543 1 florin and 15 groschen, namely 45 groschen, were paid for 30 *compactimenta alias buxy* for private connections to two breweries belonging to Sieradz burghers,[1393] the price of one connector was 1.5 groschen. This difference in price testifies to the difference in the size of the connectors (assuming with high probability that they were made in the same way). This in turn confirms the prevalent rule that public stretches of water supply systems had a greater flow capacity than private connections.

The places where two pipes were joined together were sealed with moss, tar and hemp rope dipped (boiled?) in tallow. This was probably what the latter was used for when it was given for the needs of the installation as a part of the payment from meat stalls in Sieradz to the town starosty that financed the town water supply system.[1394] Expenses made for tallow are also recorded in accounts of the water supply system in Kazimierz near Kraków (e.g. a groschen weekly "for the fat", "for the tallow" near Easter of 1561).[1395]

Water supply system pipes were fitted with special devices that regulated the flow of water, which was to contribute to the saving of water. In Kraków archaeologists found a pipe with an opening cut in it measuring ca 11×30 cm in which a block-plug was fixed. The flow of water was regulated by lifting or lowering it.[1396] In the course of the present research, in one of the town councillors' books of Kraków the author came across a mention dating from 1545 of the use of a copper tap (*adhibito œnio canali alias kureck*) to block and unblock the flow of water in a connection to a private house on the corner of Wiślna and Gołębia/Garncarska Streets.[1397] Perhaps it was a valve/plug that was mentioned in a tariff of services of a master fountain-builder from Wrocław from the same year: "vom Wasser zuuerschlo[ss]en 6 gr." (for closing a pipe?).[1398] Archaeological research conducted in Toruń revealed that three copper valves/plugs forming part of a

1393 Op. cit., folio 188v.

1394 Op. cit., folio 2 (year 1541 – 3 stones of tallow: "Ad opus cannalium Lap. 3" out of 20 stones of rent) and folio 199, year 1545: 4 stones of tallow: "pro necessitate cannarum Sirad. Lp. 4".

1395 ANK, K. 509, p. 43.

1396 Ligęza 1971, p. 29.

1397 ANK, CC 440, p. 230.

1398 This tariff was found by Professor Mateusz Goliński in: APWr, Akta miasta Wrocławia, 554 (E 1,1), folio 176., who dated it at ca 1545. The author of the present work wishes to express her gratitude to Professor Goliński for this mention.

water supply network probably dating from the 18th century were used to regulate the flow of water.[1399]

III.3.4.3 Water storage reservoirs (zompy, rząpy, rząpia)*: inspection wells, water storage reservoirs connected to a water supply system open to the public, and decorative fountains*

Permanent and indispensible elements of the uniform structure of town water supply systems, water storage reservoirs performed several functions. Firstly, they separated single stretches within the network and fulfilled the role of both sedimentation tanks and inspection wells. Once again, this function was best described by L.B. Alberti, who wrote that something had to be added, something that would serve as a well or a reservoir, so that water could be purified there and also in case a damage occurred in the pipes, it would enable noticing the failure and checking where and how the pipes should be repaired.[1400] Jacques Le Lieur suggested the use of this method to control the water supply system in Rouen every one or two years, in order not to put the town to enormous expense connected with possible repairs of the network.[1401] Such reservoirs were also used as points from which conduits branched off when the networks were being expanded.[1402]

Secondly, some of the reservoirs in question served the purpose of public distribution of water. In the Norman town of Rouen the first reservoir of the 13th-century network was located next to the town walls, inside the town. It was very large and open ("une grande cuve descouverte") so that everyone could use it to draw water.[1403] Judging from its location, we can infer that it mainly performed the function of *castellum*, as Vitruvius called it, *caput fontium* existing in Florence, namely that of a reservoir from which pipes were conducted throughout the town. A *caput foncium* of that kind certainly existed in Bruges at the end of the 13th century.[1404]

Water storage reservoirs connected to a network of subsurface conduits open to the public performed the same role as dug wells or rainwater cisterns. If such reservoirs had above-ground casings, they were very similar to wells or cisterns

1399 Kola/Kotlewski 2003, p. 76.

1400 Alberti, 1960, 284.

1401 Le Lieur 1911, p. 9.

1402 Loc. cit.: "et ce faict la séparations des eaues en ladicte cuve".

1403 Op. cit., pp. 9 and 11.

1404 De Rekeningen 1965, p. 713 (year 1298/1299): *Item pro pipis positis in fossato juxta Hoye ad capud fontium per Petrum habin 69 lib.8 s.,* p. 715 (year 1298/1299): *Item petro Habin pro pipis ponendis ad capud fontium extra Wulfhaghe et faciendis 84 lib. 21 d.*

(hence it is sometimes difficult to tell them apart). The example of Celle, where still-preserved casings of dug wells and water storage reservoirs are situated next to each other (they are out of use at present), shows that while building town water supply systems, their constructors consciously placed the reservoirs next to dug wells, so that public water points were located in the same place. The same is true for the mid-17th century Marienplatz (Mary's Square) in Munich, as depicted in an iconographical source from that period showing a water storage reservoir with a water-pillar fountain next to a dug well[1405] (fig. 62). An analogous situation might have existed in Kraków until the mid-17th century, i.e. until water supply systems were used there.

Fig. 62: A water storage reservoir next to a dug well in Marienplatz in Munich, mid-17th century, after: Hoffmann A., 2000a, p. 34, fig. 26.

In towns with no dug wells water storage reservoirs were built in various parts of the town, according to the needs, like in the case of rainwater cisterns in other places (e.g. in Venice), however, the former reflected the course of the pipe water supply network. And yet the example of Tábor shows that the opposite situation

1405 Hoffmann A. 2000a, fig. 26, p. 34.

was also possible: in that town rainwater cisterns later became water storage reservoirs, as the water supply system was conducted to the existing tanks.

In Western European towns some public water storage reservoirs were built in the shape of decorative, expensive fountains. This tendency can be observed in the example of 14th–15th-century fountains in Bruges,[1406] fountains in Rouen, including the one called *Masacre*, built in 1456 near the big town clock *Gros Horloge* in the main street (fig. 63) and another one, built between 1510 and 1524/1525, bearing the representation of the Parnassus,[1407] five fountains in Tours built in the years 1506–1518 for 17,230 livres,[1408] as well as the above-mentioned fountains in Italian and German towns.

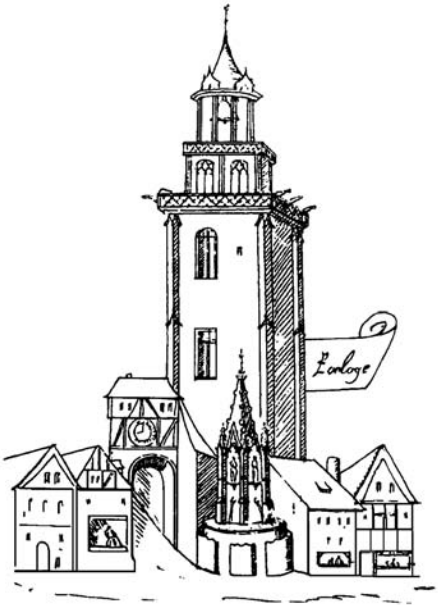

Fig. 63: "Masacre", a decorative fountain in Rouen, built in 1456. Drawing from the years 1524–1525, after: Le Lieur 1911, plate 12.

1406 In 1403 the cost of building two new fountains near the Jacobin Monastery, "from blue stones, very well trimmed", amounted to 720 livres. Moreover, 800 livres were paid for a conduit for the water supply system and 508 livres – for a lead connecting pipe of 11 digits in diameter. – InvBruges, vol. 9: E. Gaillard, Table analytique, (1883–1885), p. 194.

1407 Le Lieur 1911, p. 24 and illustration 12, p. 59 and illustration 78.

1408 Leguay 2002, p. 217.

In the 16th century vertical "water pillars" were built on the ground, with a narrow conduit ("tap") attached to them. Water flowed from the tap, sometimes to a reservoir placed below, like in the illustration for Petrarch's work: *De remediis utriusque fortunae*, published in Augsburg in 1532[1409] (fig. 64) or in a slightly later one, from the 1548 edition of Crescenzi's treatise (fig. 65).[1410]

Fig. 64: A water storage reservoir connected to a water supply system – a chest with a water-pillar. Petrarch, De remediis utriusque fortunae, *Augsburg 1532, after: Braudel 1992, fig. no. 3 after p. 32.*

1409 Braudel 1992, illustration no. 3 after p. 32.

1410 Crescenzi 1548, p. 5. Cf. also: Široký 2000, p. 367, with a fragment of a veduta by Filip and Franz Heger from 1794, depicting the Market Square of the Malá Strana in Prague, with such a water pillar from which water flowed to a wooden vat; from this vat people drew water to their buckets.

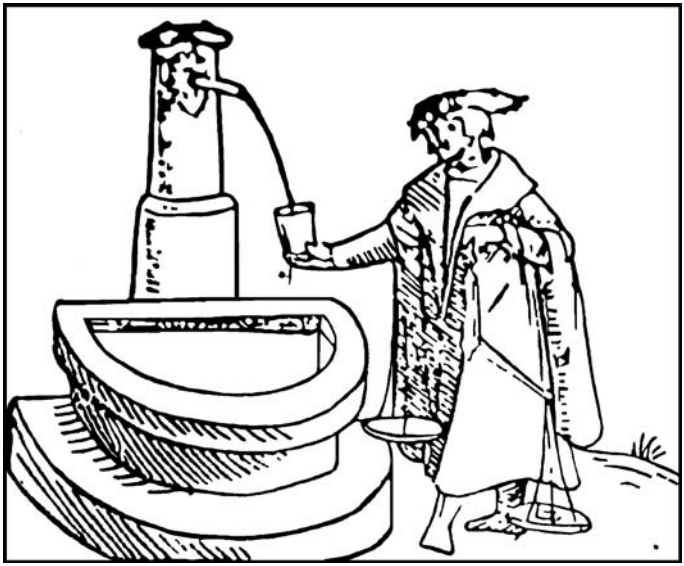

Fig. 65: A water storage reservoir connected to a water supply system – a reservoir with a water-pillar, after: Crescenzi 1548, p. 5.

In written sources from towns in the Polish lands water storage reservoirs were referred to using Latin words denoting boxes or cisterns: *cistae*,[1411] *scriniae cannalium*[1412] and *cisternae*,[1413] but also – as was mentioned in the present work – *fontes*, which fact caused difficulties in telling them apart from dug wells that were described using the same word (like in Kraków).[1414] Water storage reservoirs connected to a network of underground conduits were called in Polish "żąp" or "rząpie", which was a Polish equivalent of the German word "Sumpf". This in turn implied their terminological identity with rainwater cisterns and even sewage pits (which was touched on earlier as well).[1415] For that reason the most important factor for a correct identification of water storage reservoirs is – again – the context of source mentions.

1411 ANK, rkps/MS 1589, p. 305.
1412 AGAD, ASK LVI, p. 2, vol. II, folio 188v.
1413 ZbPłock II, 1987, no. 393, p. 167.
1414 Cf. Part III.2 of the present work.
1415 Cf. Part III.1 of the present work.

And thus certainly in 1399, at the time when the Kraków water supply system was being built, a water box was being prepared; it was most probably made of wood, since there exists a mention of 16 groschen being spent on timber used to build it: *pro robore ad cistam aque*. In 1401 27 groschen were paid for linen *ad cistam cannarum*.[1416] It is thought to have likely served as a kind of filter. Expenses made for linen are repeated also in later accounts for materials needed for the "Rurhaus". In these earliest mentions the box was probably a reservoir into which water was poured by means of devices raising water; from this chest water was then conducted in the direction of the town. It would be a kind of the Vitruvian *castellum*[1417] and a counterpart of the Wrocław "distribution station" of the water supply system in Ketzerberg, which shows the similarity of the two constructions: the one in Wrocław and the one in Kraków, apart from the fact that they represented the same model of the "norias de corriente".

At the same time more chests/water storage reservoirs were built along the course of the Kraków water supply system. In 1401 a blacksmith received the whole payment in the amount of 3 marks without 3 groschen for working on two water chests.[1418] Kraków accounts from the year 1404 testify to the fact that water chests – just as pipes – underwent cleaning.[1419] Also later were water boxes built in Kraków, as is evidenced by a record in the "Chronicle of a Kraków Burgher", according to which in the year 1582, when Mister Marcin Urbankowic and Mister Krzywokolski held the post of Lohnherren, two covered water boxes were placed near the pipes. Another two boxes were placed in 1590 AD.[1420]

Letting water into a new water chest in 1488 in Pilzno meant that the local water supply system must have functioned at that time.[1421] A contract with a master fountain-builder and his assistant to build a water supply network in Lublin, dating from 1506, included the town's stipulation concerning the construction of two "chests" in the Market Square (*Ex tunc in primis et ante omnia in duabus cistis aquam in medio Civitatis dare debent*).[1422] In Płock, according to a contract entered

1416 ANK, rkps/MS 1589, p. 305, year 1399 and MS 1591, p. 60, year 1401.

1417 Considering, however, the closeness of the intake and of the devices connected with the water-work and the chest-distributor, in Kraków – like in Bruges – there was no need to conduct water in pipes from the intake to the *castellum* (*caput aque*) – as was described by Vitruvius, and done e.g. in Florence and Rouen.

1418 ANK, rkps/MS 1591, p. 60.

1419 ANK, rkps/MS 1592, p. 156: *Item ij gr. mundantibus cistas*.

1420 KronikaMieszKr., 1939, p. 19.

1421 Giedroyć 1907, p. 104 and the source text: Kowalska-Urbankowa 1986, p. 457.

1422 APL, Dokumenty miasta Lublina/ Documents of the town of Lublin no. 30.

into in 1534 with a master fountain-builder and his two assistants, *tria maiora aque receptacula seu fontes et cisternas* were to be built in the town. Two of them were to be situated at a typical location, namely in the Market Square: one in front of Jan Alansee's house, the other one in front of the house of the *vicecapitaneus* of of Płock named Radzymiński. The third one was to be placed in the square in front of the Cathedral, because this was still to be a common enterprise with the chapter.[1423] Four months after this contract was made, the King ordered that the town build at its own expense one more chest, this time in front of the castle, in the most appropriate place; into this chest water was to drip down from a pipe. This chest together with conducting water to the square in front of the Cathedral (also financed by the town) would constitute – in the King's opinion – the town's repayment for exempting Płock from paying an indemnity for the mill that the town had received for the needs of the water-work.[1424] In Sieradz in 1541 and 1543, in the course of works on the local functioning water supply system, a blacksmith was paid 12 groschen for making 7 clamps (Polish: *klamry*) for a water chest placed in the Market Square (*Fabro a labore 7 klamri ad Scrinia Cannarum in circulo Siradiens.*); two years later a blacksmith received 4 groschen for one clamp for that chest[1425]

Archaeological research conducted in Wrocław[1426] and in Kraków[1427] shows early barrel- and chest-shaped water storage reservoirs dating from the 14th and 15th century respectively (fig. 66). Describing the Wrocław water supply system of the end of the 15th century, Mateusz Goliński pointed to a "rząp" (water storage reservoir)[1428] which was placed at the end of a dozen-kilometer fragment of a ceramic water supply system excavated to the south of the river-moat, in the area of plots in Kacerska Górka Street (Ketzenberg) 17, 19, 20. This reservoir was an oak barrel; its staves were made of a tree cut down in 1293, whereas the tree whose wood was used for its bottom was felled in 1356. Together with ceramic material discovered there, this enabled the researchers to date the whole conduit to the second half of the 14th century.

1423 ZbPłock II, 1987, no. 393, p. 167.
1424 Op. cit., no. 395, p. 173.
1425 AGAD, ASK LVI, S. 2, vol. II, folio 62v. and 188v.
1426 Buśko 1995, p. 94 (reconstruction by Zdzisław Wiśniewski); Goliński 2001a, p. 109; Janczewski 2005, p. 96.
1427 They were described as "huge barrels" – cf. Radwański 1964, pp. 229–234 and Ligęza 1971. After K. Radwański cf. also: Rajman 2004, p. 192.
1428 Goliński 2001a, p. 109.

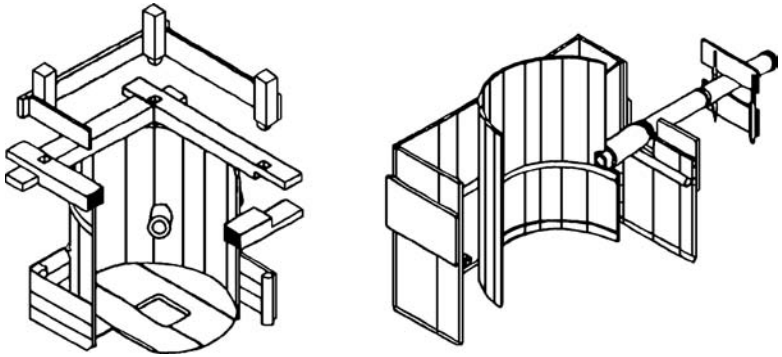

Fig. 66: Mediaeval water storage reservoirs connected to Wrocław water supply system, barrel-shaped and chest-shaped, after: Buśko 1995, p. 94 (reconstruction: Z. Wiśniewski).

Wooden barrels with iron and wooden hoops used as "rząpia" or "rząpy" (water storage reservoirs) were also found in the course of archaeological excavations in Lublin. One of such barrels, discovered in the yard of a plot at 16 Grodzka Street, was dug into the ground ca 2 meters deep (as measured from the present street level). Its diameter equalled 122 cm and its volume is estimated at about 750 litres.[1429] It was used in the first half of the 16th century, i.e. exactly in the same period as two Kraków public water storage reservoirs confirmed in written sources. The first one, "zamb", at the end of the 1520 was situated next to Bursa Jerusalem (Collegium Jerusalem), i.e. where Garncarska and Przecznica (later called Jagiellońska) Streets met.[1430] Its role as a public water point with drinking water may have been significant: mentions in echevin books testify to the fact that it served the needs of a rather poor neighbourhood. Apart from students from the Bursa Jerusalem, it was used by inhabitants of Kraków living in the nearby little wooden houses (*domuncula ligneae*), e.g. a pavior.[1431] Another water storage reservoir was placed in 1530 in Żydowska (Jewish) Street, as is shown in a record from town accounts, from an entry entitled *Edificia Ciuitatis Communia*, about spending 13 groschen on a large barrel intended to perform the function of this very reservoir.[1432] However, it

1429 Hoczyk-Siwkowa 1997, pp. 165 and 167.

1430 ANK, SC, 11, p. 42, year 1528 and p. 72. About the water storage reservoir near the hall of residence cf. also ANK, SC 10, p. 750, year 1527. The localisation of the Bursa Jerusalem, funded in the third quarter of the 15th century by Zbigniew Oleśnicki, after: Włodarek 2000, pp. 341–358, especially p. 352.

1431 ANK, SC, 11, p. 72, year 1529.

1432 ANK, MS 1601, p. 107.

has to be debated whether it was its total price, considering a much higher cost of making a water storage reservoir for the Wrocław Dominican monastery in 1500. In the monastic accounts survived a record dating from 5 May of that year about paying 3 marks without 8 groschen (136 groschen) to a cooper for making this kind of a water reservoir (*doliatori vor en sümp*).[1433] To this was added the cost of iron elements (probably also of the hoops) (*pro ferreis circumferenciis ad praedictum fontem*) in the amount of 6 fertones and 2 groschen (i.e. 74 groschen) paid to a blacksmith. This made up the total sum of 210 groschen, namely 7 florins or 4 marks and 18 groschen. It can be noted that this price was very much like e.g. sums mentioned in contracts with well builders for new dug wells or for extensive renovation works on dug wells in Lelów.[1434]

To the above-mentioned cost of the construction of the water storage reservoir could also add the cost of its fitting – performed by a master fountain-builder, like the one recorded in a Wrocław tariff dated by Mateusz Goliński to the year 1545: "vom Sompe zusettzen 12 gr."[1435] Hence, a very similar sum of 13 groschen paid in Kraków in 1530 may have been merely the cost of fitting a water storage reservoir: a solid, leak-tight construction designed for many years of smooth operation.

Mentions of building public water intakes connected to a water supply network, found in some of the preserved 16th-century royal privileges concerning the construction of water supply systems in towns of the Kingdom of Poland, make it possible to state that besides chests or barrels, also the above-mentioned "water pillars" were planned. The following piece of information taken from a contract entered into in 1508 between the Kamieniec town councillors and two hired water supply system constructors conserve as an example: the constructors were to place *duas cistas et duas statuas absque cistis* in the Market Square in the vicinity of the Town Hall as part of the installation. This meant two reservoirs and two water pillars without reservoirs. In the local Old Town they were also to build one of each of these devices (*unam cistam et unam statuam absque cista*).[1436] The same explanation should also be given to the planned form of some public water intakes in Płock connected to the local water supply network in 1534. Apart from the above-mentioned reservoirs-chests and cisterns placed in the most important places in

1433 RachDomWr., 1858, p. 299. The author of the present work wishes to express her gratitude to Fr Jan A. Spież OP for making this publication available to her.

1434 Cf. Part III.2 of the present work.

1435 APWr., Akta miasta Wrocławia, 554 (E 1,1), k. 176.

1436 AGAD, MK 23, pp. 397–398, published by: Kiryk 2005, pp. 103–104 (the quotation from p. 103).

town, the pipe water supply was also to feed two *statuas aquarias cum ducillis*,[1437] one of which was to stand at the intersection in Grodzka Street, near a house of a local notable, the *advocatus* and burgomaster Wietrzychowski; the other one was to be placed at the crossroads near Dobrzyńska Street, in the vicinity of a house belonging to another Płock patrician, a town councillor named Nowak. It can be supposed that the water pillars not only in Płock, but also in Kamieniec were fitted with a bung, so that water would not flow for nothing.

However, the construction of decorative fountains in towns in the Polish lands has not been recorded. Only Gdańsk acquired such an "Italian-style" fountain, and only in 1549. According to Teresa Zarębska's urban research, this resulted from the Renaissance aesthetic that prevailed during the reconstruction of the Długi Targ (Long Market)[1438] (fig. 67). If we treat these constructions (as in the case of the 16th-century Flemish towns) as an expression of the manifestation of communal power (which was possible only in strong centres), the lack of fountains will be one of the signs of the weakness of towns in the Polish lands; the uniqueness of the Gdańsk fountain should be thus regarded as going hand in hand with the special independence that Gdańsk enjoyed within the Kingdom of Poland.

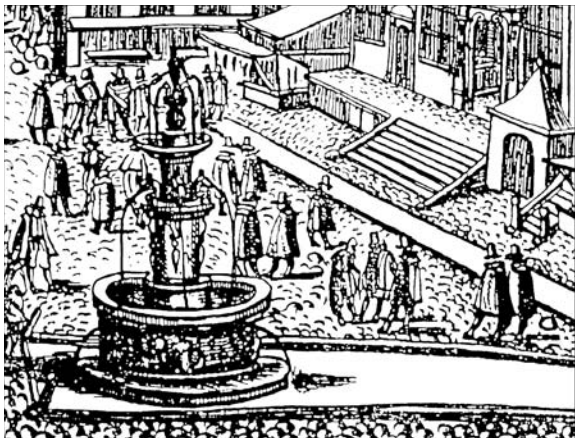

Fig. 67: A decorative "Italian-style" fountain in Długi Targ (Long Market) in Gdańsk, built in 1549. Engraving by I. Dickmann, 1617, after: Zarębska 1998, p. 41.

1437 *Ducillus* (*docillus*) referred to a bung, as in a barrel, and was synonymous with *clapsydrae* and *aquatilae* – cf. Du Cange, 1710, p. 206 and 1123. Cf. also SŁacŚr., vol. III, 1969–1974, column 885 – entry: duciculus (ducillus, duciolus, "czop"). Sometimes it was in the shape of a pine cone (Grewe 1991a, p. 27).

1438 Zarębska 1998, p. 40.

Public water intakes connected to a water supply network were – like dug wells – a place where members of the local community met.

Only rarely can one find traces of conflicts arising from using these intakes. The following situation was recorded in a Poznań law passed by the city council on 7 August 1549: *Judaeis aqua ex cisternis civilibus conceditur.*[1439] Since conflicts occurred between Christians and Jews when they used public water reservoirs located in the Market Square, town councillors, *volentes eiusmodi incommodis ansam praecedere*, at the request of the elders of the Jewish community, decided that two such water reservoirs should be built in streets inhabited by Jews: one in Sukiennicza Street, in front of the synagogue, the other one in Ciasna Street, in front of a house owned by a Jew named Chajm, neighbouring with houses belonging to Szloma and Mojżesz respectively. Because of the considerable cost of conducting water to these reservoirs that was to be covered by the town, the councillors decided that on behalf of the Jewish community the elders would pay a yearly charge to the Town Hall (due on the Green Week) amounting to 20 marks as long as the town water should be supplied by means of two pipelines to these cisterns. At the same time the town councillors undertook that they or their successors would maintain in good condition both these pipelines and the cisterns so that the town water conducted and stored there be clean and healthy. Water from these cisterns could be drawn by Jews and Christians; in order to avoid conflicts, the city council decided that the first one to come, no matter whether it be a Jew or a Christian, was the first one to draw water; the second person had to wait and was not allowed to disturb the one who was drawing water, under penalty of fines imposed by the town.

III.3.4.4 Connections

The term 'connections' is used to refer to conduits branching off from the town water supply system and reaching town plots as well as public devices and institutions.

As far as connections to plots are concerned, let us begin the presentation with the ones considered to be the earliest, namely the 13th-century connections in Provins, a town in the region of Champagne. According to André Guillerme, the solutions used there were absolutely novel in these lands in the 13th century.[1440] This statement requires a comment: this solution was novel in that particular time; however, obviously its origins reached the Roman times; the fragment from Vitruvius' treatise quoted above about managing water from water supply systems

1439 WilkierzePozn. I, 1966, no. 100, p. 33.

1440 Guillerme 1985, pp. 192–193 and p. 199, footnote 55.

can serve as an example. This solution was a realization of one of the two rules described by Frontinus as valid in the republican Rome, and in the period of the Roman Empire – in towns of its provinces.[1441] This rule pertained to fees charged for concessions to build private connections. Nevertheless, prevailing at that time in Rome, the second of these rules stating that granting such concessions was free of charge was used – as André Guillerme's research reveals – from the early 15th century in two largest cities of late mediaeval France: in Paris and Rouen, but only for the members of the royal family and for former prefects.[1442] The description of the water supply network called Yonville in Rouen[1443] shows the permission to establish a private connection which was granted by town councillors in 1520 (only for life) to "*Guillaume Preudoonme, notaire et secretaire du Roy…, et recepveur général dudict seigneur en Normandie*". In his garden a water storage reservoir with a tap was to be located (*chantepleure*[1444]), i.e. with a plug. At every moment water could be cut off, e.g. in times of a drought. The other owners of gardens must have used the numerous "vuidenges", namely the outflows of surplus water, branching off from the water supply system.[1445] One of such outflows was certainly used by "*maistre Robert Surreau, général de la justice et à présent conseiller en la cour de Parlament*".[1446]

In towns of Central Europe, including the Polish lands, like it was in Provins, the construction of connections to private plots was allowed everywhere, mainly to conduct water to brew beer. The earliest confirmed connections are those conducting water to 200 burghers' plots in Lűbeck from the above-mentioned oldest town water supply system established in 1293/1294[1447] The same model was probably used in the second half of the 14th century in the Main Town of Gdańsk (*Rechtstadt*): thanks to Zofia Maciakowska's research we can trace the trend to conduct water to the highest number of private plots, either directly or through neighbouring plots.[1448] The example of connections in Kraków (which will be discussed later) indicates that single charges were made for the concessions, and in some cases the permissions were granted without payment. This was done by

1441 Frontinus 1961, p. 56; cf. also: Biernacka-Lubańska 1959, pp. 65–66.
1442 Guillerme 1985, p. 199, footnote 55.
1443 Le Lieur 1911, p. 52, quated in: Sowina 2001, p. 33.
1444 Cerné 1930, p. 411: chantepleure, champleure, champleleure = robinet.
1445 Godefroy 1891–1902, vol. VIII, p. 311.
1446 Le Lieur 1911, pp. 51–52.
1447 Grewe 1991a, p. 62 and a photograph of the preserved fragment of the wooden connection on p. 36 (no. 27).
1448 Maciakowska 2005, pp. 331–338.

the town authorities as the owners of the network who controlled the distribution of water from the town water supply systems.

Among towns in the Kingdom of Poland the earliest confirmed are the connections in Kraków. The first mentions of granting permissions to conduct water to private houses date from 1441; there are very few of them in the 15th century. They were always personal and referred only to prominent burghers, mostly town councillors. This can testify to the fact that the 15th-century water network in Kraków consisted mainly of public stretches and water storage reservoirs and of very few private connections.

The oldest discovered permission to build a connection is a document dating from 12 August 1441 issued for a town councillor called Marcin Chmiel so that he could conduct water ("eyne Ror zu setczen") to his house on the corner of St John's Street, situated next to a "great" house that also belonged to Chmiel. The connection was to be fitted to the town pipe water supply ("Stat Ror") in Sławkowska Street and to run along St John's Close connecting two arteries: Sławkowska and St John's Streets. The permission was granted for ever free of charge; however, Chmiel was to pay 10 marks in the common coin for conducting the "pipe".[1449] Marcin Chmiel, the then town councillor, was mentioned in town books also in 1452 when the city council made him responsible (together with Herman Krancz) for the follow-through of such laying of water supply pipes as to save water in the town network, so that it would serve the town to its benefit.[1450] As a town councillor, in 1463 Chmiel also performed the function of the burgomaster of Kraków.[1451] In the permission concerning the connection for Marcin Chmiel the charge of 10 marks is noteworthy, as it was the same as the one required in Wrocław for making a connection to the pipe water supply in Ketzerberg, mentioned in its description dating from 1499.[1452] Hence, in this respect the same organizational model was applied in both of these centres.

Coming back to Kraków private connections: nine more permissions concerning their construction issued by the town council between 1441 and 1500 were found. They were granted to the following people: a town councillor named Peter (Piotr) who used to be the Queen's dressmaker (18 April 1441) to his brewery in a plot *intra muros* that has not been identified;[1453] Lawrence (Wawrzyniec) Raciborski, a blacksmith (*smed*) (25 April 1453) to his house on the corner and his

1449 KDMK II–IV, 1882, no. 424, pp. 553–554.
1450 CA I, 1917, no. 451, p. 141 (from:) ANK, CC 429, p. 46.
1451 CA I, 1917, no. 539, p. 172 (from:) ANK, LT 772, p. 80 (4 April 1463).
1452 Goliński 2001a, p. 117 and quotation on p. 123.
1453 KDMK II–IV, 1882, no. 425, p. 554.

curia plot (*Erbe*) in Sławkowska Street (*Slokischin gassin*);[1454] Michał Ederer,[1455] a town councillor (25 September 1457) to his house on the corner near St Stephen Church;[1456] Kuncza Lange, a town councillor (25 September 1458) to his house in Szewska Street;[1457] Mikołaj Ditrich, a town councillor (10 December 1459) to his house[1458] (as yet unidentified); Piotr Salomon (5 October 1481) to his house in the Market Square;[1459] Leonard, a coopersmith (1482, without the exact date) to his house in St John's Street;[1460] Georg Morsztyn (12 May 1488) to his house in the Market Square situated between the houses belonging to Abraham and Fryderyk Schilling; Hanusz Kizinger (4 November 1500) to his house in the Market Square that earlier had belonged to Paweł Ber. Consequently, together with the permission for Marcin Chmiel, the city council issued ten such documents. However, it must be added that the permission granted to Piotr, the former dressmaker to the Queen, did not concern a connection made in the town water supply system, but a perpetual right to conduct water through pipes from the town moat near the Brama Szewska (Shoemakers' Gate). The water was to be conducted through underground pipes in the vicinity of the town "Rurhaus", then the pipes were to cross the town wall and reach Piotr's brewery. Hence, we can infer that water in this part of the moat, namely between the water-work devices and the Shoemakers' Gate, was considered suitable for drinking.

All the other permissions concerned connections fitted to "the town pipe/town pipes" ("Stat Ror[1461]/Stad Roren"[1462]). Only two of them referred to people who were not town councillors. The fact that the right to conduct connections was granted to craftsmen: a blacksmith and a coopersmith, can be explained: they received it in return for their consent to conduct the town water supply network through their plots. The documents concerning Wawrzyniec (Laurentius) Raciborski and the town councillor named Ederer contain the stipulation that the measurement of the water granted to them amounted to one inch (the above-mentioned module repeated from antiquity). The purposes that the water was to serve, were specified in pieces of information about conducting it to front houses, breweries and

1454 Op. cit., no. 438, pp. 573–574.
1455 The son of Jan Ederer, the *advocatus* in 1441? – cf. ADKr., Prothocollon, p. 6v.
1456 KDMK II–IV, 1882, no. 443, p. 578.
1457 Op. cit., no. 445, p. 580.
1458 Op. cit., no. 447, p. 582.
1459 Op. cit., no. 472, p. 621.
1460 KDMK II–IV, 1882, p. 621.
1461 KDMK II–IV, 1882, no. 424, p. 553.
1462 Op. cit., no. 472, p. 621.

kitchens. Such permissions were granted to the owners of the property for ever. This principle was changed by a law passed by the city council in 1500 into the right of a lifetime ownership of the connection.[1463]

The development of a network of private connections conducted from the Kraków town water supply system is evidenced in two kinds of entries of the town income. The first one was the above-mentioned *braxatura alias rorgeld*, found in the town accounts from 1487 onwards; the second one, called *venditio cannalium de rorhaws*, was found in the town accounts from 1517 onwards. However, ever earlier, in the entry entitled *Venditiones* from the accounts pertaining to the year 1487 appeared records of sales of pipes and connectors-cans.[1464]

According to the account book of 1542 in which the whole Kraków income of the period was recorded, the *braxatura alias rorgeld* was paid by "*braxatores*", who had a connection to their house ending in a water storage reservoir. An analysis of 16th-century Kraków town books revealed that "*braxatores*" were all the people who had the right to brew beer for sale, the right of tavern, regardless of their other profession (e.g. goldsmithing). They had to pay 6 groschen for every gyle of beer. Those who did not have connections, but only dug wells, were exempt from this charge.[1465] Taking these principles as a starting point (including the assumption that every person who paid this tax had his own connection with a water storage reservoir!), we can follow the registers of this income and on their basis try to calculate the minimum (traceable) number of pipe connections to houses of the payers of *braxatura*. Another assumption was that the yearly total sum of the Kraków *braxatura* was made up of a number of sums/instalments that equalled the number of times in a year that brewing a gyle of beer was allowed. In the case of Kraków in the analysed years 1487–1538 it was from 48 to 62 times, which gives

1463 KDMK, part II–IV, 1882, no. 355, p. 471, year 1500: "De aqueductibus. Decretum et Conclusio generalis. [Feria 4. post Omnium Sanctorum]. Dor neben ist auch durch dy Heren Iung vnd alt beschlossen, das fort mer keynem burger noch rotheren keyne röre auff ewigk czeit nicht zal vorkowfft werden vmbe vyl orsach willen, zunder czw etlicher lebetagen ader czw der heren willen mögen rören vorkowfft werden noch der heren erkentnisse, zunder awff ewikeit nymmer".

1464 ANK, rkps/MS 1597, p. 10.

1465 KDMK, part II–IV, 1882, p. 734 (year 1542): *Braxaturae Cereuisiorum alias Rorgelt… Quilibet autem braxatorum, qui domi suae canale habet alias szumpp, a qualibet coctura racione sibi pro cereuisia coquenda suppeditandae aquae tenetur ciuitati soluere grossos six. Qui vero puteos seu fontes domi habent et non canalia (quorum pauci admodum sunt), hij ab tali exactione sunt liberi…*

an average of 52.5 times; this shows that brewing beer was allowed once a week.[1466] The sums/instalments were sums of the 6-groschen payments; if we choose one maximum instalment from all of the instalments for every year and divide it by 6, we will obtain the minimum number of connections in a given year. Every such connection supplied water from the town water network to one payer of *braxatura*. According to the only surviving 15th-century register of this tax, pertaining to the year 1487, the total income from *braxaturae* amounted to 169 marks, 33 groschen and 9 denarii.[1467] It was received in 50 instalments, the highest two amounted to 4 marks and 18 groschen each, which gives us 31 connections.

The following are values pertaining to a number of years in the 16th century:

1517: 443 marks 16 groschen[1468] – 62 instalments – max.: 10 marks 40 groschen – ca 86 connections;
1518: 373 marks 14 groschen[1469] – 48 instalments – max.: 10 marks 42 groschen – 87 connections;
1524: 373 marks 46 groschen[1470] – 53 instalments – max.: 9 marks 28 groschen – ca 76 connections;
1530: 505 marks 7½ groschen[1471] – 53 instalments – max.: 12 marks 27 groschen – ca 100 connections;
1531: 603 marks 24 groschen[1472] – 52 instalments – max.: 18 marks 30 groschen – 149 connections;
1533: 567 marks 8 groschen[1473] – 51 instalments – max.: 15 marks 6 groschen – 121 connections;

1466 Therefore, three times more often than in Prussian towns in the 15th century (Klonder 1983, p. 67), but as often as in Poznań for burghers who had the right to brew beer, according to the local law passed by the city council dating from 1462 (Wilkierze-Pozn., I, 1966, no. 32, p. 10). Greater restrictions as to the frequency of brewing beer in Prussian centres in comparison with both of the above towns of the Crown of the Kingdom of Poland testify to a higher competitiveness of this activity in the conditions of a better developed beer production in the former centres.
1467 ANK, rkps/MS 1597, p. 3.
1468 ANK, rkps/MS 1598, p. 120.
1469 Op. cit., p. 143.
1470 ANK, rkps/ MS 1600, p. 11.
1471 ANK, rkps/MS 1601, p. 13.
1472 ANK, rkps/MS 1602, p. 13.
1473 ANK, rkps/MS 1603, p. 13.

1535: 504 marks 16 groschen[1474] – 52 instalments – max.: 14 marks 42 groschen – 119 connections;
1537: 653 marks 24 groschen[1475] – 52 instalments – max.: 16 marks 14 groschen – ca 130 connections;
1538: 649 marks 26 groschen[1476] – 52 instalments – max.: 18 marks 44 groschen – ca 151 connections.

This list shows that between 1487 and (1531) 1538 occurred a fivefold increase in the number of connections to houses of people who had the right to brew beer for sale; this in turn resulted in a fourfold increase of the town's revenue from the *braxatura*: it constituted one of the highest sums in Kraków's annual revenue[1477] The city must have been anxious that the water supply network should develop, especially the connections in question, because it directly contributed to an increase in the city's revenue. Building connections to houses of the burghers who for brewing beer used water from their own dug wells or from public water storage reservoirs (for the latter everyone had to pay a special tax called "rurne" (pipe tax), much lower than *braxatura*) meant that they would be obliged to pay the *braxatura*, a tax that was much more advantageous to the town.

The second kind of town revenue mentioned above from which we can drawn information concerning the growing number of connections to private houses in Kraków was a tax called *venditio cannalium de Rorhaws*.[1478] The value of this entry lies not only in the information included in the title about the sale of pipes from the "Rurhaus" (made by a master fountain-builder) to individual clients, but also in the fact that in the course of the present study it was precisely in these records that permits issued by town councillors to conduct private connections were found. The conditions of these permissions were the same (i.e. identical for Kraków and Wrocław) as those stipulated in the two above-mentioned oldest known permissions for Marcin Chmiel dating from 1441 and from the Wrocław Ketzerberg from 1499, imposing the obligation to pay a one-time fee in the amount of 10 marks. In the case of Kraków 16th-century permits, this was called "the sale of a pipe" or "the sale of a pipe, that is a water storage reservoir" (*venditum est canale alias zap*); it is

1474 ANK, rkps/MS 1604, p. 11.
1475 ANK, rkps/MS 1605, p. 13.
1476 ANK, rkps/MS 1606, p. 13.
1477 Cf. PrawaPrzywilejeKraków, 1885, passim.
1478 This meaning of this entry was noted by E. Ligęza (1971, p. 62), who, however, did not discuss it for the 16th century, only for the 17th century, when this entry contained solely the revenues from the sale of pipes from the pipe hause, and not – as had been the case before – also from the sale of stones and timber.

probably for that reason that they were placed together with the revenue from the sale of pipes from the "Rurhaus".

The earliest permision preserved in this entry was dated to 1524 and was issued for Piotr Tanigel, a merchant and the then Kraków town councillor, Piotr Salomon's grandson.[1479] The town council unanimously granted Piotr Tanigel the right to conduct a connection to his house in St John's Street, for which privilege Piotr paid 10 marks (*Item domini Consules unacum voto dederunt Cannale domino Petro Tanigel in domum eius in platea Joannis iuxta litteram sibi data pro qua solvit* – m.10, gr.0).[1480] In the same year 7 pipes from the "Rurhaus" were sold to Piotr for 12 groschen each, the total cost being 1 mark and 36 groschen. Consequently, a 14-meter connection to Tanigel's house could be built using these pipes, if we assume that pipes laid to private plots were of the same length as the 2-meter wooden pipes of the public water network confirmed archaeologically and that connectors were completely hidden inside the pipes.

In the next preserved accounts, from the year 1530, in the analysed entry the following record was made: *Canale venditum est* to the baker's (Grzegorz Szczerba) house in Szewska (Shoemaker's) Street at the consent of the town councillors and that Grzegorz made a payment to the town; however, (later) he took the money back, and thus he was forbidden from conducting the connection.[1481]

In 1531 Jan Noska (Jan Noskowski, a physician, a brother of Łukasz, also a physician[1482]) paid 10 marks for a connection to his house in Świnia Street (*in platea Scroffarum*); the same sum was paid by *dominus* Pankracy Gutteter,[1483] probably for a connection to a house on the corner of the Market Square and Floriańska Street. Pankracy was a town councillor at that time; he died in the same year.[1484] The next mention dates from 1535 and pertains to the "sale of a pipe" to Fryderyk Schilling's house.[1485] He was a son of a Kraków town councillor who came from Wissembourg and a grandson of a local (Wissembourg) echevin, both called Fryderyk.[1486]

1479 A biographical entry about Tanigel – Noga 2003, p. 346 and information about his activity in the town – op. cit., according to the index on p. 377. Cf. also op. cit., p. 336 – a biographical entry about Piotr Salomon.

1480 ANK, rkps/MS 1600, p. 22.

1481 ANK, rkps/MS 1601, p. 24.

1482 Noga 2003, p. 327.

1483 ANK, rkps/MS 1602, p. 24.

1484 Information about Pankracy Gutteter Senior after: Noga 2003, pp. 208, 211 and a biographical entry on pp. 311–312.

1485 ANK, rkps/MS 1604, p. 26.

1486 Noga 2003, pp. 337–338.

In 1538, the last year included in the present study, the town council issued three such permissions (only that year the expression used was *Canale alias zap/sap*): to Skalski's house on the corner of Sławkowska Street, to Wiewiórka's house and to Franciszek Rezler's house, possibly also in Sławkowska Street.[1487]

As far as income from the sale of single pipes is concerned, namely pipes that were surely used to replace old pipes in private connections, according to the oldest preserved mention dating from 1487[1488] Mr (*dominus*) Thurzo paid a total sum of a threescore of groschen for 4 pipes and 3 connectors, whereas Mr Piotr Salomon paid 18 groschen for one pipe. In the same year six more pipes and three connectors were sold, including 4 pipes for 12 groschen each (1 ferto), 1 pipe for 3 fertones, 1 pipe and 1 connector for a total sum of 15 groschen, and 2 connectors for a total sum of 6 groschen. In 1517[1489] 12 pipes were sold to Mr Jan Morsztyn for 12 groschen each, giving a total of 3 marks; 7 pipes also for 12 groschen each were sold to Mr Leonard Fogelweder, the then town councillor,[1490] which added up to 1 mark and 36 groschen; 1 mark was paid for 4 pipes by Mr Zeyfrid Bonner (namely Seweryn Boner, Zeyfrid Betman's son-in-law[1491]); Mr Schilling paid 12 groschen for one pipe for a connection (probably to one of two houses in the Market Square mentioned in the permission of 1488 for Georg Morsztyn as the neighbouring houses); 3 pipes were sold to a nobleman named Gliński, the then town councillor,[1492] for 36 groschen; one pipe together with poles were bought by *nobilis* Prosper for 30 groschen.

If we compare the above-mentioned information concerning the people who obtained permissions to conduct connections to their houses before 1500 with accounts from the sale of pipes in 1517, we can observe that e.g. the 15th-century permission issued "perpetually" could be transferred from father to son: from Georg to Jan (Johann) Morsztyn.[1493] Pipes bought by Jan Morsztyn were enough

1487 ANK, rkps/MS 1606, p. 28.

1488 ANK, rkps/MS 1597, p. 10.

1489 ANK, rkps/MS 1598, p. 110.

1490 According to a biographical entry (Noga 2003, p. 306), he was a town councillor in the years 1513, 1515, 1517–18 and later. Apart from this, he was also, inter alia, a mining investor in mines owned by the Fuggers in Hungary and a partner of the Thurzo family. He died in 1533.

1491 About the family relations of both of the patricians – cf. Noga 2003, p. 297 and 299 (biographical entries).

1492 Merchant, Mikołaj Salomon's son-in-law, a mining investor in the Tatra mountains, the owner of a village called Bobowa – cf. Noga 2003, p. 309 (a biographical entry, in which also about Gliński's other, subsequent fields of activity).

1493 Noga 2003, p. 325 – a biographical entry about Jan Morsztyn, Georg's son.

for a 24-meter long connection (assuming the same technical solutions as the ones used in the connection to Piotr Tanigel's house). If we assume that pipes bought in 1517 were meant for the connection existing from 1488, we can draw a reasonable conclusion that this connection was repaired (and the pipes were replaced) after 29 years.

Accounts dating from 1518[1494] provide us with the following information: Stenzel (Stanisław) Morsztyn paid 1 mark for 3 pipes and labour ("Vor 3 rör Stenczel merstyn und vor arbeit mr. 1, gr.0"); 24 groschen were noted as payment for two pipes for the Dominicans; Marcin Ziemianin, the then echevin of the Supreme Court of German Law at Kraków Castle[1495] paid for one pipe 28 groschen; "doctor Regulina"[1496] paid 7 groschen for one and a half pipes; whereas Kuncza Krupek paid for one pipe ("vor rör in sein haus") as much as 2 marks and 27.5 groschen. Since the income from the sale of (wooden) pipes was noted together with the income from the sale of timber by the town,[1497] it is not known what exactly the payment of 30 groschen from the baths of Mr Morsztyn and Mr Salomon was made for ("Vom herrn Morstin und Salomonis badstube 30 gr."). The three instances of a different price of a pipe ("ror") than 12 groschen are worth our attention. In the opinion of the present author, at least in the third case the cost did not concern a single pipe, but a whole connection – which would be unique in Kraków written sources. In 15th-century permissions written in German connection were called "eyne Rore", whereas in 16th-century documents drawn up in Latin it was referred to as *Cannale*. The whole connection to Kuncza Krupek's house in 1518 must have consisted of pipes, connectors and a water storage reservoir. The prices of one pipe being 12 groschen, of one connector – 3 groschen and of fitting a water storage reservoir – up to 13 groschen (on the basis of only one known mention quoted above, of such cost of fitting a public water storage reservoir in Żydowska (Jewish) Street in 1530), this connection which cost 2 marks and 27.5 groschen (123.5 groschen) may have consisted of 7 pipes (84 groschen), 6 connectors (18 groschen)

1494 ANK, rkps/MS 1598, p. 155.

1495 Noga 2003, p. 352 – a biographical entry about Stanisław Ziemianin, a town councillor, Marcin's son.

1496 This concerned Benigna Regulina, the widow of Jan Reguła, physician, who died in 1515. For more details on the history of this house in the Market Square (no. 20, on the corner with Bracka Street) from the beginning of the 16th century, including Jan Reguła, one of its owners – cf. Komorowski/Follprecht 2005, p. 23 and Sowina/Pacuski 2011, passim.

1497 The full name of this entry from the year 1517: "*Vendicio cannalium de Rorhaws et roborum de Czimerhoff*".

and one barrel-water storage reservoir. However, it is difficult to tell what the remaining 8.5 groschen was paid for. Probably it was the price of labour of the master fountain-builder who laid the connection; this sum was also paid to the town coffers, like in the case of Stenzel Morsztyn noted in the same year. Nevertheless, compared with the latter (4 groschen per pipe), it would have to be higher; thus, the number of pipes and connectors in Krupek's connection would have to be reduced to 6 pipes and 5 connectors (in that case it would be about 12 meters long, taking into consideration only the length of pipes with connectors entirely hidden inside). The cost of labour would amount to 23.5 groschen, i.e. the sum paid per pipe would be almost the same as in Stenzel Morsztyn's connection. The cost of fitting the water storage reservoir was counted separately; the cost of making this reservoir was not accounted for, as it was not included in the scope of the master fountain-builder's duties. Hence, the matter must have been left to be settled between the maker of the reservoir (the cooper) and the owner of the connection.

In 1523[1498] the connection to the Dominicans was again supplemented: the monastery paid 12 groschen twice, every time for one pipe. In the same year four pipes and one connector (*puska*) were sold to Remer for 1 mark and 3 groschen. Another 39 groschen was noted as income from the sale of three pipes and one connector (*una puska*) to Kasper Zuttor's (Zutter's) house.

In 1524[1499] apart from the connection consisting of 7 pipes to the house of Piotr Tanigel, also pipes and/or connectors were mentioned in the following connections: to Morsztyn's house; to the Dominican monastery; to Mr Boner's house; to Mikołaj Włodarz's house; and to Mr Salomon's house. One pipe and connectors--cans were bought for Morsztyn's connection for the total sum of 23 groschen; the Dominicans bought one pipe for 12 groschen; Boner paid 15 groschen for one pipe and one connector, and perhaps additionally 24 groschen for one and a half pipes and two connectors-cans, and 12 groschen for one more pipe. For one and a half pipes and two connectors Mikołaj Włodarz had to pay also 24 groschen; Mr Salomon bought two pipes and two connectors for 30 groschen.

In 1530[1500] only one pipe was sold from the pipe house for 12 groschen – as a replacement in one if the Schillings' connections.

In 1531 apart from 20 marks paid for conducting two connections: to Jan Noskowski, a physician, and Pankracy Gutteter, a town councillor, also 1 mark was noted for 4 pipes *ad Vieliczka*, 2 marks and 24 groschen for pipes to a house

1498 ANK, rkps/MS 1599, p. 24.
1499 ANK, rkps/MS 1600, p. 22.
1500 ANK, rkps/MS 1601, p. 24.

on the corner belonging to vicars[1501] (hence either for 10 pipes or – which is less probable – for a whole connection, as in the case of Kuncza Krupek in 1518); 36 groschen for pipes and poles from Mikołaj Stille, a notary; 43.5 groschen for pipes from Konrad Krupek, a town councillor; and 24 groschen for pipes from Marek bookseller.

In 1533[1502] the method of registering the income in the analysed entry changed: from that year it was underlined that money to the town coffers was paid by the master fountain-builder for pipes that he had made and sold. However, this system does not always reveal for whose connection the pipes were used. In five instances when the master fountain-builder gave money to the town, only once it was mentioned that it was the income from the sale of pipes to Mr Pilecki (*pro Cannalibus a d. Pileczki Rormagister dedit Sabbatum Pasce m. 0, gr. 27*). In none of the cases was it a multiple of 12 groschen, i.e. the price of one pipe, found regularly in earlier accounts. Not even in the one instance when the agency of the master fountain-builder was not mentioned, and the record only read that 1 mark and 30 groschen was noted for pipes from Konrad Krupek.

In 1535,[1503] without mentioning the master fountain-builder, the following payments were noted: 1 mark and 3 groschen for pipes from the Krupeks; 12 groschen for one pipe (sold to an unknown person); and 45 groschen *pro Canali a Frederico*. The latter sale undoubtedly referred to Fryderyk Schilling younger, who – as was mentioned before – precisely at that time paid 10 marks for the privilege to build a connection.

On the basis of a mention dating from 1538: *pro duobus Cannalibus in Circulo* it is impossible to establish who paid 27 groschen to the town coffers, and therefore where the connection was situated in which the two pipes were replaced. The same applies to two other mentions dating from the same year and written as in 1533, namely taking note of the agency of the master fountain-builder: *pro Cannalibus Jacobus Rormagister soluit m. 3, gr. 20* and *pro Cannalibus Rormagister dedit m. 1, gr. 22 ½*.[1504] The only mention from that year providing us with information about a connection is the one about three marks obtained from the sale of two pipes, two connectors and for labour in the manor house of the voivode of Sandomierz

1501 This most probably concerned the vicars from St Mary's Church; at that time their corner house was thus either on the corner of the Market Square and Szkolna/Sienna Street, or on the corner of this street and the Small Market Square – about the topography of this part of the town – cf. Tomkowicz 1926, p. 51.

1502 ANK, rkps/ MS 1603, p. 24.

1503 ANK, rkps/MS 1604, p. 26.

1504 ANK, rkps/MS 1606, p. 28.

(*pro duobus cannalibus et duobus pyxidibus et labore in Curia Magnifici pallatini Sandomiriensis m. 3, gr. 0*).

On the basis of an analysis of all the descriptions and of the income from the sale of pipes in the years (1487) 1517–1538 one can assume that in registers dating from the 1530s in some of the prices of pipes that were not multiples of the price of a single pipe also the price of connectors-cans was included (e.g. 27 groschen would equal 24 groschen for 2 pipes and 3 groschen for a connector; 1 mark and 3 groschen would equal 48 groschen for 4 pipes and 3 groschen for a connector etc.) and/or the price of labour. The question of the exact meaning of the repeated sum for 1.5 pipes remains to be solved. It might have referred to twin/double conduits (this can only be confirmed by detailed archaeological research) or to the method of paying money to the town coffers by the master fountain-builder, who sold and laid the discussed elements of water supply conduits.

The analysed sources revealed two methods of conducting connections in Kraków: either by connecting the new conduit to the "town pipe" ("Stat Ror"), or by making a hole in the wall between two plots and conducting the conduit from a neighbour who already had his water installation in his plot. The first method is illustrated by the oldest 15th-century permissions to conduct connections to patrician houses and also by 16th-century examples, like the following description given by the Hauptmann of the Town Hall (*praefectus praetorii*), from the years 1564–1565. On the command of the burgomaster and upon request of Ambroży, who was a goldsmith and an innkeeper, together with Stanisław the master fountain-builder, the Hauptmann of the Town Hall went to inspect a cellar in a house belonging to a man called Phol, in Szewska (Shoemakers') Street, next to a house owned by Szczęsny (Felix), an innkeeper. They saw a connection there through which water flowed from the town water supply network through this cellar to breweries situated at the back of Phol's house. However, since two pipes were rotten in this connection, water ceased to flow to one of the breweries. Moreover, they stated that another brewery situated there, belonging to Ambroży the innkeeper, was deprived of water as well, because pipes rotted also in another connection going through the second cellar of the inspected house.[1505]

The second method, which could be called 'neighbourly lending a conduit', is clearly shown in two examples of 1494 pertaining to the connection to Morsztyn's house, which belonged to Zeyfrid Bethman/Betman. On 20 September of the same year Zeyfrid gave his consent (having obtained the town council's permission) to conduct water from his connection to a brewery belonging to Jan Skórka,

1505 ANK, rkps/MS 899, pp. 192–193.

a shoemaker from Grodzka Street,[1506] whereas on 11 October the town council granted their permission to conduct water from this connection belonging to Betman to a brewery owned by Paweł, a shoemaker.[1507] According to the records, this would require making a hole in Zeyfrid's wall and conducting the conduit through the cellar of the neighbouring house "of the seven stalls", also belonging to Zeyfrid; the latter house faced "Breyten gasse",[1508] i.e. Stolarska (Carpenters') Street. In return for this favour Jan Skórka was to pay Zeyfrid 3 groschen per gyle of beer, and Paweł was to pay 6 groschen to the town and 3 groschen to Zeyfrid per gyle. It cannot be ruled out that both of the permissions referred to the same brewery, especially that they were granted to each of the shoemakers for their lifetime (in that case Jan Skórka must have been dead before 11 October). Perhaps this situation found its continuation in a case dating from 1549 found in written sources and described by Jan Ptaśnik. According to his interpretation, in 1549 the Morsztyn's house belonged to Zeyfrid's son-in-law, Seweryn Boner, and the neighbouring house was owned by Mikołaj Kaszki, a tailor. Boner testified before the town council on behalf of himself and his sons that at Mikołaj's request he allowed to make a hole in the wall of his house so that Kaszki could conduct a water connection to his house and to his brewery, for which favour Kaszki obliged himself to pay Boner and his heirs 3 marks a year and to pay the town 4 groschen per gyle of beer (*a qualibet coctura cervisie*).[1509] Two aspects deserve our attention. Firstly, the *braxatura* paid by Kaszki was lower than the one prevalent in Kraków in 1542. Secondly, the yearly payment made for the neighbour who granted him the water was higher than the one paid in Wrocław a half of a century earlier, where for the right to connect one's conduit to a neighbour's pipe (hence, for the same favour) a single fee of 5 marks prevailed.[1510]

As a result of the development of the water supply system (apart from the earlier, 14th-century sewerage) the equipment of a wealthy urban house in Kraków was such as the one presented in 1544 in one of the early records of municipal officials called *quartalienses*, at that time still placed in town councillors' books. In a list of pieces of equipment of a house on the corner of Mikołajska (St Nicolaus)

1506 ANK, CC 430, p. 409.

1507 Op. cit., p. 411.

1508 Information concerning the location of this house, in relation to the permission granted to Zeyfrid Betman to conduct a gutter from that place up to the canal which flowed to the Rudawa River near the Dominican graveyard – cf. KDMK II, 1882, p. 634.

1509 Ptaśnik 1905, p. 73, footnote 1, after: ANK, CC, 441 (1547–1549), p. 630.

1510 Goliński 2001a, p. 117 and quotation on p. 123.

Street (the house was divided between several families) the following common water and sewerage installations were noted: – – *Aque sunt Balneum* – – *Canalia, Imbrices* – – *Aqua etiam fontana et canalis. Cloaca* – –,[1511] and thus a house bath, sewage canals, roof gutters, water from a well and from the water supply system, and a cesspit.

Due to the fact that we know the localisation of many houses to which connections were laid, we can trace the course of the pipeline of the public water supply system until the end of the 1530s. (cf. the colour insert) Its starting point was the water-work (*Wasserkunst*) from where it was conducted along Sławkowska (Sławków) Street; when it reached the Świętojański (St John's) close, it branched and following the course of this close it entered St John's Street (the permission for Marcin Chmiel from 1441) and ran towards the Market Square. Its other part – starting from Sławkowska Street – branched again at the corner of the Market Square and Szczepańska (St Stephen's) Street. One of its branches entered this street and ran all the way to St Stephen's Church (the connection to a house on the corner belonging to a town councillor called Ederer, near the Church, dating from 1457). The other branch ran along the west side of the Market Square. From that stretch it was conducted along Szewska Street (the permission for Kuncza Lange, a town councillor, from 1458). In the Market Square it ran along all its sides (15th-century permissions for connections to houses in the Market Square; the purchase of pipes and connectors in 1487 to the house belonging to the Thurzo family in the south side of the Market Square). It is difficult to establish the exact time when the pipelines of the west and north sides of the Market Square were lengthened beyond this Square: the first line ran along Wiślna Street and later into the following streets: Żydowska, Przecznica and/or Garncarska/Gołębia; the second line ran along Mikołajska (St. Nicolas') Street and reached Świnia (Swine) Street. As was already stated, the oldest found mention of the existence of a water storage reservoir in the vicinity of Bursa Jerusalem, in Przecznica Street (later called Jagiellońska), was dated to the years 1527 and 1528, whereas the existence of such a reservoir in Żydowska Street was noted in 1530. The oldest found mention of a connection to a house in Świnia (Swine) Street dates to the year 1531 (for Jan Noskowski, a physician). The pipeline from the east side of the Market Square probably as early as the mid-15th-century turned into Szkolna (School)/ Sienna (Hay) Street and Stolarska Street to reach the Dominican monastery (thus from the same side as the "old water granted by Leszek" in the past[1512]), if the aim

1511 ANK, CC 439, p. 536.

1512 ADKr., Prothocollon, pp. 110v–111.

of conducting the water was to carry out the sentence of the Court of Arbitration of 1454 concerning the connection to the monastery, namely the "new water". It was from this line that in 1494 the connection to Morsztyn's house may have branched off. At that time water from this house was lent to a brewery situated on a plot from the side of Grodzka (*Castrensis*) Street, since water was conducted through the cellar of a neighbouring house "of the seven stalls", described in written sources as a house on the corner of Braci Kaznodziejów (Preaching Friars') (Stolarska – Carpenters') Street.

The exact chronology and the full extent of the water supply system in Grodzka Street remains to be established. What should be taken into consideration is the fact that the "rurne" (pipe tax) was collected from the whole Grodzki (*Castrensis*) quarter just like from all the other quarters as early as 1400 (however, this may have concerned only the water storage reservoirs placed in the Market Square for this quarter). The still great importance of deep dug wells situated in plots in Grodzka Street should not be forgotten: let us recall the role of the well that was referred to as "der Schacht" located on the boundary between plots on the corner of Grodzka and Szeroka Streets in the years 1450–1503 and later.

Undoubtedly the fact that the water supply system was conducted as a separate line to the Jewish bath (*balneum Judeorum*, "Judenbadstobe") deserves special attention. This piece of information was found in a record of 1436[1513] from which we can infer that the pipeline ran along the moat, hence on the outer side of the town walls. This solution was more convenient, as the bath was situated behind St Anne's Gate.[1514]

From the course of the Kraków town water supply system and its connections in the 15th century and in the first half of the 16th century we can infer the primary purpose of the establishment of this installation: it was to serve the needs of patrician houses situated in the best places of the town. Therefore, the situation was different than the one in Rouen, where water supply systems (including the oldest one, dating from the 13th century) conducted water chiefly to the most important market and production devices and to public buildings[1515] (not to mention the oldest network in Paris which supplied water to the main marketplace, Les Halles). In the case of Kraków the installation of water storage reservoirs open to the public along the course of the town water supply system made it possible for nearby devices connected with trade to use them. For example, in the 15th century

1513 ANK, CC 428, p. 357; print: CA I, 1917, no. 322, p. 97.
1514 Lachs 1919, p. 4. Ligęza 1971, p. 37.
1515 Sowina 2001, p. 29 et seq.

such devices located near the pipeline along the west side of the Market Square and (perhaps) in the first half of the 16th century devices in the Small Market used water storage reservoirs situated on the pipeline running into Mikołajska (St. Nicolas') Street and (which is less probable) reservoirs on the pipeline in Sienna (Hay) Street. These reservoirs may have been located near older dug wells like the one on the corner of the Small Market and Mikołajska Street as well as the one in front of the School of the Virgin Mary.

The profitability of the *braxatura*, the tax that rapidly became (between 1524 and 1530–1531) one of the highest town's revenues (which would testify to the establishment of a "new" water-work on the small Nieciecza River in the period in question), set the next development goal for this installation in Kraków, namely the increase in the number of connections to people having the right to brew beer for sale. However, it must be clearly underlined that the conditions on which they were allowed to conduct water were completely different from those on which the above-mentioned patricians obtained their permissions. The latter used the water not only in their breweries, but also in their houses and kitchens, whereas *braxatura* payers were only allowed to draw as much water as was required to brew beer. And thus in 1545 Paweł Sczirba, a belt maker, living in a house on the corner of Wiślna Street, near the Bursa Pauperum, which means that on the corner with Gołębia/Garncarska Street, solemnly promised (on behalf of himself and of all the future owners of the house) to observe the following rule: water from the pipe water supply, granted to this house to the well and to the maltings, must not flow uselessly or excessively in any way. It must be regulated with a copper plug (*adhibito œnio canali alias kureck*) so that only the amount needed for brewing beer would flow; later it should be turned off (plugged – *ducillabitur*) under the penalty of taking away both the water and the connection.[1516]

The Kraków water supply system together with its connections (although still not to every property) is well illustrated by a mention from the year 1597 about an inspection of a stretch of the town water supply system, done by several town councillors and a master fountain-builder. There were five connections in the inspected stretch that ran from the Market Square along Sienna (Hay) Street and later along Stolarska (Carpenters') Street: 1) to the brick dwelling house belonging to the Kraków voivode; 2) to the brick dwelling house owned by a Kraków patrician family called Gutteter; 3) to the Grey House; 4) to the Dominican Monastery, where the stretch in question ended. As regards the fifth connection, the town councillors permitted a certain Kraków burgher named Andrzej Fladrowicz to

1516 ANK, CC 440, p. 230.

draw it, but in such a way as not to cause any disturbances in the water supply of the above-mentioned: Kraków voivode and the Gutteter patrician family, as they were given priority in drawing water.[1517]

Apart from connections from the Market Square to patrician brick dwelling houses situated along Sienna (Hay) Street, the connection to the Dominican Monastery seems especially noteworthy. In spite of events and decisions of 1454 mentioned before,[1518] according to a record dating from 1611 in the 17th-century *Prothocollon*, in which important events for the Kraków Monastery were noted, it was only in 1578 that the town councillors permitted the Dominicans to use the town water supply system. Not only were the friars to store the water in a water reservoir connected to the water supply network, but they were also to use it sparingly. Yet, they did not take care of the water and stored it in a water pillar from which it easily overflowed. They also broke the devices. For that reason, when the town suffered from a great scarcity of water, in 1611 water was cut off from the Monastery and the pipes that ran in front of the Monastery along Stolarska Street were dug out from the ground.[1519] This had serious consequences for the monastery, which was described by commissioners appointed to arbitration in 1612. First of all, beer was in the middle of the process of being brewed; also malt from 12 measures of wheat required water; and so did 7 times threescore, i.e. 420 carps and other fish stored in barrels for the current needs of the friars.[1520] Perhaps it was due to these dramatic events of 1611 that in the 17th-century monastic records no mention was made of what was found in town accounts from the years 1518, 1523 and 1524, namely of the purchase of new pipes by the monastery. The later prove that there must have been a functioning connection to the monastery in these years, and what is more, it must have been functioning for some time, since the pipes required replacing with new ones.

As far as connections in other centres are concerned, according to preserved royal privileges to build town water supply systems, pipelines branching off from the main network to burghers' plots (mostly to their breweries) were to form an integral part of the installation. The fact whether this plan (such permits were often

1517 ANK, CC 454, pp. 648–649. The author of the present work would like to thank Professor Zdzisław Noga, PhD for this mention which he found and gave to her, especially so, as the archival research conducted by her did not encompass town councillor's books from the second half of the 16th century.

1518 Cf. part II of the present work. KDMK I, no. 157, pp. 222–223; and ADKr., Prothocollon, p. 5.

1519 ANK, Prothocollon, p. 111.

1520 ADKr., Prothocollon, pp. 106 v. and 107 v.

treated as a plan) was carried out and to what extent is a completely different issue. This can be verified only when one comes across written or archaeological pieces of evidence that testify to the functioning of connections in the centres in question. In towns where water supply systems existed, conducting connections was still undoubtedly a privilege as late as in the first half of the 16th century. A similar situation to the one described above for Kraków in the second half of the 15th century took place in 1527 in Kazimierz near Kraków. In that year the burgomaster and the town councillors – both incumbent and former (*consules residentes et antiqui*) – issued a regulation in which they granted themselves and everybody who fulfilled this function or who would fulfil it in future a perpetual right to use the town water supply system without a charge. The only payment they were obliged to make was for conducting private connections to their houses, even without the single charge for the right to do this (as opposed to Kraków patricians). However, in the event that their houses were transferred to people who did not perform the role of town councillors but who wished to use the existing connections, these people should pay 4 groschen yearly to the town coffers. This payment should be used for the town's expenses.[1521] Such an obvious discrimination in favour of town councillors was one of the so-called "fruits of the office". In studies concerning the stratification of urban society this can be treated as one of the small, yet important elements of this division. However, when one compares the step taken by the town councillors of Kazimierz with a strict self-discipline in this respect of the authorities of Rouen, an economically powerful centre, one cannot avoid the impression that the decision taken by the councillors in Kazimierz was a result of their selfish neglect of the town revenues, and consequently of the economy of the centre, which was never one of the strongest (it might have been the poor possibilities of getting rich in such centres that made people eagerly seize every opportunity). Testifying to the lack of care for the public (local) interest, such and similar financial decisions – if made not in one, but in many centres – in the long run led to the weakening of towns.

Besides connections to private plots that were either actually built or only planned but never realised, in written sources we can also find another form of granting water which could be called intermediate: between the possibility of using water from a connection from the town water supply system on one's own plot and (only) the access to a public water storage reservoir connected to the town water supply system. Such a situation occurred in Kalisz in 1540, when the local town council at the request of a burgher, Małgorzata Iglarka (Igielniczka),

1521 PrawaPrzywilejeKraków 1885, no. 32, p. 43; Giedroyć 1907, pp. 94–95.

conducted a water supply system along Świńska Street (*in platea pecorum*) at the town council's expense, in front of Małgorzata's house and for her needs. In return Igielniczka and her heirs would pay the town 30 groschen yearly due on St Bartholomew's Day until they used this stretch of the water network. The cost of its repairs and conservation was to be borne by the Kalisz town council.[1522] Three years later other owners of houses situated in the same street declared their will to use the pipeline built for the needs of Małgorzata and her family. Before the same town council appeared four notable Kalisz burghers[1523] and on behalf of themselves and their neighbours undertook to pay one groschen quarterly.[1524] One of these burghers was to collect the money and hand it to the officials in charge of the town money. One week earlier two Jews, Daniel and Jakub from Sieradz, inhabitants of Kalisz, perhaps the elders of the Jewish Community, in the same way as the above-mentioned burghers, i.e. on behalf of themselves and of their neighbours-Jews, undertook to make a common payment for water in the amount of 4 florins yearly (1 florin quarterly). In return the town councillors were to let them conduct water from a public water storage cistern standing in the Market Square to Żydowska (Jewish) Street,[1525] perhaps to a water storage reservoir placed there, like in Poznań, but it is not impossible that for the needs of a mikveh (or mikvehs in private houses).

III.3.5 Builders of water supply systems

It can be considered that the oldest known mention of a master fountain-builder, hence undoubtedly of a builder of water supply systems in the Polish lands, was the mention from Kraków dating from 1385 of the banishment of Piotr Swalme, referred to as "rorenmeister".[1526] For the sake of comparison, in Wrocław a master fountain-builder was mentioned in 1386.[1527]

As was mentioned before, Swalme returned to Kraków around 1391, protected by the royal *litera securitatis*. In the following years, however, no mention was made of him, even when in 1399 accounts from the construction of the Kraków

1522 APP, Kalisz, I/6, p. 91.

1523 An archival research in Kalisz town books revealed their high economic activity (real estate transactions, financial operations etc.).

1524 APP, Kalisz I/6, p. 177.

1525 APP, Kalisz I/6, p. 173.

1526 KsRachKraków, 1878, p. 65; and KsProscrKraków 2001, no. 741, p. 79.

1527 CDS, Bd. 3, 1860, p. 147. The earliest preserved contract with a builder of the Paris water supply system, from the Belleville intake, was drawn up in 1393 – Lafay 1991, p. 123.

water supply system began to be recorded. The first one to appear as the manager of the construction process was *Martinus magister cannarum*, working on conducting water to the town (*super aqua ducenda ad Civitatem*).[1528] On 10 occasions various sums were paid to him, and only once there was a note that he received 1 ferto *super precio suo*. None of these sums was repeated regularly enough to establish whether he obtained regular remuneration at that time. In the same manner money was paid to Mikołaj the rope-maker who accompanied Martinus and who was referred to as the one who *parat modo cannas*.[1529] This could mean that he prepared pipes, as Elżbieta Ligęza translated it many years ago.[1530] However, in the opinion of the present author it cannot be excluded that he only "dressed" the pipes, using ropes to seal the places of their connection. E. Ligęza identified him with Mikołaj, who in 1401 for his work at conducting water through pipes to the town (*aqueductura per cannas ad Civitatem*) was paid (only as remuneration; the money for unspecified works and materials was recorded next to the instalments of his remuneration, on the same page) 9 times 18 groschen and 38 times 9 scots, i.e. also 18 groschen.[1531] If we assume that it was a weekly wage, this amounts to 47 weeks of his work at building the Kraków water supply system (5 weeks can be subtracted e.g. owing to unfavourable weather conditions, including a severe winter and frozen ground[1532]). However, such sums had been recorded many times one year earlier under the same accounting entry;[1533] the person who received the money was not always mentioned; however, if he was, it was just a laconic note: *magister*, and later only *Nicolaus*. At the beginning of this register the *magister* twice received 1 fert o, i.e. 12 groschen, which indicates that the remuneration of a master fountain-builder (as the mention most probably concerned him) increased by 6 groschen a week. There is no certainty as to whether Mikołaj the rope-maker from 1399 and Mikołaj the manager of the construction process of the water supply system in 1400 and in 1401 was the same person, especially that in the above-mentioned register another record appeared in 1400 concerning 6 groschen paid to (an undefined) rope-maker. In the subsequent years Mikołaj

1528 ANK, rkps/MS 1589, p. 305.
1529 Op. cit., p. 309.
1530 Ligęza 1971, p. 55.
1531 ANK, rkps/MS 1591, p. 60.
1532 Or perhaps this was the number of working weeks, which would testify to the fact that the building works at the earliest network with the water-work (*Wasserkunst*) were less intensive than those at its 16th-century enlargement.
1533 ANK, rkps/MS 1590, p. 46.

the works manager was paid also 9 scots: in 1402 and in 1403 in 49 instalments,[1534] in 1404 in 34 instalments[1535] (which means that that year he was 18 weeks out of work), in 1405 in 46 instalments.[1536] No data exists for the years 1406 and 1407. In 1408, in the new accounting system introduced in Kraków consisting in recording weekly both the income and the expenditure, the remuneration of the builder of the water supply system, called *magister aqueductor* or *aqueductor* in the accounts, most probably amounted to 0.5 mark, i.e. 24 groschen, because this is the sum most frequently repeated. It was recorded as being received twice by Piotr;[1537] however, most of the payments were made to an unnamed *aqueductor* working at the water supply system. In the same year Mikołaj appeared once on the "payroll": as *Nicolaus condam aqueductor*, i.e. as a person who used to be a master fountain-builder (the former master fountain-builder), and was given 2 marks by the town councillors in return for fish he had caught and that had been sent by the councillors to the royal table *ad honores*. On the same occasion he also received his outstanding wages, 9 marks in total. In the following year (1409) Mikołaj Rörenmeister was paid 2 marks for carting a stone,[1538] whereas in 1410 the person most frequently recorded as being paid (weekly) wages in the amount of 0.5 mark was again *Nicolaus aqueductor*, working at the water supply system. In the latter year only once was another *aqueductor* mentioned by name: Albert (in Polish: Wojciech), who was paid 1 mark for unspecified works.[1539] In accounts from the year 1414 appeared Mikołaj Rormeister who received payment for timber twice.[1540] In the same year a separate entry was introduced: *aqueductor* (similar to the one that had existed in the years 1402–1405). In 1414 the town council paid him his wages in 47 instalments: he was paid 9 scots (i.e. 18 groschen) on 42 occasions, on 3 occasions he received 0.5 mark (3×24 groschen =4×18 groschen), once he was paid 3 fertones (36 groschen =2×18 groschen), and finally at one occasion he received his 3-week payment. He was thus paid for 51 weeks of work. In 1424, as was mentioned before,[1541] Mikołaj, and "old" master fountain-builder (*antiquus aqueductor, d'alde rormeister*), entered (before the town council) into the following agreement with Stanisław Czanstoff, a royal fisherman. On the strength of the

1534 ANK, rkps/MS 1591, p. 158 and rkps/MS 1592, p. 66.
1535 ANK, rkps/MS 1592, p. 156.
1536 ANK, rkps/MS 1593, p. 68.
1537 ANK, rkps/MS 1594, pp. 23 and 24.
1538 Op. cit., p. 137.
1539 Op. cit., p. 168.
1540 ANK, rkps/MS 1595, p. 9.
1541 Cf. part II of the present work.

entry in the town books and having paid a deposit of 2 marks, Mikołaj committed himself to paying 1 mark for fishing in the royal waters (*in aquis domini nostri Regis*); Stanisław, the royal fisherman, was to pay the same amount of money to the town councillors if he fished in the town waters.[1542] Thus, the occupation that Mikołaj, the old master fountain-builder, still followed (as in 1408) was fishing. He owned a garden with utility buildings in the suburb near the Brama Szewska (Shoemakers' Gate), not far from the royal fish stores.[1543] Nevertheless, it is difficult to establish (mainly because of the lack of town accounts from the years 1415–1430) whether in 1424 and later he still worked at the water supply system. This possibility cannot be excluded, considering the fact that in 1408 he was referred to as the "former" master fountain-builder, whereas in the two subsequent years he was recorded in town accounts again as a master fountain-builder. In accounts from the year 1431 a mention of a "new" (again unnamed) master fountain-builder was discovered,[1544] and two entries[1545] in which the wages of a master fountain-builder (*aqueductor*) and an "old" master fountain-builder (*antiquus aqueductor*) were recorded. The weekly wage of the former was the same as in the years 1408–1410 and it amounted to 0.5 mark;[1546] in 1431 he received the total sum of 26 marks paid in 50 instalments (48 instalments 0.5 mark each and 2 1-mark instalments, which means that he received payment for the whole year). The "old" master fountain-builder was paid 23 times 6 groschen,[1547] which amounted to 2 marks and 32 groschen. This interesting phenomenon (traceable in Kraków sources up to the year 1431, namely in the first period of the functioning of the town water supply system) consisting in the co-occurrence of the "old" and the "new" master fountain-builders, paid separately in 1431, indicates that the old master fountain-builder did only ancillary works, worse-paid than the tasks performed by the new, main master fountain-builder (the old one was paid the same amount of money as journeymen, namely 6 groschen daily). However, in case of the lack or absence of the main master fountain-builder, the old one could take his place. It remains unknown what exactly decided that one became the "old" master fountain-builder: whether it was the age, or the length of the contract, or the scope of the works, or the "specialisation" concerning the works at the water supply system.

1542 ANK, CC 428, p. 211.
1543 Op. cit., p. 278 (year 1430).
1544 ANK, rkps/MS 1596, p. 95.
1545 Op. cit., pp. 89 and 92.
1546 Op. cit., p. 92.
1547 ANK, rkps/MS 1596, p. 89.

The town council hired a new master fountain-builder named Matis on Ash Wednesday, 21 February 1436, at the latest, because on that day the council specified his duties,[1548] presented in detail by E. Ligęza.[1549] His duties included taking care of the whole installation, starting from the intake, i.e. from the Rudawa-moat near the water-work built in front of the Sławkowska Gate. This means that Matis was obliged to take care of the stretch of the moat from the water-work up to the Brama Szewska (Shoemakers' Gate) and to perform all other necessary duties at the "Rorhaus" and at the network, including drilling pipes at his own expense, making new water chests and repairing old ones. In case of work overload, the town council was to assign one or two municipal servants to help him. In the contract there was no mention of the master fountain-builder's wages; it was only said that he could perpetually draw benefits, allowed by the council, from the above-mentioned stretch of the moat, but in such a way as to not cause harm to the near-by walls, grinding workshop or pipes laid all the way to the Jewish bath ("Judenbadstube") outside St Anne's wicket. Most probably this fragment referred to fishing in the moat. Consequently, once more it seems to have been the second important occupation of Kraków town master fountain-builders. On this occasion we can note that the stretch of the moat that was stocked with fish was the same stretch from which water was drawn to the town water supply network, which fact testifies to the purity of the water (as well as the fact that from that very stretch the town councillor named Piotr, the former dressmaker to the Queen, could lay conduits to his brewery by the council's consent granted him in 1441, which situation was described earlier in the present work). For reasons enumerated before, putting fish into the moat was to contribute to the purity of the water.

As far as the wages of a master fountain-builder are concerned, they were found only in accounts from the year 1487 (in the next preserved accounts after 1431). It follows from the entry entitled *aqueductor* that in that year he earned 31 marks and 12 groschen paid in 50 instalments of 0.5 kopa of groschen (i.e. 30 groschen) each.[1550] Before 1500,[1551] the weekly wages of a master fountain-builder were increased to 36 groschen. In the entry entitled *Roermeister per se* from the year 1517 this sum was recorded, but paid in as much as 63 instalments:[1552] probably 11 instalments were outstanding from the previous year 1516. If this was the case, then

1548 ANK, CC 428, p. 357, print: CA I, 1917, no. 322, p. 97.

1549 Ligęza 1971, p. 56.

1550 ANK, rkps/MS 1597, p. 23.

1551 Heydeke 2009 (an income list of 1500), p. 43,: "Rormeistir hat alle wochen XXXVI groschen, seyn lon ist. Das her erbeitir hat, den mus man sunderlich lonen."

1552 ANK, rkps/MS 1598, p. 127.

it was recorded that the 35th instalment (the 24th for the year 1517) was the first one paid to a new master fountain-builder. Bearing in mind that the financial year in Kraków began on 2 January,[1553] and if we accept the above assumptions, we can infer that the new master fountain-builder was hired in the middle of June 1517. An earlier, neighbouring entry entitled *Ad Curiam Rörmagistri Empta* includes the record of 36 groschen being paid three times to a certain Szostek, who was twice referred to as "the new master fountain-builder".[1554] Since these sums formed part of expenses made towards the "Rorhaus", irrespective of the number of instalments recorded in the entry concerning expenses made towards the master fountain-builder, we can assume (considering the highly reliable way in which the town accounts were recorded) that Szostek was paid three instalments more, which meant that he had been hired three weeks earlier, namely at the end of May 1517, at the time when the previous master fountain-builder had still been active (hence, for three weeks both of them received equal wages). The entry in the town expenditures entitled *Ad Curiam Rörmagistri Empta* shows that in the same year a certain Marcinek was paid for work at the "Rorhaus" three times 24 groschen, including once for work at a wheel (*circa rota*), once 12 groschen, and once 18 groschen. At one occasion he also received 2 marks and 14 groschen for his trip to Olkusz. Under the same entry also the following record was found: *Nuncio misso ad Ilkusz in causa rormagistri – mr. 0, gr. 4*. If the latter mention concerned Marcinek, it may have been him who had been the master fountain-builder before Szostek, paid 36 groschen weekly until ca the mid-1517.

After 1517 the 36-groschen weekly wages of a master fountain-builder remained the same in all Kraków preserved town accounts (the entry entitled *Rormagister per se*) until 1533 inclusive. In 1518[1555] he was paid 36 marks in total in 48 instalments; in 1523[1556] – 39 marks in 52 instalments; in 1524[1557] and in 1530[1558] – 39 marks and 36 groschen in 53 instalments in both of the years; in

1553 This can be proved by the chronology of the weekly records in Kraków town accounts from the years 1407–1410 – ANK, rkps/MS 1594, passim, and later e.g. by a record from the accounts dating from the year 1524: *Braxature ceruisiarum Rorgelt a die 2 Januarii* (ANK, rkps/MS 1600, p. 11).

1554 ANK, rkps/MS 1598, p. 126: *Szostkoui laboranti in Rörhaws mr. 0, gr. 36; – – Szostkoui nouo Rormagistro mr. 0, gr. 36; – – Szostkoui nouo Rormagistro laboranti …mr. 0, gr. 36.*

1555 ANK, rkps/MS 1598, p. 265.

1556 ANK, rkps/MS 1599, p. 123.

1557 ANK, rkps/MS 1600, p. 135.

1558 ANK, rkps/MS 1601, p. 75 (expensa p. 113).

1531[1559] and in 1533[1560] – again 39 marks yearly paid in 52 weekly instalments. An archival research into the preserved town accounts, conducted by the present author and reaching the year 1538 inclusive, shows that in the years 1535 and 1537 a weekly wage of a master fountain-builder amounted to 30 groschen: in both of these years he was paid 32 marks and 24 groschen in 52 instalments.[1561] In the same years a master fountain-builder was included in the town *familiae*, whose members received 6 ells of London cloth and 10 ells of Wrocław cloth once a year, on Michaelmas (28 September).[1562] In 1538 a Kraków town master fountain-builder was paid during 27 weeks (namely in the first half of the year) 30 groschen weekly, and throughout the next 25 weeks – only 15 groschen weekly.[1563] His wages being thus once more drastically decreased, his remuneration in kind remained the same as in the years 1535 and 1537.[1564]

Having gathered all the information about the remuneration of Kraków master fountain-builders between 1399 and 1538 and having collated it with data collected by Julian Pelc,[1565] we obtain the following compilation:

1399 – 12 groschen (Pelc: no data)
1400 – 12 groschen, increased to 18 groschen (Pelc: no data)
1401 – 1405 – 18 groschen (Pelc: 1402–1405 – 18 groschen)
1408 – 1410 – 24 groschen (Pelc: no data)
1414 – 18 groschen (Pelc: 18 groschen)
1431 – 24 groschen and 6 groschen – "old" master fountain-builder (Pelc: master fountain-builder – 24 groschen)
1487 – 30 groschen (Pelc: no data)
1500 – 36 groschen (Pelc: no data)
1517 – 36 groschen (Pelc: 36 groschen)
1518 – 36 groschen (Pelc: no data)
1523 – 36 groschen (Pelc: 36 groschen)
1524 – 36 groschen (Pelc: no data)
1530 – 36 groschen (Pelc: 36 groschen)
1531 and 1533 – 36 groschen (Pelc: no data)

1559 ANK, rkps/MS 1602, p. 74 (exp. p. 151).
1560 ANK, rkps/MS 1603, p. 175.
1561 ANK, rkps/MS 1604, p. 163 (exp.) and MS 1605, p. 163 (exp.).
1562 ANK, rkps/MS 1604, p. 91 (year 1535) and MS 1605, p. 100 (year 1537).
1563 ANK, rkps/MS 1606, p. 169 (exp.).
1564 Op. cit., p. 105 (exp.).
1565 Pelc 1935, p. 168.

1535 and 1537 – 30 groschen + cloth (Pelc: no data)
1538 – 30 groschen, later decreased to 15 groschen + cloth (Pelc: no data[1566]).

The present author is inclined to link the decrease in the earnings of the town master fountain-builder in Kraków in the second half of the 1530s mainly with a reduced scope of works at the Kraków water supply system, judging from lower expenses connected with devices for the water-work (*Wasserkunst*) in comparison with the ones from the 1520s and the beginning of the 1530s, and from the fact that the revival of activity at the water supply system, which began in 1541, was accompanied by a rise in the earnings of the town master fountain-builder to 30 groschen a week in the same year.

Szostek worked at the town pipe water supply in the years 1517–1523, i.e. also at the time when following the royal decision of 1521 the construction of a new water-work began. The town accounts reveal that the greatest intensification of works fell on the year 1523,[1567] but it was precisely then that Szostek was taken ill and died. The costs of his treatment and later funeral (together with Gregorian Masses) were covered by the town. The former were recorded in the Town Hall expenditures (*ad pretoria necessaria exposita*): *dati medico qui curabat Rormagistri marc.0, gr.45*.,[1568] the latter – in expenditures on alms and pious deeds (*Elemosina et pia opera*): *pro sepultura Rormagistri Szostek et tricesimas marc.4, gr.12*.[1569] It cannot be excluded that it was Szostek's death that contributed to suspending (or at least limiting) the works at the new water-work in the following year.[1570] His great importance for the town is evidenced by the fact that money for his treatment and later funeral was taken from the town coffers.

After Szostek died, it was probably *Gregor de Lewczonia* (i.e. from Levoča in the Spiš region) *rormagister* who became the town master fountain-builder. We can base our supposition on the fact that already in 1524 the town council paid him 1 mark and 12 groschen as well as 1 mark and 42 groschen and recorded these sums under the entry *Edificia Communia Civitatis*.[1571] This was an unspecified additional payment that he received apart from the above-mentioned fixed weekly wages registered under the entry *Rormagister per se*.

1566 Cf. also op. cit., with data from later years: 1541–36; 1551–30–36; 1560–45; 1570, 1580, 1590 and 1599–53.
1567 ANK, rkps/MS 1598, pp. 101, 122, 129 and 130.
1568 ANK, rkps/MS1599, p. 85.
1569 ANK, rkps/MS 1599, p. 75.
1570 According to E. Ligęza (1971, p. 32) the situation did not involve "a planned completion of the construction, but its being interrupted for unknown reasons".
1571 ANK, rkps/MS 1600, p. 107.

In 1532 a master fountain-builder was recorded as the executor of the last will of a blacksmith and weapon producer (who also made connectors for pipes used in the water supply system) named Mateusz, who was also referred to in source mentions as *Mathusz faber Boemus*, i.e. Bohemian. This master fountain-builder was called Mikołaj Luscheck *magister canalium civitatis*.[1572] His personal data and his profession allow of identifying him with Mikołaj Łuszczek from Bochnia (most probably a close relative, perhaps son, of Stanisław Łuszczek, a *viceadvocatus*, and later court *advocatus* in Bochnia from the turn of the 15th and 16th centuries[1573]), who two years later entered into a contract with the town council of Płock to build a water supply system with a water-work (*Wasserkunst*) there (this construction was described earlier in the present work).

One more town master fountain-builder known by name was found in Kraków accounts: Jakub *rormagister*, who in 1538 paid to the town coffers 3 marks and 20 groschen for selling pipes he had produced.[1574]

In 1533 in town councillors' books from Kraków court books an unnamed master fountain-builder (*magister cannalium*) was recorded when he took a silver belt worth 50 florins as a security against a loan of 30 florins he gave to Bernard the saddler.[1575] However, it is unknown whether the credit was given by the town master fountain-builder or by the castle master fountain-builder, since at that time both of them were in town. The results of prosopographic research point to the latter possibility. The castle master fountain-builder was Jan *rurmagister castri Cracoviensis de Dobruska* (a town near Hradec Králové), who in 1526 was admitted to citizenship of Kraków.[1576] This was the same master who in the early 16th century built a water-work under the castle and "raised" the water, leading it up to the Wawel Hill. His remuneration was as follows. On 9 March 1502[1577] King Alexander granted Jan (*magister canalium alias rurmistrz de Dobruska*) 20 florins (12.5 marks) of a yearly *census* for his services (*pro meritis*), and especially for conducting water from the River Rudawka *ad castrum Crac. canalibus et aliis instrumentis*. Additionally, once

1572 ANK, LT 772, p. 257 and CA II/3, 1948, no. 1335, p. 536.

1573 ASB, 10, p. 309 and 416. In 1530 Mikołaj Łuszczek owned a butcher's stall in Bochnia – cf. Kiryk 1980, p. 113.

1574 ANK, rkps/MS 1606, p. 28.

1575 ANK, CC 435, p. 93 (year 1533).

1576 CA II/3, 1948, no. 1287, p. 514 and KsPrzyjKr., 1993, no. 1064, p. 58: *Johannes rurmagister castri Cracoviensis de Dobruska ius habet et pro littera dominus Sczensni fid., ded. gr. 48.*

1577 MPRS III, 1908, no. 304, p. 20 (regestrum); AGAD, MK 17, p. 320 (text); printed text: CA II/1 1936, no. 26, p. 10.

a year he was to receive 6 ells of Mechelen cloth (from Mechelen in the Duchy of Brabant),[1578] whereas every three years he was to get a fur coat made of fox backs or its equivalent in money, i.e. 5 florins. Two years later the King increased Jan's remuneration by an ell of the Mechelen cloth a year, by a sum equal to the daily cost of the diet of the Kraków general procurator by 5 quarters of beer, 6 loaves of bread supplied daily from the Burgh (Wawel Castle), 10 candles yearly from Michaelmas to Mid-Lent Sunday and timber for domestic use (firewood?) supplied every week as long as Jan performed this function.[1579] According to a royal document of 1507, Jan's remuneration was to amount to 5 marks quarterly, i.e. 20 marks a year, 10 loaves of bread from Burgh (Wawel Castle), 6 quarters of beer a day and 10 tallow candles from Michaelmas to Sunday *Letare singulis annis et diebus*. What is more, Jan received a house at the foot of the Wawel Hill on the banks of the River Rudawka, in the place from where water was drawn and flowed through pipes. He also got wood and timber (*ligna et robora*) for domestic needs and for necessary repairs of the water supply system.[1580] In 1518 the King granted Jan *iure hereditario* a royal meadow called Krzyżowska near the village Płaszów, next to another royal meadow and to the moat,[1581] *quae protenditur a dicta villa Plaschow versus villam Byezanow*.[1582] Jan obtained from the King yet another meadow which in 1545 was bought back by the royal treasury from Jan's son for 20 marks.[1583] Having acquired the citizenship of Kraków in 1526, Jan documented his activity in the town at least three times: in 1531, 1535 and 1545. In 1531 he was recorded in town accounts together with his wife Katarzyna when they leased for life a "salt stall" from a salt merchant (*sallicida*) called Mikołaj Jandraka, situated at the back of the bread benches (stalls), between Eliasz and Andrzej Lanÿ, for a customary rent.[1584] Mikołaj and Jan established a business relationship mainly because they supported each other as fellow countrymen: one year before Jan vouched for Mikołaj when

1578 The usual cost of Melechen cloth, namely Brabant cloth, which came from Malines (Mechelen), in the 1470s amounted to 15 groschen for an ell. The royal court used a lot of this cloth, inter alia, as presents for officials and foreign deputies – cf. Wyrozumski 1972, p. 135.

1579 MRPS, III, 1908, no. 1125 (regestrum); AGAD, MK, 19, p. 122 (text); printed text: CA II/1, 1936, no. 63, p. 23.

1580 CA II/1, 1936, no. 128, pp. 50–51.

1581 It might have been either a ditch (with water), an embankment or a baulk – cf. SłŁacŚr., IV, 1975–1977, column 345.

1582 MRPS, IV/2, 1912, no. 11932, p. 193 (regestrum); AGAD, MK 33, p. 97 (text).

1583 RachBoner, 1955, p. 29.

1584 ANK, rkps/MS 1602, p. 54.

the latter was being admitted to citizenship of Kraków.[1585] On Friday 9 July 1535 *famatus Joannes Cannalium Regiorum Magister* bought for 1400 florins (i.e. for 875 marks, counting 30 groschen for a florin) a house with a malthouse and a brewery from Zofia Monczarka, represented by her husband and tutor, Paweł Monczarz. This house stood in Szewska Street, between houses belonging to two other burghers: a certain Zimnowoda and Andrzej Biały. Jan the master fountain-builder instantly leased this house for ten years to the above-mentioned Paweł and Zofia Moncarz for a yearly *census* of 17 marks.[1586]

Therefore, Jan decided not to live in the expensive house in the street running into the Market Square. The house he had received from the King many years before served rather as a workshop; it is unknown whether he lived there with his first wife and later with his second and third wives.[1587] We can learn about his family relations, profession and possessions amassed during his lifetime from his last will. The degree of detail presented in this document makes it one of the most valuable among 632 oldest preserved testaments of Kraków burghers that the present author analysed. The measure of its worth for the present studies lies in the fact that it shows the life of a builder of water supply systems in the first half of the 16th century.

The last will of Jan, the Kraków royal master fountain-builder, was registered in 1545 in *Liber Testamentorum*[1588] about 3 days after the testator's death, when the document was unsealed and read, i.e. on Friday preceding the feast of St Lawrence, in the middle of summer (7 August) and also in the middle of possible works at the water supply system. The last will had been drawn up not much earlier, on Wednesday in the octave of Corpus Christi, namely on 10 June, in Polish; during the registration in the *Liber Testamentorum* it was translated into Latin (*Illud ipsum testamentum hodie est apertum perlectum atque actis nostris inscriptum quod ex polonico idiomate translatum sonat de verbo ad verbum ut sequitur*). In Kraków town councillors' documents the following record was preserved: on 13 June 1545 *providus Joannes Aquilex siue Rormagister Regius Castri Cracoviensis*" entrusted his testament to the Town Council, and the council confirmed his last will.[1589] Not

1585 KsPrzyjKr., 1993, no. 1382, p. 72 [without the exact date]: *Nicolaus Jandricka de Szączna sallicida ius habet, pro littera fideiussit Jan rormagister regius, dedit marcam 1, gr. 0.*

1586 ANK, CC 435, p. 603 (Friday, 9 July).

1587 It is known from a record from a Kraków town councillors' book that in 1551 in the house of the late Jan, in Szewska Street, some of his heirs lived (his third wife with minor sons) – ANK, CC 442, p. 593.

1588 ANK, LT 772, pp. 385–391.

1589 ANK, CC 440, p. 75.

willing to die without a testament (i.e. in sin) and in order to prevent conflicts between his wife Anna and his children from his previous marriages, having carefully considered the matter, he decided the following:

Firstly (*In primis*), as a Roman Catholic, he commended his soul to God Almighty and the Virgin Mary and his body to the soil, wishing for a modest (and not a grand) funeral at the Benedictines. He assigned 15 florins to such a funeral. To his beloved wife, Anna Hanuszwayszowna (Hanusz/Jan Waysz's daughter), he left a dower of 200 florins (and nothing more: *et non amplius*). To his heirs, namely to his first-born son Wawrzyniec/Lawrence (the son from his first wife, Katarzyna from Kleparz, i.e. the one with whom in 1531 he had leased the "salt stall") and to Benedykt, Jan and Sebastian (his sons from his second wife, Jadwiga), he left 200 florins each. Then – as he phrased it – he drew up a detailed inventory of the things that he possessed "in gold, silver, in jewels, clothes and equipment as well as in paraphernalia (*Item confecit rerum suarum sufficiens Inventarium quas habet in auro, argento in clenodiis vestibus et in suppellectili geradaque*). Mostly divided into groups, these items were as follows:

- jewels: gold rings with various precious stones (*clenodia, annuli aurei cum variis gemmas siue preciosis lapillis*) – 10 pieces in total;
- silver objects: spoons, goblets, belts, rosaries; pearls in broken and burnt silver (*in argento cochlearibus cyphis, cingulis, legibulis, in fracto et cremato argento sunt margarethi*) – 42 pieces in total;
- a rosary made of aloe vera root with an apple, i.e. a silver lump and five silver balls (*legibulum de aloe cum pomo siue nodo argenteo et quinque globulis itidem argenteis*);
- a pearl collar (*colnerium de margaritis*);
- a small pearl headband (*praetextula alias bramka de margaritis*);
- 12 spoons made of figured wood, with a silver decoration and silver along the edges which contain 1 mark in silver (*Cochlearia de fladro argento ornata et redimita 12 in quibus est marc. argenti 1*).

Tin and copper objects (*Stannum et Cuprum*):

- 39 tin shallow bowls (*Stanneae patine siue scutelle*);
- 17 tin jugs (*Canthari stannei*);
- a tin aspergillum (*aspergilli receptaculum parion stanneum*);
- 33 tin plates (*Talaria siue orbes stannei*);
- 7 tin bottles (*Lagenes stanneae*);
- 3 cauldrons (*Caldearia*);
- 6 pans (*Sartagines*);

– 2 copper cauldrons (*Ahena siue olle aeneae*);
– 2 small cauldrons (*Caldeariola*);
– 2 copper colanders (*Crebra aenea*);
– a mortar (*mortarium*) and a pestle (*pistillum*);
– 3 deep vessels/ bowls (*pelves*);
– 3 copper candelabra (*Candelabra de aurichalco*);
– a copper plate for the bath (*lamina eanea ad balneum*).

Clothes (*Vestes*):

– a fur-lined camlet overcoat with fox's occiputs (*subducta de czambilotho cum vulpinis occipicÿs*);
– a light-blue fur-lined overcoat made of purpurian cloth with fox bellies (*subducta de panno purpuriano clari caelestini coloris cum vulpinis ventriculis*);
– a lion-coloured (fawn) fur-lined overcoat made of purpurian cloth with dormouse bellies (*subducta de panno purpuriano leonati coloris cum ventriculis scismarum*);
– a tunic made of lion-coloured purpurian cloth (*Tunica de panno purpuriano leonati coloris*);
– a sheep-wool *diplois* with 12 silver buttons (*Diplois de veluto cum argenteis nodulis 12*);
– 2 Wallachian collars with gold buttons (*colneria Walachica cum aureis nodulis*);
– an Italian biretta trimmed with marten fur (*byretum Italicum cum marduribus*);
– a marten-fur hat (*pileus de marduribus*);
– a dormouse-fur hat (*pileus de scismis*);
– a mink-skin hat (*Pileus de pellibus norcinis alias Norkowa*);
– 3 bed or wall quilts or new carpets (*Tapetia Noua*);
– 2 bed or wall quilts or old carpets (*Tapetia antiqua*);

Linen and bedding (*Alba linea vestimenta et lectisternia*):

– 6 pillows (*cervicalia*) 1161;[1590]
– 10 feather duvets (*plumaticae*);
– 2 bedheads/bolsters (*pulvinaria*);
– 5 leather bedheads (*pulvinaria coriacea*);

1590 Considering the fact that the word *pulvinaria*, meaning bedheads or bolsters, occurred in the same text, it was decided to translate the word *cervicalia* as pillows, which decision was based on Kraków source materials – cf. *cervicalia alias poduszki* [poduszki is a Polish word for pillows] in a bricklayer's posthumous inventory from the year 1521 – ANK, AC 114 (*Hospitalis*), pp. 284–85 and print: CA II/1, 1936, p. 173.

– 30 pieces: duvet covers/pillowcases, linen tablecloths, towels (*superinductoria, linteamina mensalia, manutergia*), not counting the old ones;
– 100 ells (ca 58 meters) of fine linen (*Telae lineae tenuis vlnae 100*);
– 3 leather stationary beds (*Lecti stationales coriacei*);
– a table chest (*scrinia mensae*).

Weapons (*Armatura*):

– 3 swords (*Enses*);
– 2 Scythian swords (*scythici gladÿ*);
– 2 choppers (*Gladÿ bohemici alias thessaki*);
– 2 spears (*Cuspides*);[1591]
– 3 guns (*Pixides*);
– a spear or its head (*Lancea alias Glawia*);
– an arquebus (*Archabusüm*);
– 3 small axes (*secures parvae*).

Work tools (*Instrumenta*):[1592]

– 5 augers for drilling pipes (*terebra canalium*);
– 2 round augers resembling a spoon, but ending with teeth, commonly called thinner leaf augers (*Terebra rotunda instar cochlearis sed in fine dentata que vulgo Swydry lysczasti kensze vocant*);

1591 SłŁacŚr., t. II, 1959–1967, szp. 1542: *cuspis = lancea*.

1592 For the sake of comparison: Klose 1847, p. 279 stated that among tools, entrusted to the new master fountain-builder in Wrocław in 1483, were chains ("Ketten"), iron beaters ("Schlegern"), axes ("Aexten"), iron wedges ("eisernen Keilen"), shovels ("Schauffeln"), spades ("Grabschweiten"), hoes (mattocks, pickaxes – "Hauen") and one copper fire squirt ("eine Kopperen sprötze"). Cf. also the text of a contract from 1516, according to which a man called Smola was to repair a waterwheel, the towers and all pipes in the Prague New Town, and a miller gave him chains, shovels, mattocks (pickaxes), clamps, wheelbarrows and yokes – Winter 1906, p. 494, footnote 1. Also: a posthumous inventory from the year 1610 of Zuzanna, the widow of a Poznań master fountain-builder (InwPozn., 1961, pp. 354–355), which included things belonging to her late husband, namely his tools, inter alia: "a small copper cauldron containing tar and an iron spoon […], 1 auger belonging to the late husband, 2 augers and a third small one, four pieces of iron elements for a pump, a large saw and two small ones, an axe for cutting knots, with a twisted handle, and an axe and 4 chisels, 2 clamps, a hewing axe, a hammer, a lock with a key, a small copper pipe from a pipe, a plane and a file […], a small axe, 1 plane, 1 spade, four connectors ("buksy")". As tools belonging to the town ("town's objects"), the following were listed separately: "3 augers, a spoon, an axe, a chisel (InwPozn., 1961, p. 607), a hoe, 3 pipe end-pieces, 2 ropes, 15 shovels".

– a wide axe (*Securis lata alias topur*);
– another axe, longitudinal, but narrow, not wide, i.e. prziszyeck (an axe for cutting knots, with a twisted handle);
– 2 other axes of different width used for cutting the first roots from tree trunks, commonly called stachowacze (*secure aliae non preinde latae quibus robora ex primis rudioribusque amputamentis resecantur vulgo nuncupatae Stachowaczcze*);
– 3 carpenter's axes (*securicule Carpentariorum*);
– axes that are not as long, sharpened, not different from carpenter's axes, called pobijaczki (*secures non perinde longae acuminatae haud multum dissimiles communibus securibus carpentariorum alias Pobyaczkj*);
– 3 carpenter's or bricklayer's hammers called bulls (*Mallei Carpentariorum siue muratorum alias Byky*);
– 3 digging tools, i.e. hoes (*Instrumenta pro fodiendo et cariando alias motikÿ*);
– a saw (*Serra*);
– 2 small saws in frames (*serrulae fimbratae alias pylkÿ w ramyech*);
– 2 entwined (?) augers (*terebra plexa*);
– auger (*Terebrum pro canandis palis*);
– 5 chisels (*Instrumenta canatoria alias dloth*);
– 2 narrow chisels (*Instrumenta canatoria angusta*);
– 3 iron spades (*palae ferreae*);
– 3 garden forks (*furcae*);
– 2 iron garden forks for domestic use (*furcae ferreae pro domo*);
– 3 iron garden forks for manure (*furcae ferreae pro fimo*);
– a chisel for pipes (*Instrumentum canatorium pro Canalibus*).

And also other tools, apart from the pliers used for pipes which belong to the King (*Tum et alia Instrumenta Exceptis forficibus canalicÿs Regys quae pertinent ad Regiam Maiestatem*).

Further, Jan testified that as long as he lived he could use a royal meadow on the strength of the King's privilege. After his death his heirs were to receive 20 marks for that meadow. All the above-mentioned possessions Jan assigned to be equally divided between his sons. He excluded his daughter from the Little Poland's town of Tarnów, because, according to his testimony, she had received a sufficient and satisfactory dowry.

Next on the list were debts (*debita sibi contracta*) that 9 persons owed him, calculated exclusively in florins: from 2 to 50, amounting to 126 florins and 7.5 groschen in total. Out of three largest sums two were secured with a pledge: 22 florins with a pledge of an overcoat lined with fox-fur belonging to the debtors:

a nobleman called Ciekirzyński and his brother, and 16 florins with a pledge of a pearl headband belonging to the debtor *dominae* Barbara, a hunchbacked goldsmith. Jan's father-in-law, *dominus* Jan Waysz, owed him 50 florins; it cannot be excluded that this was the remaining part of his wife's dowry. One of the two smallest debts (amounting to 2 florins) owed to Jan by Jerzy the blacksmith had been partly paid back in kind: with a spear worth 10 groschen and 3 digging forks worth 4.5 groschen each.

Jan left all his claims to his sons, not including his daughter, as was previously the case. The claims were to be collected by the executors of the testament, namely Marcin the malster and Mikołaj Junior the salt merchant (probably Mikołaj Jendraka, from whom Jan leased a salt stall in 1531, or his son).

What is striking in Jan the master fountain-builder's testament-inventory is his meticulousness and thrift: there is no trace of chaos or reminding oneself of things, people or matters, as was the case in many other last wills or inventories. The testator is in control of everything, even on his deathbed, despite the fact that he is an old man, at least 70 years of age. It was a fragment of his last will concerning the sale of a meadow that enabled his identification as the Bohemian master Jan of Dobruska. It follows that he was the royal master fountain-builder for over 43 years! Over the years he got married three times and had five living children by two wives. When Jan died, three of his sons from his second marriage were still boys, because he had married their mother after 1531 (in that year he was still married to his first wife, Katarzyna, cf. above). Despite his advanced age he was a strong man (he survived the great plague of Kraków in 1543, and work at the water supply system was by no means light), professionally active to the end, judging from the description of his work tools being in good condition, still in use. Moreover, the additional explanatory details included in this description testify to the fact that it was specialised equipment, known not by everybody (clearly, the scribe had considerable difficulty in translating the Polish terms into Latin). As far as Jan's other movables are concerned, he managed to collect a rather typical set, systematised according to categories encountered in most other testaments.

What is noteworthy in Jan's last will is his large weapons arsenal (in other testaments individual weapons are encountered) and luxury objects, including gold and silver buttons and valuable hats trimmed with expensive marten and dormouse fur (thus he broke anti-luxury regulations). As to furs, he also had 2 overcoats lined with fox-fur; however, the list did not include a fur coat made of fox backs that he was to receive every three years on the strength of a royal privilege of 1502.[1593]

1593 CA II/1, 1936, no. 26, p. 10.

Furthermore, the fact that Jan equally divided 1000 florins between his four sons and their stepmother, his last wife, testifies to his wealth. The 200 florins that Jan left his third wife were at the same time her dower, as it corresponded with the dowers left by Kraków craftsmen to their wives.

Jan must have enjoyed a special position among Kraków burghers, because as long as 20 years after his death his son Sebastian was mentioned as the son of the burgh master fountain-builder (*rormagistri castrensis filius*) when in 1566 he was admitted to citizenship of Kraków.[1594]

It is difficult to establish who became the successor to Jan. In February 1545, i.e. when Jan was still alive, the King assigned an annual remuneration (*pensio*) of 100 florins[1595] paid in two instalments of 50 florins each to Mateusz from Moravia;[1596] the King wanted to keep Mateusz in his service, because he was entrusted with the construction of "numerous water supply systems". The present author described Mateusz's professional activity in greater detail years ago.[1597] Here, let us recapitulate that the "numerous water supply systems" consisted at least in building an installation in the Little Poland's town of Opatów and in proceeding with the construction of an installation that his late brother had begun in Sandomierz. In the latter town, following in his brother's footsteps, he settled down and took care of his orphaned nephew, he started his own family and bought a house in the Market Square for which in 1552 he paid the same Schoss as a local patrician and Vistula grain trade magnate called Bartłomiej Serny. Around the year 1557, having widowed, Mateusz moved to Kraków (he did not take his little daughter with him). In 1568 he took the oath of obedience to the Kraków town council and to the town law.[1598] Nevertheless, it remains unknown whether as early as from 1545 he had been also responsible for the maintenance of the Wawel water supply system; maybe together with Jan, like in the case of the two above-mentioned town master fountain-builders: Szostek and Marcinek.

The long (lasting for over 40 years) stay in Kraków of the master fountain-builder Jan of Dobruska was an exception. Builders of water supply systems were itinerant workers remaining outside guild structures, working only with one or

1594 KsPrzyjKr., 1993, no. 3645, p. 212.

1595 An annual fixed salary of the same amount, i.e. 100 florins, was paid to the royal physician (*phisicus regius*) to King Sigismund I from the year 1523, Jan Benedyktynowicz Solfa from Trebuły near Zgorzelec (1483–1564) in Lusatia – cf. RachBoner 1955, p. 35 and footnote 61 where relevant literature was listed.

1596 Giedroyć 1909, pp. 378–379: 11 February 1545.

1597 Sowina 1998b, p. 144 et seq.

1598 KsPrzyjKr., 1993, no. 3308, p. 189.

two helpers (for technical reasons described above), often in family undertakings like the ones in Sandomierz or Czchów (this phenomenon was also observed in several Western European towns). They were hired on the basis of a contract for a remuneration stipulated therein; sometimes, however, like in Lublin or Czchów, they were the investors with a considerable capital. Only their attempts to settle down in towns show what place they had or aspired to have in the burghers' community. Besides Jan of Kraków and Mateusz and his brother Walenty of Sandomierz, two master fountain-builders from Krosno in Little Poland are worth our attention. According to Franciszek Leśniak's research, the master fountain-builder the earliest confirmed in sources for that town was Jan Szab (Schab) who owned a house on the western side of the Market Square[1599] from 1515, which fact can testify mostly to his wealth, and not only (as the researcher presented it) to his social recognition. A significant standing (in medium-sized town Krosno) of another 16th-century master fountain-builder called Stanisław may have been reflected in conducting a private connection to the house and brewery owned by a tanner named Wawrzyniec Bergiel,[1600] who – according to F. Leśniak – was Stanisław's son-in-law.[1601] The question is whether Bergiel the tanner bought the house and the brewery for the dowry money he had received from his father-in-law: Stanisław the master fountain-builder.

Coming back to the place of Kraków master fountain-builders in the burghers' town community, let us present a few pieces of information concerning social contacts and economic activity of their wives.

Mentions of "rurmistrzowe" or "rurniczki", i.e. wives (or widows) of master fountain-builders, constitute a valuable supplement to the information about the master fountain-builders, most of all about the range of their social contacts and the size of their family economic activity. This was undoubtedly the case in Kraków at the turn of the 15th and 16th centuries. In the town books of the tribunal of *advocatus* the following women were mentioned: Helszka "rurmystrzowa", who in November 1499, as the owner of a manor farm (*predium*) in Prądnik, exchanged it for a garden in Kleparz;[1602] Małgorzata "rormystrzowa", who on the strength of a decision passed by the court of *advocatus* on 13 May 1502 was to receive 8 florins as inheritance from her mother from the latter's sister Gritta Zynczowa and

1599 Leśniak 1999, p. 103.

1600 Leśniak 2005, p. 47.

1601 Leśniak 1999, p. 103, footnote 552 – unfortunately, it was not stated when Stanisław's daughter married Bergiel.

1602 ANK, AC 96, p. 333.

Gritta's daughter Regina;[1603] and Marusza "rurmistrzowa" also called "rurnyczka", who was mentioned on 29 August 1502.[1604] Bearing in mind that Marusza was one of the forms of the name Małgorzata,[1605] it cannot be excluded that the master fountain-builders' wives: Małgorzata and Marusza were the same person. In the above-mentioned case from the end of August 1502 Marusza "rurniczka" sued before the court of *advocatus* Jan Loszagk who ran a public bath and his wife Zofia, who owed her half a mark and 3 groschen (27 groschen) for things sold in stalls. Until 10 October Zofia did not appear in court for the hearings (12 September, 8 and 10 October).[1606] In the meantime (6 October) Marusza "rurmistrzowa" sequestrated all movables and property belonging to a tailor named Kuncza and his wife Katarzyna of the value amounting to 52 florins.[1607]

Most probably a different Małgorzata "rurmistrzowa": *Margarita Rormistrzowa* appeared in the 1530s before the Kraków echevin court to settle her financial matters. Soon after White Sunday, i.e. on 20 April 1531, represented by her legal guardian, Jan Biskup, a tailor, she undertook – on the strength of the record in echevin books – to repay 257 florins and 10 groschen to the above-mentioned Franciszek Rezler, who had provided the money for the construction of a house in Sławkowska Street. The following day she was to pay back 200 florins and the rest – before the feast of St Michael, without delay.[1608]

Considering the fact that Jan of Dobruska, active in Kraków from the beginning of the 16th century until 1545, had three wives: Katarzyna, Jadwiga and Anna, all the other above-mentioned wives of master fountain-builders, engaged in the town's credit market, were married to town master fountain-builders whose names remain unknown.

III.4 Private and professional ways of supplying water

Water was needed for cooking and drinking and also for craft production. Drawn from a natural or an artificial reservoir, water had to make its way to the house, usually to the kitchen, or to the workshops. The shortest distance it had to cover was from a cistern, a dug well or a water (storage) reservoir connected to a water

1603 ANK, AC 98, 499 (*Recognitiones debitorum*).
1604 ANK, AC 98, p. 359 (*Hospitalis platea*).
1605 SSNO, vol. III, 1971, pp. 381–382 and 411; op. cit., p. 411 – Marusza also as a form of the name Maria.
1606 ANK, AC 98, pp. 360–361.
1607 ANK, AC 98, p. 527 (*Arestationes*).
1608 ANK, SC 11, p. 184.

supply system, situated nearby. If there were no such reservoirs (public or private) or if the water stored there was unsuitable for the given needs, it had to be carried or carted from places further away either by the person who needed it or by a professional water carrier or water carter. Effective and quick supplying water to extinguish fires was also extremely important. Organized forms of supplying water in case of fire can be traced in written sources.

Drawing water directly from the above-mentioned reservoirs by inhabitants for their private use (that is, in relatively small quantities, e.g. with the use of vessels that could be carried by one person (fig. 68) or transported in one cart) did not require any official regulations drawn up in the written form, because everywhere in Europe water was available to the public. "According to the old custom, water must be free for use by anyone," as was written about river water in records of the Kraków *quartalienses* of 1568.[1609] Therefore, such information in written sources is difficult to find, as it sometimes appears when other events or phenomena are being described. Apart from the difficult situation of the inhabitants of Płock mentioned above, presented in written sources as a direct consequence of the lack of water supply system and of the scarcity of water in wells, there is one more example worth mentioning, namely a story from Jan Długosz's *Żywot św. Stanisława* [*The Life of St Stanislaus*]. This story tells us not only about the miracles connected with the so-called lake/pool of St Stanislaus (*lacus, piscina S. Stanislai*),[1610] but also about the fact that the inhabitants of Kazimierz used to draw water from the Vistula River at least for some of the household needs.

1609 KsWiertelKraków, 1997, p. 43.

1610 Legend has it that while St Stanislaus's body was being hacked, his finger fell into this lake and was swallowed by a fish that in turn was later miraculously caught. From then on water drawn from this spot has been known to possess medicinal properties.

Fig. 68: A woman carrying water. Italy, 14th century, after: Wijntjes 1982, p. 197; Grabowski/ Mührenberg 1994, p. 20; Hoffmann A., 2000a, p. 45.

There was a woman from Kazimierz, from the parish of St Stanislaus, who led a decent life and enjoyed a good reputation and was deeply devoted to her parish. One day she wanted to wash her linen clothes, so she sent her female servant named Piechna to fetch some water from the Vistula River. Piechna had only recently come to town from her village and did not know the way to the river, and so she went to St Stanislaus' lake and drew water from it. On her return, her mistress, unaware of the servant's mistake, put some soap into the water and placed it over the fire to bring it to the boil. When she wanted to immerse the clothes, she looked inside the cauldron and saw a multitude of crickets. Taken aback, she called for Mikołaj Kaym, the cathedral scribe who used to live in her house, and asked him whether it had been him who had put the crickets in the cauldron.

Mikołaj firmly denied, saying that the water had been taken from St Stanislaus' lake and that it had been the Saint who had frightened her so much. The woman called the servant and asked her where she had drawn the water from. Piechna replied that she had brought it from a pool (*piscina*) whose banks were planted with willows in the vicinity of a tall house near St Stanislaus' Church. The woman took the cauldron and without a moment of delay together with her whole family (or rather all the servants – *familia sua*) rushed to the lake and poured out the contents of the cauldron, including the crickets that disappeared instantly. The people who saw it praised the Lord and St Stanislaus, asking them for forgiveness, as they had sinned not deliberately, but out of ignorance.[1611] However, Długosz mentioned one instance of a deliberate attempt at drawing water for everyday use from this miraculous lake. One day Jan Gładki, an elderly citizen of Kazimierz, brewed beer at home. He ran out of water needed to finish the process, so he sent his servant to bring a barrel of water (*vas aquae*) from this lake using a horse-drawn cart. Willing to follow his master's order, the servant drove the cart into the lake. When he was filling the barrel with water, the horses suddenly shied and reared. There was no way to take the horses from that place or to move the cart before the barrel had not been completely emptied.[1612]

This story – apart from the main piece of information about one of St Stanislaus' miracles – shows a highly realistic image of everyday life in Kazimierz, a town near Kraków, in the 2nd half of the 15th century, including its supply in water. Thanks to its location, Kazimierz should have even better conditions for digging wells with good water than Kraków. Nevertheless, as in the second part of the story, there were times when people suddenly ran out of water that had been carted to them for brewing beer, which meant that at least some of the wells did not satisfy their needs either at all (in that case water necessary to make beer had to be supplied regularly), or temporarily (e.g. because the well dried out[1613]). It also cannot be excluded that e.g. on Jan Gładki's plot (or in its vicinity) in Kazimierz there was no such reservoir. Hence, also Piechna the servant might have been sent to fetch water from the Vistula River not because river water was better for washing clothes than water taken from a well, but because there could have been problems with acquiring well water for the above-mentioned reasons.

1611 Długosz 1887, p. 167.

1612 Op. cit., p. 168.

1613 As was mentioned before, the same happened with a deep well standing on a plot that belonged to a patrician from Świdnica named Wacław Thommendorf; due to the drying up of the well water had to be carted to this plot for a whole year – Goliński 1998, p. 38.

These conjectures call for archaeological research carried out in Kazimierz, with particular emphasis on dug wells both on plots and in the public space. For lack of research, especially into the topography of the plot and its immediate vicinity, it is difficult to establish whether the reason for which water for everyday needs had to be carted or carried to the plot could be the close proximity to a cemetery.[1614]

Due to insufficient written sources, it is hard to state who in general carried water in private households in which production also took place. The story about the miracles connected with the water from St Stanislaus' lake reveals an undoubtedly important role of servants in carrying water, even in families in which the mistress or master dealt with everyday chores herself or himself (like the above-mentioned woman from Kazimierz who boiled soapy water and was about to start doing the laundry, or the burgher who brewed beer at home himself). It can be assumed that water was also carried by apprentices and journeymen apprenticed to master craftsmen.[1615] This was an onerous duty especially for very young people of both sexes who were in fact still children: it required pulling up from wells heavy buckets with iron fittings (that had been mentioned before) or carrying vessels filled with water from a river, sometimes situated below the level of the town (like in the case of Płock), all the way up to the house.

When water was drawn directly from a river, people sometimes used steps and/or piers connecting the land with the water built to facilitate access to the watercourse. The way the structures looked can be found in iconographic and archaeological sources. Let us take a look at the example of a painting by Pieter Brueghel the Younger called *Adoration of the Magi*, existing in several versions,[1616] patterned on an earlier work executed by the painter's father, Pieter Brueghel the Elder. In the foreground of the painting we can see two people climbing three or four steps up from the river, their backs bent under the heavy load of buckets filled with water they had just drawn from the river. A painting by an imitator of the Master of the Altar with the Legend of St John the Almoner dated at ca 1504 consists of four quarters depicting the legend of St Stanislaus. In the background of a quarter entitled *St Stanislaus' Body Hacked to Pieces* we can see a fragment of a town with the

1614 Cf. also Sowina 1991b, p. 106 et seq.

1615 The duty of carrying water by young people apprenticed to a master in the Middle Ages is referred to in comparative studies from other parts of Europe, e.g. it was not uncommon in notarial files confirming apprenticeship in Italian towns – cf. Tramontana 1999, p. 441 and footnote 117 (*servicia infra domum et deferre aquam*).

1616 Web Gallery of Art, created by Emil Krén and Daniel Marx, retrieved 31.1.2013, from http://www.wga.hu.

surrounding fortifications. There is a wooden pier/jetty covered with a roof leading from the fortifications to a meandering river.[1617] Archaeological excavations from Wrocław reveal material remains of mediaeval piers.[1618] Such piers were probably used not only to draw water directly from the river, but also to wash clothes by the river and even to process some goods that were produced, like the piers at the back of plots belonging to Poznań tanners, described by Jacek Wiesiołowski in his socio-topographical study of the town, or like analogous constructions on canals of mediaeval Chartres (fig. 69), preserved to the present day, used in the past by local weavers.

Fig. 69: Jetty on a canal in Chartres. Photograph: U. Sowina.

When water was drawn in larger quantities, people sometimes drove their carts directly into the reservoirs, as was described in the second part of the story pertaining to Kazimierz. This is probably what carters (*vectores*) did when they carted

1617 Otto-Michałowska 1982, table 26 (in black and white).
1618 Wiśniewski Z., 1995, p. 139.

water needed to brew beer in the Royal domain of Kraków in the late 14th century. Accounts of the Kraków *viceprocuratio* show a situation when there were not enough of these carters, who were called upon "to perform other royal services." Then the *viceprocuratio* paid 3 scots (6 groschen) *pro ductura aquae ad eandem cervisiam braxandam.*[1619] The fact that water was carted in such a way means that carting water was an organized activity, necessary if brewers did not have their own wells or if water from wells was unsuitable for the second stage of beer production, or if there was a shortage of water in the wells or in the water supply system, or if there was no water at all. In towns in the Polish lands this was not an uncommon occurrence. Apart from the above-mentioned direct instances, one can point to identical excerpts from two different royal privileges granting the right to establish water supply systems: one of 1532 referring to Proszowice, a town in Little Poland, and the other one of 1539 referring to Pyzdry, a town in Greater Poland. The same words were used in their preambles to describe the situation of the respective towns: both towns suffered from the scarcity of water and had to keep horses to transport water, which put the town to a lot of expense.[1620] This gives rise to a suspicion that the royal chancery used a ready form presenting the most typical (the most common) situation, namely carting water organized by the town. In towns where water supply system already existed, in times of a breakdown the town authorities at their own expense organized carting water to the inhabitants, as was shown in the example of Nowy Sącz, in which such a situation occurred between autumn of 1559 and spring of 1560.[1621]

In European towns organized water supply (also as a professional activity) can be observed to a greater or lesser degree. The case of Venice and Amsterdam, two powerful centres suffering from the lack of drinking water where water was transported on barges, was described above. It is also worth mentioning that there were 80 water carters recorded in Paris in the late 13th century who supplied people in drinking water due to a high salinity of water in local wells.[1622] At the same time in Chartres existed a "wealthy" water carters' fraternity that funded a stained-glass window in the town Cathedral.[1623]

1619 Rachkról., 1993, p. 21.

1620 Giedroyć 1907, pp. 413 (Proszowice) and 416 (Pyzdry), quoted after: MK 47, p. 376v. (Proszowice) and MK 58, p. 226v. (Pyzdry).

1621 ANK, AD 149, p. 107. Cf. Part III.3.3 of the present work.

1622 Guillerme 1985, p. 185 – this piece of information quoted from: Gueraud, Paris sous Philippe le Bel, d'apres les documents originaux, Paris 1837. Cf. also: Guillerme 1994, p. 12, for calculations that there was one water carter to 3000 inhabitants.

1623 Guillerme 1994, p. 12.

In every case when water carters were mentioned in town records it meant that the town suffered from a temporary or a permanent water shortage. On the other hand, the lack of information concerning water carters sometimes results from the scarcity of sources or incomplete studies, especially pertaining to the centres which are known to have had problems with supplying water that would be suitable for drinking and cooking to their inhabitants. For example, written sources pertaining to Płock mentioned only carrying water in ewers from the Vistula River for the needs of ones own household and that servants walked to the river in order to draw water. No information is available about water carters in Toruń because due to the lack of written sources the local plebs was ignored in a socio-topographical analysis of the town.[1624]

Such an analysis pertaining to late-mediaeval Wrocław[1625] showed that there were four water carters who were taxpayers, i.e. the smallest number of people professionally carting water that was recorded in written sources. And yet Wrocław had a better developed water supply system than Toruń and more favourable natural conditions to dig wells.

Another difficulty connected with identifying the activity of water carters in written sources was that (as was mentioned above) in Latin records both water carters and master fountain-builders were referred to as *aqueductores*, which fact together with the lack of other data could lead to (sometimes very far-reaching) misunderstandings. All such instances required supplementary source data, including the Polish translation of the above-mentioned Latin term referring to the same person. This way the present research lead to the identification of 3 water carters active in Środa in Greater Poland in the years 1518–1533. In a book of the tribunal of *advocatus* under the year 1518 is a mention entitled: *dotalicium honeste Catherine per Stanislaum aque ductorem virum eius* legittimum.[1626] This mention reveals that *providus Stanislaus voszyvoda* [Stanisław/Stanislaus the water carter (*woziwoda* in Polish)] appeared before the court in order to register the dower in the amount of 12 marks. This sum was secured on a quarter of a lan (*laneus*) that he owned in the suburbs. It was not stated that it concerned the entire property belonging to Stanisław (as was usually done in analogous cases), we can thus assume

1624 Mikulski 1999, p. 132.

1625 Goliński 1997, p. 445 – in the professional structure of the town in 1403 four water carters (*Wasserfurer*) were among taxpayers from the lower class, including one who owned a house and three who did not; and p. 481 – the above-mentioned water carters were located one in each of the following quarters: Merchants' Quarter, Large/Great Quarter, Furriers' Quarter and Malsters' Quarter.

1626 APP, Środa I/30, p. 83.

that in 1518 he owned at least a quarter of a lan in the suburbs,[1627] i.e. a comparable property to the one that an averagely wealthy small town burgher possessed in farmlands within the town limits in the period in question.[1628] The 12-mark dower settled by Stanisław the water carter was 40% smaller than the 20-mark dower registered on the same day by Walenty the furrier and *advocatus* (*protunc advocatum*: he was probably a court *advocatus*) for his wife Małgorzata.[1629] This situated Stanisław the water carter lower in the hierarchy of income earned in Środa than Walenty the furrier, who at the same time was a member of the town authorities.[1630]

In the year 1521 in the same book Marcin Wozywodka (i.e. a water carter's son) was recorded as the one who bought for 3 marks rent on a house situated in the corner of the Market Square in Środa, belonging to the above-mentioned Walenty the furrier and (court) *advocatus* and to his wife Małgorzata.[1631] On the strength of this agreement of sale with the right to repurchase (*Wiederkauf*) Walenty committed himself to paying Marcin one ferto (i.e. 12 groschen, namely 8.(3)% of the capital) annually due at Easter *usque se non exemetur*, that is until the full repayment of the sum he had received from Marcin. Hence, Marcin Woziwodka must have had at least several marks in cash (which was by no means a small sum in

1627 APP, Środa I/30, p. 94v.

1628 Sowina 1991b, p. 171.

1629 APP Środa I/30, p. 83.

1630 For the sake of comparison: on 19 January 1526 the burgomaster of Środa, nobilis dominus Stanisław Wnorowski, secured a dower in the amount of 100 marks for his wife Małgorzata *proconsulissa*. This sum resulted from the wealth of both of the spouses (and also from the wife's sufficiently high dowry, equal to about a half of the dower); however, it is difficult to establish to what extent it was representative of other burgomasters of Środa (and perhaps also members of the local town elite) and to what extent it was connected with Wnorowski's (and possibly his wife's) noble origin. Let us note that in Poznań in Greater Poland, which at that time was already a big city, in the first quarter of the 16th century 4 dowers in this amount were given by the local dyers to their wives; during this period dyers entered the upper middle group (the highest dowers in this group, amounting to over 400 marks, were settled by *pannitonsores*, including members of the town authorities); on the other hand, dowers in the amount of 20 marks were given by a town servant and a cook, whereas 12-mark dowers were settled by a linen weaver, a gardener and a porter, the representatives of the lowest social strata (Wiesiołowski 1982, pp. 38–39). Nevertheless, the comparison of the data pertaining to Poznań and to Środa only shows the economic differences between a large and a small centre in Greater Poland in the period in question.

1631 APP, Środa I/30, p. 94v.

a little town like Środa[1632]), as he entered into credit contracts (as the creditor!) with Walenty the (court) *advocatus*, a person undoubtedly belonging to the town's elite. In January of 1526 Marcin *ductor aque* was recorded as the owner of a house in the Market Square,[1633] and in the spring of 1531 as the owner of a suburban *predium*,[1634] that is – in a town of the size of Środa – a separate farm used for agricultural and breeding purposes that was the dwelling place for suburbanites and an additional source of income for burghers. In the case of both burghers and suburbanites, owning a *predium alias folwark* (a manor farm) was one of the main indices of their wealth.[1635] *Paulus Wozywodka* (i.e. water carter's son) had a higher social, professional and economic standing than his father Stanisław and than Marcin. He was also mentioned as *Paulus ductor aque*,[1636] which could mean that (like in the case of Marcin, who was referred to in the same way) he practised the same profession as his father. Records made it possible to take a closer look at Paweł and to define the forms of his economic and professional activity. He was active in the town at least from 1525. On 2 March 1526 he was recorded among the witnesses to the receipt of a bequest of 127 marks by Jadwiga Czapniczka.[1637] On 9 May of the same year two full brothers: the *honorabilis dominus* Maciej, a provost from Dębno, and the already mentioned Wojciech Sobocki, the cloth shearer, echevin and owner of a house in the Market Square (earlier, since 1518, the owner of a windmill[1638]), acting as their sister's guardians (tutors), gave to Paweł a house with the entire equipment (situated between the house belonging to Luboński and the house belonging to Walenty Kyerzek), a malthouse together with a plot of land near the town walls, and a suburban manor farm located next to the manor farm belonging to Marcin *ductor aque* and to Marcin Przech's manor farm.[1639] In the same year (without the exact date) in Paweł's house the *laboriosus* Błażej (*socius laniorum)* drew up his testament and made Paweł the main executor of his last will, referring to him as to *magister suus*.[1640] On 9 September 1526 and on 5 July 1527

1632 Cf. Łydkowska-Sowina 1989, passim.
1633 APP, Środa I/30, p. 140.
1634 APP, Środa I/30, 191.
1635 More about this in relation to Sieradz – cf. Sowina 1991b, pp. 158–159.
1636 APP, Środa, I/30, p. 132v., year 1525.
1637 Op. cit., p. 143v.
1638 APP, Środa, I/30, p. 84v., year 1518. The presence of a windmill, like the presence of a horse mill elsewhere, testified to the scarcity of water as the power source.
1639 Op. cit., pp. 145v.–146.
1640 Op. cit., p. 179, between records from the year 1529.

Paweł the *ductor aque* was recorded as a town councillor.[1641] At the same day the last will and testament of his wife, the *honesta domina* Małgorzata Zażegalczyna[1642] (the widow of Michał Zażegała, the *advocatus* of Środa[1643]) was recorded in documents of the tribunal of *advocatus* and in echevin books (this can indicate that she had died a couple of days before that date). What can be assumed from this act is that she was the sister of Maciej the provost and Wojciech Sobocki. In her last will, drawn up a year before that date, i.e. two months after her brothers had given Paweł the above-mentioned properties, Małgorzata confirmed this transfer of property, but at the same time she obliged Paweł to pay 17 marks in return for these properties to her daughter from her previous marriage, Dorota. Paweł was also to get three tin bowls, the same number of plates, one cauldron, all his own money (!), as well as winter crops. Maciej the provost got a quarter of a lan for the maintenance of his altar, whereas her servant Barbara got one tin bowl and three plates. Dorota inherited a quarter of a lan, two cows and all the remaining movables (including 3 tunics, 3 fur-lined overcoats and 3 coats, pearl jewellery, 3 silver spoons, 2 gold-plated rings and 5 golden Hungarian florins).

In the following years Paweł purchased more property: a garden,[1644] *predium* (identified with *allodium* in records referring to him)[1645] and a quarter of a lan.[1646] Being ill, on the first Friday after Easter 1531 (14 April) he wrote his last will.[1647] Having indicated the executors of his testament and having entrusted his soul to God Almighty and his body to the soil and having earmarked 3 marks and an overcoat lined with fox fur for his funeral, he divided his possessions between his wife Dorota and his two very young daughters: Katarzyna and Barbara. In his possessions he included the following: a malthouse near the town wall, a house in the vicinity of the brick dwelling house, two quarters of a lan (a half of a Franconian lan in total), two *predia* (including one next to a *predium* belonging to Marcin the water carter) and 24 marks in cash, 20 marks in malt and ca 30 marks in liabilities for stones of wool. Apart from this, in his last will he made a bequest of corn, both in the field and in barns, 20 cows, 1 ox, 2 horses (gray and

1641 Op. cit., pp. 148 and 157v.
1642 Op. cit., pp. 159–159v.
1643 He was noted as an *advocatus* presiding over the echevin court in 1518 – APP, Środa, I/30, p. 84v.
1644 Op. cit., p. 169, year 1528.
1645 Op. cit., p. 177, year 1529.
1646 Op. cit., p. 181v., year 1530.
1647 Op. cit., pp. 190–191v.

piebald) and 250 sheep in leased lands in the neighbouring villages (he listed the names of the villages).

After he had written the testament, Paweł Woziwodka lived at least two more years: on 21 March 1533 he settled a matter concerning a half of a quarter of a field used by his stepmother Katarzyna.[1648] He died before 26 May 1536, because in two subsequent records from that day he was mentioned as being deceased: *laboriosus pie memorie Paulus wozÿwodka*.[1649]

Paweł Woziwodka joined the social and economic elite of Środa in Greater Poland, because he accumulated considerable wealth (not only in the scale of his own town) consisting of farmland and farm animals. He also skilfully used the matrimonial market (he got married twice, to widows belonging to the local elite) and thus he became related by marriage to the first families of Środa. At the same time he was a cloth weaver dealing with the whole cloth production process: from breeding sheep for wool to wool processing. Considering his social standing, he probably organized carting water to the town. In that case he would be the epitome of a member of the Polish small-town elite, performing more than one job, but drawing his wealth mainly from the land he owned.

The above-mentioned examples of water carters from Środa are all the more interesting that they make us aware that every time we come across a water carter in written sources we should be cautious about classifying him in a routine way as a member of the lower social strata of the given town. Just as in Środa, also in other small towns this standard classification could prove erroneous, as small centres provided members of the same professional groups with greater opportunities for increasing their social status than large cities. Here, it is worthy of notice that in the course of the present archival research a mention of a certain Grzegorz, a carrier (*vector*), who was the burgomaster of the town of Turek in 1557, was found in the earliest book from this small centre in Greater Poland.[1650]

1648 Op. cit., p. 213.

1649 Op. cit., pp. 230v.–231: Paweł's daughters' guardians (*tutores*) (at least one of whom, Marcin Przech, was also his neighbour, as their suburban manor farms were next to each other) took care to ensure resources for these children's education by entering into a financial agreement with Stefan Kyerzek and Jan Kamieniczny Wnorowski. The former at least from 19 January 1537 was the next husband of the widow of Paweł, the latter – also at that time – was the husband of her daughter Anna, Paweł's stepdaughter, and a relative of the above-mentioned burgomaster Stanisław Wnorowski (this part of the prosopographic studies – on the basis of a mention in: APP, Środa, I/30 p. 235v., year 1535, and two other mentions, op. cit., p. 252v., 19 January 1537).

1650 APP, Turek I/1, p. 143v.

The example of Paweł, the *ductor aquae* from Środa, throws a new light on such a service profession as carting water. First of all, it shows its different possible dimension: as a job organized into a kind of an enterprise. Secondly, the efficiency in which Paweł amassed his wealth through taking profitable steps shows that also this job was lucrative. Thirdly, one can assume that since being a professional water carter was profitable for a town councillor, the town must have had problems with water supply. As was stated earlier, one can infer a rapid development of home and professional beer production in Środa from the presence of private maltings on numerous plots belonging to the burghers. Since most of the maltings had their own dug wells (also working for other crafts requiring water), the above-mentioned problems could have resulted from the fact that water from these wells did not satisfy the needs of the second stage of beer production, namely its brewing, due to its unsuitable quality.[1651]

Research concerning a large centre, namely Kraków, did not yield any information about the social and economic standing of the local water carters (*aqueductores*, *Wasserführer*), because they were mentioned in court books only sporadically. In laws passed by the city council and in town account books they were mentioned as performing their main service role: as water suppliers, chiefly (and obligatorily) to extinguish fires. The oldest preserved law passed by the Kraków city council on 5 April 1375 pertaining to this element ordered all water carters to appear at the scene of a fire with water ("Daz wenne fůyr uskumt, an welchin enden der stat daz si, so sullen alle wasserfůrer gereyt sin mit wassir…").[1652] The first water carter who showed up with a barrel of water was given one ferto from the Town Hall, the next water carter received 6 groschen, and the rest – 2 groschen each. The same law also included a rule that every water carter had to keep barrels full of water on their carts at night in case of a fire under the penalty of one ferto. However, the words written next to this clause: *non debet*, indicate that this rule (at least at that time) was not in force.[1653] The same law enumerated ten water carters functioning in Kraków at that time. They were as follows: Pessco Valhenne, Hannus Grife, Jacobus

1651 Not much is known about water supply systems in Środa; in 1560 in town accounts the following expense was recorded: 24 groschen for the master fountain-builder – APP, Środa I/73, p. 102.

1652 PrzywWilkierzeKraków, 1936, no. 6, p. 24. Cf also: KDMK, part II–IV, 1882, no. CCLXXII, p. 382: "[De incendiis restinguendis]. Von den Wasserfurern zo fewer aws kwmpt, feria V ante Iudica 1375 Gewilkorth. § 1. Wenne fewer aws kompt, an welchem ende der stad das zey, zo sullen alle wasserfůrer bereit zeyn mit wasser […]"

1653 Cf. Wyrozumski 1992, p. 469.

Kochan, Michil am Thore, Jekil, Proger, Stobner, Peschco Gloger, Petrus sororinus Sobotconis and Hanco Schůer.

In the oldest preserved Kraków account books the entry *Ratio ductorum aquarum ad ignem distributorum* appeared for the first time in 1392. It began with the sum of money paid for supplying water to extinguish a fire: *primo xiii scotorum,*[1654] that is 26 groschen. This was thus a total sum, but it is difficult to tell how it was divided between individual water carters. Assuming that (according to the above-mentioned law passed by the Kraków city council) it concerned one fire, it can be divided as follows: 12 groschen + 6 groschen + (4 × 2 groschen), which would mean that there were 6 water carters who were paid for this compulsory service. In town accounts pertaining to the year 1395 there is the first mention of the payment of one ferto to Jan pfasse for supplying the first barrel of water (*qui adduxit primum vas aque*) to the scene of a fire that broke out in the corner of the Market Square.[1655] The same sum of money was paid to an unnamed person *pro vectura aque* to a fire that started in front of the Szewska (Shoemakers') Gate in 1396[1656] However, in 1397 a man called Tempilfeld got as much as a threescore of groschen *super vasa aque ante Valvam Sutorum*, namely for a barrel of water brought to a fire that broke out in front of the Shoemakers' Gate.[1657] This sum was five times higher than the one stipulated in the above-mentioned law of 1375, and hence it would be difficult to explain it otherwise than by the occurrence of five fires in this place throughout the whole year 1397 and by the fact that Tempilfeld was always the first one to appear at the scene with a barrel of water. In the accounts of 1398 only one entry confirmed the expense of 8 groschen *pro ductura aque ad ignem* (fire in the Market Square)[1658] By contrast, in the accounts of 1399 an ample entry was made: *Item aqueductoribus super igne*.[1659] An analysis of the expenses written there leads us to the conclusion that it was about all the fires that happened in the whole financial year,

1654 ANK, rkps/MS 1588, p. 67.

1655 ANK, rkps/MS 1589, p. 53: *Ignis fuit accensus in domo neorze in acie circuli et Johanni pfasse qui adduxit primum vas aque datus fuit 1 ferto.*

1656 ANK, rkps/MS 1589, p. 122.

1657 ANK, rkps/MS 1589, p. 178.

1658 ANK, rkps/MS 1589, p. 241.

1659 Op. cit., p. 328: *Item aqueductoribus super igne primo j fert. Item xj scot. Item ix scot. Item iiij scot. Item xiiij scot. Item Jacusch grunber j fert. Item duczulrich xiiij scot. Item Stanislaw x scot. Item peschic viij scot. Item Gabrich xj scot. Item Stenczlaw xiij scot. Item Marczin viij gr. Item antonio viij scot. Item Marczin iiij scot. Item Hannus Woyt j fert. Item Andree j fert. Item Osanna j fert. Item Norkowa vj gr. Item eidem vj gr. Item hannusoni j fert. Item Jacussio vj gr. Item pro ductura aque libiskus 1 fert.*

for the extinguishing of which the town paid. There were seven such fires, because seven times a ferto (12 groschen) was paid; the other sums, listed further, in scots and groschen, were apart from five instances larger than one ferto, and therefore they must have constituted a sum of smaller single payments for appearing at the scene of each of the fires with a barrel of water. Despite the ambiguousness of the record but because of its consistency we can infer that every such sum referred to a different person. In this record are 15 people whose names are stated and 5 people remain unnamed. If we assume (in the light of the above-mentioned law passed by the Kraków city council) that they were water carters from Kraków, we will obtain their minimum number in the year under research: 20, and we will also find out that among them were two women known by name: Osanna and Norkowa. One can notice that between 1375 and 1399 the number of water carters doubled, which testifies to an increase in demand for water in Kraków in the last quarter of the 14th century preceding the construction of pipe water supplies.

In the first years of the 15th century expenses made towards carrying water to fires were recorded three times as separate entries in accounts and – as always (in the oldest preserved Kraków accounting system) – at the end of all town expenses. In 1401: *Ductura aque ad ignem. primo iij gr. cuidam de vase aque*.[1660] In 1402: *Ignis accensus circa Scolas omnium sanctorum. primo ducta(m) aque ½ marc*.[1661] In 1404: *Super igne. Primo super igne de aqua ducta primo ½ marc… Super igne iniecto apud piczczin primo de primo vase aque 1 fert*.[1662] Only in the latter case the expense of one ferto was specified as being the payment for the first carted barrel of water. Incidentally, the barrel could be filled with water the fastest, and water to extinguish the fire could be directly drawn from a deep dug well situated right in front of Piszczyn's house (that was on fire) located in the Market Square, which was established earlier in the present work.

In the "chronological" system of keeping accounts pertaining to Kraków in the years 1408–1410 all the receipts and payments of the week were recorded every Saturday. In 1408 expenses connected with extinguishing fires occurred three times, including *primam ad ignem vas aque adducenti 1 fert*.[1663] It is worth noting that thanks to this system one can learn that at least one fire broke out shortly before 20 October of the same year "behind the Dominicans".[1664] In the years 1409–1410 no expenses towards *super igne* were recorded; only week's wages of

1660 ANK, rkps/ MS 1591, p. 86.
1661 Op. cit., p. 182.
1662 ANK, rkps/MS 1592, p. 174.
1663 ANK, rkps/MS 1594, p. 87.
1664 Op. cit., pp. 86 and 88.

a half a mark were paid to one *aqueductor*, but this time the word denoted not a water carter, but a master fountain-builder, as transpires from the context of the mentions. The only trace of the existence of the service of carting water for which the town paid is an entry dated Saturday, 14 September 1409, concerning the payment of two marks to Hanusz Voyt,[1665] most probably the same water carter who had been mentioned in accounts of 1399. However, as opposed to the latter, in the mention of 1409 it was not recorded that it was about carting water to a fire. Due to the fact that the sum was considerable and the day of the payment was the date of paying taxes and making payments on the third Ember Days, we can assume that it was a total sum for carting water for the needs of the town (Town Hall?) in general, without indicating its purpose.

When it comes to compulsory attending to fires in Kraków, according to the law of 1375 it concerned not only water carters, but also people who ran public baths (*balneatores*) who were to come with more people and water containers (*myt eyner wannen*) under the penalty of one mark.[1666] It is hard to say whether already at that time it was decreeded that the first *balneator* to arrive at the scene of a fire was to receive 4 groschen and the next people – 2 groschen each, as can be read in *Balthasar Behem Codex*.[1667] According to S. Estreicher, who discovered a 14th-century *Codex* that became the model for *Balthasar Behem Codex*, this fragment was "written by a slightly later hand."[1668] However, this must have happened before 1468, because in that year it was recorded as part of a collection of earlier, "old" laws passed by the city council.[1669] It was also in the 1468 collection of "old" laws that the order for everybody to keep a barrel of water at night was stipulated. The non-observance of this rule was to be punished with a fine of one ferto.[1670] Due to the twin character of this rule and of the 1375 order that referred only to water carters (and probably was not in force) and also owing to the fact that in the 1468 collection this paragraph was placed between paragraphs pertaining to water carters, Stanisław Kutrzeba was of the opinion that it referred solely to the latter professional group.[1671] However, considering the fact that we can come across rules concerning the obligation to keep a barrel of water on every plot for firefighting purposes in laws passed by councils of other towns in

1665 ANK, rkps/MS 1594, p. 145.
1666 PrzywWilkierzeKraków, 1936, no. 6, p. 24.
1667 KDMK, part II–IV, 1882, p. 382.
1668 PrzywWilkierzeKraków, 1936, no. 6, p. 24.
1669 KDMK, 1882, no. CCCXXXIV, pp. 453–458.
1670 KDMK, 1882, no. CCCXXXIV, p. 455.
1671 Kutrzeba 1900a, pp. 112–113.

the same period (e.g. Pilzno in Little Poland, which will be elaborated on later in this book), it seems not out of the question that already at that time also the Kraków rule recorded in the 1468 collection referred to all people who owned property in the town, not only to water carters.

Without examining the subject of fires in towns in detail, we have to mention buckets used for carrying water to fires. As opposed to well wooden buckets, often lined with metal, these buckets were made of leather (fig. 70), and thus they were lighter, which made them easier to use. Apart from hooks (pike poles) they were the most important pieces of equipment with which the inhabitants of the town were obliged to appear at the scene of a fire (in Kraków showing up without a pike pole or a bucket was punishable by a fine).[1672] In times of raging fires there had to be enough buckets for everybody who was fighting the fire to draw water and carry it instantly from every reservoir (which was obviously not necessarily always near). For that reason town authorities also had such buckets, made at the town's expense and kept usually in the Town Hall, from where they could be quickly distributed to the people. Some of the above-mentioned entries in Kraków accounts – apart from expenses towards supplying water in barrels and other, usually unspecified, tasks connected with extinguishing fires – recorded also payments for the production of firefighting equipment, including water containers. The earliest preserved information in Kraków town accounts comes from the year 1392.[1673] This happened in the entire period under research, e.g. in Kraków accounts of 1523 among expenses for the "needs of the Town Hall" there is an entry about paying 24 groschen for one cowhide to make buckets for carrying water to extinguish fire (*pro vna cutte bouina ad faciendum vrnas pro extinguendo igne*).[1674] Unfortunately, the number of new buckets made from this single hide was not stated. However, it is known that it was

1672 It was Stanisław Kutrzeba (1900a, p. 113) who was the first one to gain these pieces of information for Kraków, quoting precisely the laws passed by the city council in 1375. This scholar also described the organisational rules of attending to fires and noted that according to resolutions adopted by the town council, collected in 1468, all men from the quarter where a fire broke out were to arrive at the scene of the fire, whereas men from the other three quarters were to present themselves in readiness at the Town Hall.

1673 It constitutes the continuation of the entry "Ratio ductorum aquarum ad ignem distributorum" quoted above, cf. ANK, rkps/ MS 1588, p. 67: *Item fabro pro bucis et aliis pro attinentijs ignis laboranti. primo 1 fert. Item pro iiijor bucis ad ignem xv scot. Item iij fert. et j scot. Item iij bucos pro ix scot. Item vj gr. pro stauris. ij marc. iiij scot.*

1674 ANK, rkps/MS 1599, p. 88. Print (abridged): PrawaPrzywilejeKraków, 1885, p. 963, no. 30.

also used to make patches to mend 6 old buckets: 7 groschen were paid for mending each bucket – each with one patch (*A Consucione vrnarum ex eadem Cutti per 7 gr. – mr. 0 gr. 42*).[1675] A bit earlier in the same year the accounts mentioned more laconically the purchase of two hides to make buckets at the price of a mark (hence, one hide cost 24 groschen), and the payment of 42 groschen for mending 6 other buckets (*pro duobus Cuttibus ad vrnas – mrc.1 gr. 0; A Consucione sex vrnarum per 7 gr. – mr. 0 gr. 42*).[1676] We can assume that patches used to mend the buckets were cut out from the two purchased hides (they were undoubtedly cowhides). In the same year the purchase for 12 groschen of a ready-made barrel for storing water during a fire was recorded (*pro vase ad ducendum aquae tempore ignis*).[1677] In 1531[1678] 6 hides were bought to make buckets used for firefighting (*urnas ad defensam ignis*) for the total sum of 3 marks and 36 groschen (therefore one hide cost 6 groschen more than in 1523); also 5 marks and 12 groschen were paid for 36 buckets (the cost of labour [*a labore*] of one bucket was 7 groschen, i.e. the same amount as in 1523). Hence, in 1531 9 marks were paid only for fire buckets.

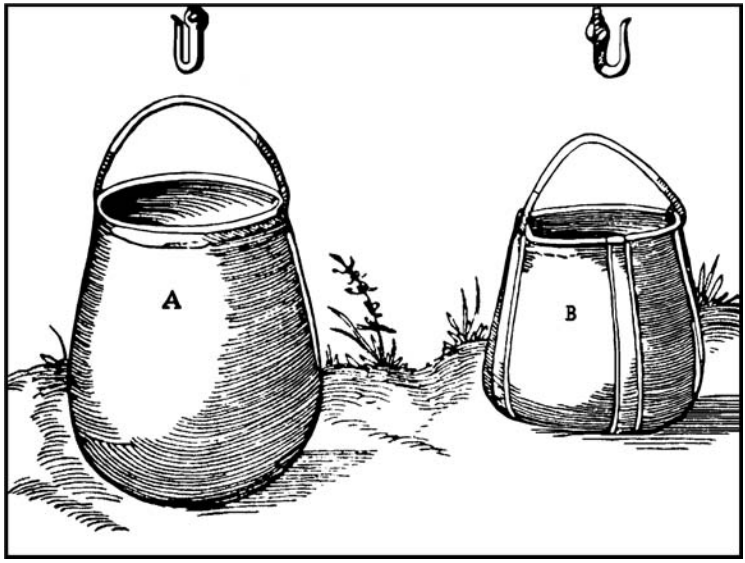

Fig. 70: 16th-century leather buckets for carrying water, after: Agricola 1928, p. 129.

1675 ANK, rkps/MS 1599, p. 88.
1676 Op. cit., p. 87.
1677 Op. cit., p. 88.
1678 ANK, rkps/MS 1602, p. 118.

The fact that town authorities owned firefighting equipment, including leather buckets for carrying water, was typical also for other European towns: the 14th-century Venice and Florence and the 15th-century Bruges. In Venice in the communal house of each parish there had to be six leather buckets (in addition to four axes, two pike poles and one ladder).[1679] In the 14th-century Florence buckets that belonged to the town were kept in "trustworthy" houses situated in the vicinity of town wells, whereas the rest of the firefighting equipment was stored in Palazzo del Popolo.[1680] What is more, according to advice of Paolo di Pace da Castaldo included in *The Book of Decencies* (ca 1360), everyone should have at least 12 leather buckets at home.[1681] In 1484 in Bruges, where a lot of houses were still wooden with thatched roofs,[1682] the town authorities bought 94 leather buckets, each marked with a decorative letter "B" denoting that they belonged to the town. All the buckets were to be returned to the house of the town echevins (*scepenhuis*).[1683]

While discussing equipment used to supply water in case of a fire we have to mention fire squirts. As was mentioned before, among things belonging to a master fountain-builder from Wrocław in 1483 there was one copper fire squirt.[1684] In the course of the present research the author found 16th-century mentions of fire squirts in Kraków written sources. In an inventory of goods of children of the late Maciej Biel, drawn up on 25 October 1513, three brass fire squirts were recorded.[1685] In the inventory of Melchior Czyrzowski, the *vice-procurator* of the Kraków castle, drawn up on 14 July 1542, there was one brass fire squirt.[1686] In 1547 in a rich

1679 Balestracci 1990, p. 437.

1680 Loc. cit.

1681 Op. cit., p. 417.

1682 InvBruges, vol. VI, 1871, p. 474. It was only in the 15th century that thatchers (workers who covered roofs with straw) disappeared from Bruges town accounts, because the town authorities began to decidedly favour tile roofs. However, carpenters still occupied the leading position among the building crafts, as not all buildings in the town were brick or stone – Sosson 1977, p. 223.

1683 InvBruges, vol. VI, 1871, pp. 474–475. During excavation works conducted in Bruges, in a well situated in one of the chapels surrounding the choir of the Romanesque St Donatus's Church, among other things a leather bucket was found with the number 1787, which was interpreted as the year of its production. This may be true, considering the fact that the church was demolished in 1799 – cf. De Brugse Burg, 1991, p. 200 and 205. However, it cannot be excluded that the number visible on the leather bucket was its ordinal number.

1684 Klose 1847, p. 279.

1685 CA II/1, 1936, no. 267, p. 100.

1686 CA II/2 1937, no. 1085, p. 418.

inventory of things belonging to a Kraków patrician Anna Salomon, we find three brass fire squirts.[1687] In *The Accounts of the Royal Domain under the Management of the Governors of Kraków* of 1558 Jan Boner recorded the purchase of 20 fire squirts for 16 groschen each for the needs of the Wawel castle.[1688] However, these pieces of equipment were used at that period also in smaller towns, as evidenced by a mention in town accounts of Środa in Greater Poland from the beginning of September 1552 of the payment of 23 groschen from the town money for 4 fire squirts bought for the Town Hall.[1689] One can notice a significant difference in price between the Wawel and the Środa fire squirts: 16 groschen and less than 6 groschen respectively, which can testify to their being of a different kind, considering almost the same time they were purchased.

Laws passed by the Chełmno city council in 1590 stipulated that burghers were supposed to have their own fire squirts and to appear with them in case of a fire.[1690] Using fire squirts during fires testifies to the need of using a pump (e.g. to draw water from a water cart). According to literature, a pump that had been used for that purpose in ancient cities, was described as late as 1578 as throwing water to a considerable height; it is said to have been used for the first time in Nuremberg in 1602.[1691] However, the example of Wrocław and the other mentions quoted above allow of the statement that this piece of equipment was used to extinguish fires much earlier.

In the course of analysing source mentions concerning the supply of water to extinguish fires in towns one can notice that the predominant organizational form (like in all firefighting actions) was the cooperation between the town authorities and the inhabitants. The proportions of this collaboration were always set by the town authorities. They were responsible for the control and management functions: appropriate services were to check the protection against fire in houses and workshops and to control the above-mentioned firefighting equipment[1692]: both

1687 CA II/3, 1948, p. 604.

1688 RachWielkorzBoner, 1974, p. 65.

1689 APP, Środa I/73, p. 59v.

1690 Suproniuk 2006, p. 50.

1691 Balestracci 1990, p. 436. Cf. also Hoffmann A. 2000b, p. 133: drawings of this pump as well as of a pump from the year 1612 and 17th-century depictions of the way these devices functioned during fires.

1692 E.g. in Toruń, where according to Halina Piskorska's (1956, p. 16) research, following the "Reformatio Sigismundi" from the year 1523: "the so-called quartermasters, subordinate to the councillor who was responsible for a given quarter, were obliged to check the condition of buildings in the streets and town quarters they were responsible

public and private (the latter could also be used for other purposes if there was no fire). During a fire representatives of the town authorities directed the extinguishing operation. Inhabitants of the town were obliged not only to own appropriate equipment, but also to take part in extinguishing the fire. The oldest orders for water carters to supply water to fires can be found not only in Kraków and in other so-called towns chartered with German law (e.g. earlier than in Kraków, because as early as 1340 in Legnica[1693]), but also – or rather in the first place – in laws of the Italian communal towns,[1694] which fact leads us naturally to the conclusion that the models were taken from there, and these had their source in ancient solutions.[1695] Far-reaching similarities between firefighting regulations found in statutes of Italian towns and in laws passed by city councils in Central Europe did not exclude a bit different solutions, including a greater involvement of town authorities than

for, especially to inspect hearths between Easter and the feast of St John in order to make sure they would not set the houses on fire". Among other things they also took care of firefighting equipment.

1693 "§ Wir gebieten ouch do zu kumen allen wassertragern mit czubern…" – quoted from: Wółkiewicz 2006, p. 142, footnote 50.

1694 Balestracci 1990, p. 432 – the functions performed by water carters ("portatori d'acqua") were usually integrated with actions carried out by "specialists" who were able to isolate the place where a fire broke out. They were almost always carpenters and bricklayers. They wore helmets on their heads and carried hatchets, thus forming an integral part of firefighting teams. Also representatives of other crafts belonged to these communal fire guards. In Florence, the fire teams consisted of bricklayers, carpenters and roofers, each quarter had its team comprising 10 men equipped with hatchets and helmets and dressed in clothes bearing the coat of arms of their gonfalone. Twenty water carriers were appointed every year by officials of the "ufficio del fuoco" to help the fire teams. Each night six water carriers together with one team consisting of 10 craftsmen were obliged to be in the "fire station" of the Pallazzo Vecchio (Manikowska 1993, pp. 212–213). In Italian communes also wine carriers performed the same function as water carters ("portatores vini" – Italian "brentadori") – Balestracci 1990, pp. 432–433. Firefighting services were paid for: e.g. in Siena in the 13th century the commune paid 6 denarii for each barrel of water and 3 or 4 denarii for each smaller container. At the same time in Bologna wine carriers were paid 3 "bolognini" for every wine barrel filled with water. In the 14th century in Florence water carriers were paid 3 solidi – Balestracci 1990, p. 437. This researcher does not mention any place where the first person who delivered water to the scene of a fire should receive a higher payment.

1695 The fact that one model became widespread also in other towns of mediaeval Europe may be visible e.g. in French towns between the 10th and the 13th centuries, including Chartres, where an important role of water carters in extinguishing fires was noted – Guillerme 1994, p. 12.

in other centres. For example, in 1486 Bruges authorities funded four four-wheel carts and placed them in the streets: on each of them was a water container fitted with hooks.[1696] Perhaps the same happened also in Antwerp, if we assume that the cart with three barrels, visible in the town plan of 1565, standing in the street near a well was a water cart (fig. 71).[1697]

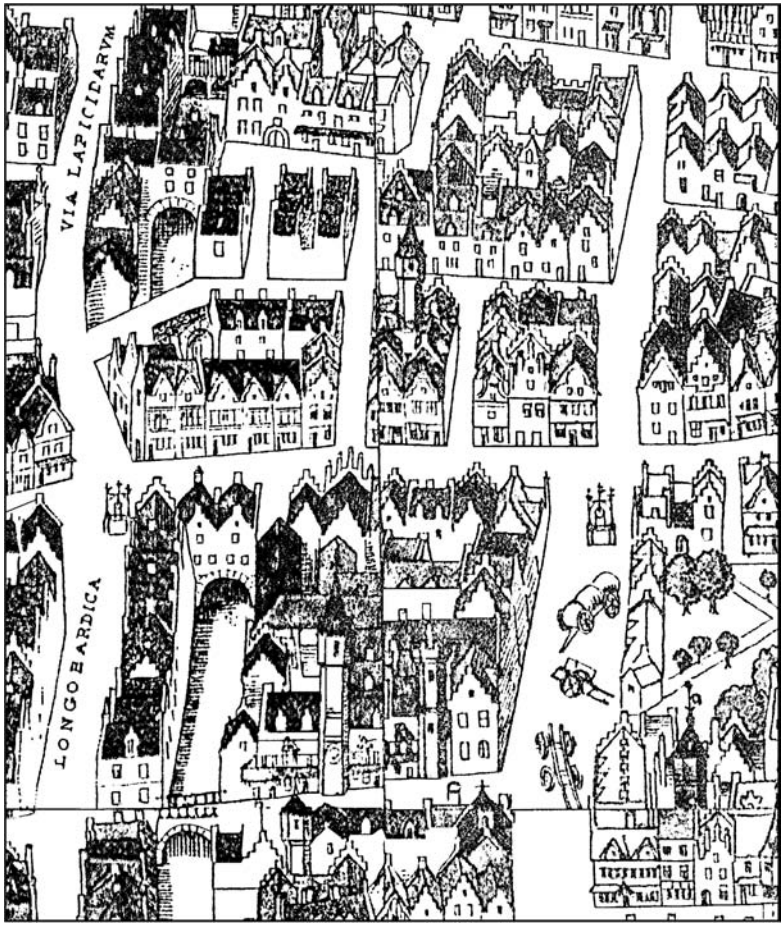

Fig. 71: A cart with three barrels near a well. A fragment of a town plan of Antwerp, 1565, after: Bononiensis/Grapheus 1565.

1696 InvBruges, vol. VI, 1871, p. 474.
1697 Bononiensis/Grapheus 1565.

In regulations from various towns of the Kingdom of Poland from the period between the end of the 14th century and the end of the 16th century one can notice the tendency to increase the inhabitants' obligations concerning firefighting. For instance, in the 15th century appeared an obligation to keep water on every plot in case of fire. At the beginning of the oldest preserved court book of the Little Poland's town of Pilzno pertaining to the years 1452–1483 among town laws passed by the city council were also regulations *De igne*. We can learn from them that – like earlier in Kraków – also in Pilzno at least from the 1st half of the 15th century existed a general obligation to appear at the scene of a fire with ones equipment: in Pilzno apart from a pike pole and a barrel one had to bring also a ladder. The non-observance of this obligation was to be punished with a fine of a threescore of groschen.[1698] The above-mentioned regulation also included an order for everybody to keep ladders, pike poles and a large barrel of water either in front of the house or inside it; people who violated this order were to be punished with a fine of 3 groschen every time this violation was discovered.[1699] What is even more interesting is the fact that the regulations from Pilzno contained a rule that was almost identical with the one found in the Kraków laws, about rewarding the first person to appear at the scene of a fire with a barrel of water. As opposed to the regulation found in the Kraków law that was clearly directed

1698 ANK, (Wawel), Rkps dep./Dep. MS 108, p. 3.

1699 ANK, (Wawel), Rkps dep./Dep. MS 108, p. 4: *Item omnes ante domos vel in domibus habeant scalas, et aculeos similiter vas aque in vasis bonis et magnis sub pena trium grossorum quociens quas culpabilis inveniatur*. Among such instructions (however, dating from the 16th century) the following firefighting regulations should be mentioned: concerning Łowicz, dating from 1525 (StatutyŁowicz, 1998, pp. 22–23, where the Archbishop ordered besides digging a well and cleaning water in a ditch-canal "that ladders and pike poles to tear down roofs in case of fire should be in every house, and in the Town Hall; and also leather water buckets to pour water over the flames"), concerning Sandomierz, dating from the 1570s (these regulations imposed a general obligation on the inhabitants to appear at the scene of a fire with buckets, pike poles, ladders and hatchets; each owner of a plot had to have within its limits a store of water in barrels – Szczygieł 1993b, p. 80), and also concerning Chełmno: a law passed by the town council in 1590 ordered each burgher to have a long ladder and a barrel of water next to his house, otherwise he would be punished – cf. Suproniuk 2006, p. 50, footnote 136. Also Andrzej Frycz Modrzewski (Andreas Fricius Modrevius) in his treatise "De Republica emendanda [On the Improvement of the Commonwealth]" referred to the issue of fire prevention: "Every householder should keep a ladder and a pike pole or a hook on a long stick next to the house" (quoted from: SłPolXVI, vol. XXII, 1994, p. 117).

to the local water carters, the Pilzno rule did not stipulate who was to receive one ferto for the first barrel of water, 6 groschen for the second barrel and 3 groschen for the third one.[1700] Probably the same strategy was adopted in the mid-16th century in Środa in Greater Poland: in the town accounts of 21 January 1554 we read: *a ductione aque ad ignem ad braseatorium 6 gr*.[1701] Surely the same rule as in Kraków and Pilzno was shown in literature as prevailing in Chełmno in 1590, again without stating who received money from the Town Hall: 25 shillings for the first barrel, 10 for the second one and 5 for the third one.[1702]

Among models taken over by Polish towns from the European communal towns was also – although in a much less developed form than in Italian towns – organizing inhabitants into communal fire guards (fire watching teams). On the other hand, the following solution adopted e.g. in Bruges was not found in Polish towns. In 1486 in Bruges sources[1703] appeared a mention that firefighting equipment and clothes (*des utensiles et des habillements d'incendie*) were given to four monasteries from Bruges: of the Franciscans, the Dominicans, the Augustinians and the Carmelites. The mendicant friars probably got this equipment as great almoners of mediaeval town police.[1704] They were obliged to take part in extinguishing fires in towns. One barrel for carting water recorded in the inventory of the Dominican friars in Płock in 1594[1705] is not enough to draw a conclusion about their performing such a service. Bearing in mind that the town suffered serious difficulties connected with supply in water, we can assume that this barrel served the Dominicans to cart water for the needs of the monastery.

In the picture of the organization of delivering water to the scene of a fire in town described above, water carters seem the main figures, as they carted water on a daily basis also for other purposes. This obligation also applied to carters of other drinks and to people running public baths, because both the former and the latter (just like water carters) used large containers in their work that they could provide in the shortest time in case of a fire.

1700 ANK, (Wawel), Rkps dep./Dep. MS 108, p. 3v.
1701 APP, Środa I/73, p. 68.
1702 Suproniuk 2006, p. 50.
1703 InvBruges, vol. VI, 1871, p. 474.
1704 Moulin 1997, p. 211.
1705 ADKr, Pd 4, p. 137: *tunna ad deferendam aquae*.

Conclusion

The ways of providing water supply and managing it in towns described in the present work are at the same time an attempt to show social and economic relations which emerge alongside this process. This kind of a research proposition should serve the most thorough identification of a town, its function and economic possibilities, and, consequently, the level of urbanization development in the Polish lands in comparison with other parts of Europe.

The conscious need to gain water of the best quality and in sufficient quantity was visible not only in treatises, but also in the actions taken by various communities: living in one household, on one plot, in the neighbourhood, in town.

If we consider opinions about the quality of water depending on its kind, dating from the Middle Ages and from the 16th and 17th centuries, we must acknowledge that in the written sources concerning towns in the Polish lands, the information regarding the acquisition of rainwater, spring water, water from rivers and from wells is not equally well recognizable. The smallest amount of data concerns rainwater and spring water, which enjoy the highest opinion in treatises. Rainwater was much more often perceived as water carried away from the town, because its excess could cause disturbance or even a disaster in the form of a flood. Only occasionally was rainwater identified as used in the space shared by neighbours: gathered by means of gutters and drainpipes, additionally in relation to dug wells (as in Kraków), enclosed in fire canals (as in Kalisz), or collected in other reservoirs of the same function in the public space (as in Chełmno). Spring water, understood as water springing out from the ground, appears in records only as suburban and countryside intakes to water supply systems, which fact confirms the prevailing opinion about its high quality.

There is incomparably more source data concerning rivers, dug wells, and water supply systems.

One can undoubtedly notice the aim of making the fullest possible use of rivers. The fact that mediaeval towns were situated on rivers was connected to the variety of functions which rivers could perform. Their role depended primarily on accessibility. Thus, for lowland towns situated on rivers, the river was not only an artery of communication, transport and trade, a source of energy, and a place where one could easily draw water and catch fish, but it also enabled the development of crafts needing water as a material for production. This phenomenon was shown by the example of large cloth-producing towns in Western Europe, which had highly developed inner water networks created by rivers, their branches or artificial canals

and moats diverging from them. Mediaeval Wrocław enjoyed similar, decidedly favourable conditions, which is why this town became one of the convenient places in Europe for the so-called Walloon weavers to settle.

On the other hand, in upland towns (many cities in the Polish lands were situated like this), even in those which were considered to be on a river, one could observe a clear underdevelopment of craft needing water and working *intra muros*, which resulted in creating low quality products, sold in the local market at best. Together with a lack of other well-developed functions, this could decide about the low economic importance of the towns, which as a consequence could constitute one of the important elements of the weakness of urbanization in the Polish lands. Towns situated on the high bank of the river were in the least favourable situation, as they suffered a constant shortage or lack of water for every need, which was a major difficulty. In that case, the acute problem was not only drawing water from the river – directly or by means of water-work appliances (*German*: Wasserkunst), very costly in these circumstances – but also the existence of a deep-lying water-bearing layer (connected with the river) in the town itself, which rendered digging wells difficult or impossible.

Taking into particular consideration the watercourse network of Kraków, the economic significance of minor streams was shown: the main driving force of every kind of *molendinae*, and also the source of water supply for fish ponds and pools. Everywhere, managing these streams for the needs of mills and fish ponds was one of the more important signs of their owner's power, which was due to the profitability of the facilities. "Giving out water" to suburban ponds of Kraków, the king had control over the waters which were still his (apart from them, there were also "town waters" in the same territory), including water from the town moat, which did not belong to the town (unlike in other cities). In the case of the old capital of Poland, this must have resulted from equating the moat waters with those from the River Rudawa, which (as a royal leat) flowed in the 1280s in the direction of the town, firstly to the Dominicans, and shortly after its waters were let into the moats created around the town.

A closer look at the royal management of waters in the suburbs of Kraków resulted in the author's new findings concerning not only the management of these suburbs in the 15th century and in the first 30 years of the 16th century, but also the system of functioning of a network of fish ponds belonging to different owners. The condition of an efficient functioning of every reservoir of this complex (together with the royal ponds) was the correlation in time between periodical draining of certain ponds and filling up other neighbouring ponds (with the same water used as fresh), according to the prevailing technical principles. This was the

way in which the local neighbours' system of the functioning of numerous Kraków suburban fish ponds was shaped. It must have been this way also in other towns where ponds were interconnected in a similar fashion but belonged to different owners. In Kraków, this system embraced lay and clerical nobles, and also Kraków patricians. The vision of profits from the developing pond economy caused some people to undertake digging fish ponds, others to try to obtain royal grants of water rights for ponds they had already owned. For everyone this was a privilege and a proof of royal grace, and often the expression of the king's gratitude to the endowed person (e.g. to one of the bishops for his Roman missions).

In the *intra muros* space of mediaeval towns in the Polish lands, wells dug to the water-bearing layer played the most important role. The water-bearing layer decided about the presence of wells in a given place and about their depth, and thus also about the level of difficulty of digging them (this was also connected with the kind of ground), and finally about the value of the reservoirs. It was sometimes underlined in the literature that there existed a directly proportional dependence between wealth and having a private well. However, this can concern only the cases when the cost of building a well with good quality water was high. Nevertheless, there were towns, for example Wrocław, where such water was found in shallow wells that were easy to dig. In this work, having established a comparison with Western-European towns, the author strove to present all possible situations in which such reservoirs occurred depending on the depth and the quality of the water-bearing layer.

The results of the research presented here unequivocally indicate that wells dug on plots in towns in the Polish lands were mostly confirmed as connected with beer-production facilities, including wells belonging to the maltings situated there, and not to dwelling houses (e.g. in 15th-century Poznań and 16th-century Środa in Greater Poland). The functions of dug wells which are best identified in written sources were perceived as the most important ones, which also shows the fundamental significance of the bourgeois beer production among other tasks needing water and done in the inner-town space. Dug wells served as basic sources of water for this production in late-mediaeval towns famous for their high-quality beer, as e.g. in the Little Poland town of Proszowice, Nowe Miasto Korczyn, or in the Silesian Świdnica, before they were equipped with water supply systems. The present research also indicated that besides rivers it were dug wells that supplied 15th-century Poznań with water for all purposes (convincing evidence of water supply systems existing in this town date only from the end of the 15th century), and it was precisely in that period that Poznań developed from a medium-sized town into a large centre.

Due to the scarceness of sources, it is difficult to establish to what degree the importance of dug wells diminished together with establishing water supply systems in individual towns in the Polish lands, but it is worth noting that the irreparable destruction of the network in many of the towns (including Kraków) during the Swedish "Deluge" (invasion of Poland in the mid-17th century), necessarily restored their former primary role to the wells. Thus, one can put forward a proposal to conduct research on the importance of these intakes in the life of towns in the 17th–19th centuries, or even maybe in the 20th century; such a study could be based on a far more ample source material.

In the period under research in the present work, dug wells were one of the most important elements not only organizing the space and society of the town, but also integrating it, mainly in the scope of neighbourhood communities. Defining the level of the neighbours' shares in the possession of the well was connected both with the possibility of drawing water from it, and with taking care of it. This has been illustrated by instances gathered during this research relating to Kraków from the beginning of the 16th century and to Środa in Greater Poland from the middle of the 16th century as well as by the examples from 15th century Świdnica already known from literature.

Recognizing the presence of wells in the public space of towns, the author made closer studies of the Old-Kraków wells from the end of the 14th century and the beginning of the 15th century; she reconstructed, socio-topographically, their arrangement in the space *intra muros*, and drew conclusions concerning their depth based on some elements of their construction or equipment. It was calculated that there were at least 25 public dug wells functioning in the town in that period. This number places Kraków between Strasbourg and Nuremberg, considering the relation between the number of public wells and the estimated number of inhabitants, and the level of difficulty in reaching the water-bearing layer.

It was also observed that the public wells in Kraków were placed by the best situated houses in town, including those in the frontages of the main Market Square. The houses belonged to the most eminent burghers, and their names or surnames were used to describe the wells. Therefore, a hypothesis was formulated that these intakes – solid constructions reaching deeper layers of good drinking water – as the basic sources of water supply could have been earlier an inherent part of the programme of the organization of space along the frontages of the Market Square, together with the measuring of plots and their development after the introduction of the Magdeburg law in 1257. Since the authors of the programme were the oldest settlers of the town chartered with German law, and constituted its first patriciate gathered around the Market Square, it is not unlikely that the wells primarily belonged only to them as to the most

wealthy citizens, as it was in Italian towns in the early Middle Ages. These patricians of the Market Square could also create the so-called "neighbours' well communities", still existing in some Western European towns in the 15th century (e.g. in Munich).

Despite the fact that in Kraków there existed solid public wells by the houses of at least some of the members of the town authorities, it was them who made the decision to build a water supply system. Its construction can be traced in the city accounts from 1399. Among the initiators from that circle, there were mine managers (*Latin*: supparii) (acquainted with the construction methods of similar mining facilities), including Gotfryd Fattinante, a wealthy merchant, who at the same time was in charge of the town money, and lived in the brick dwelling house on the corner of Wiślna Street and the Market Square, where in 1392 one of the wells presented in this work was situated. Gotfryd must have already experienced the benefits of water supply systems in use at least from the beginning of the 13th century in his home town Genoa, and from the end of that century at the latest in Bruges, from where he might have come.

The reason earliest traceable in sources for introducing in Kraków this most accomplished form of supply in water of good quality was a growing need for it in the town. The author identified two signs of this phenomenon for the last 25 years of the 14th century, i.e. for the period directly preceding the construction of the network. The first one was digging new solid public wells (even still in the first decade of the 15th century, namely at the beginning of the network's functioning), and the second one was a twofold increase in the number of town water-carriers between 1375 and 1399, from 10 to 20, as was calculated by the present author on the basis of data taken from by-laws passed by the town authorities and from city accounts.

As regards other, also smaller, towns, the same reason most often appeared in water supply system construction permits, granted to the towns in the 16th century, which were to serve mainly people having the right to brew beer. Therefore, wells were no longer sufficient. In the case of deeper reservoirs, it was because of their insufficient number in relation to the growing population; in the case of shallow wells – judging from archaeological research – due to the impossibility of digging new wells on a limited plot together with a fast pollution of groundwater with organic and household sewage. The insufficient amount of water in wells could also be connected with the decrease of the level of groundwater caused by the digging or deepening of moats (this was, however, mainly the case in large towns). An organized distribution of water was perceived to be too costly. Thus, for the further development of towns experiencing such difficulties it was essential to introduce water supply systems; and this is the way we should understand

the expression used in introductory parts of the permits that the giver did it to "ameliorate the condition of the town". The construction of the network was to enable further economic development of the town by significantly contributing to the elimination of the problem of water shortage, i.e. one of the most decisive factors inhibiting this development. Such a conviction can be seen both among the proponents and the opponents of the undertaking. The proponents, looking forward to their own benefits from the town development, assisted in the creation of water supply systems (as e.g. the *advocatus* of Bochnia), or even financed them (as in the Sieradz starosty). The opponents, picturing an increased competitiveness of the town in relation to their own activity, created problems (as the *advocatus* of Little-Poland Pilzno or the starost of Mazovian Płock). In specific circumstances, e.g. when the town's means were too limited in comparison with the cost of construction and later upkeep of the enterprise, both attitudes could also influence the fact whether the water supply system came into being, meaning whether the "best" water flowed in conduits though the town, or whether it only remained an unrealized plan. Another problem in towns which managed to create water supply systems was the maintenance of the network's proper functioning, so that it could also be the source of the town's income. As was shown by the example of the Nowy Sącz network, it was not always successful, inter alia when the method used was unsuitable for the climatic conditions (e.g. freezing of conduits which were dug in too shallowly).

In the case of the Kraków water supply system, the written records made it possible to identify also another probable and direct reason for its creation. It was namely the aspiration of the town's elite to ameliorate their living conditions, which the people could observe or experience elsewhere. This can be testified by the fact that the elite initiated the construction of the network, and that they were later its main beneficiaries, as it follows from the oldest 15th-century permits for establishing pipe connections to private houses, and also accounts from the sale of pipes to individual customers in the 15th century and in the first half of the 16th century. The most important aim of this installation was satisfying the needs of the houses situated in the best places in town, first by means of water storage reservoirs connected to the water supply system in the town centre, which would supplement or take over the role of the above-mentioned wells, and later directly through pipe connections.

Only the growing profitability of the Kraków *braxaturae*, traceable in the accounts from 1487, which between 1524 and 1530–1531 became one of the highest incomes in town, established the next goal of the Kraków water supply system development, namely increasing the number of pipe connections to people having the right to brew beer for sale. It must be strongly underlined, however, that

as long as the patricians used water not only in the brewery but also in the house and kitchen, the payers of the *braxaturae* could only take up the amount of water needed to brew beer. The Kraków network of private pipe connections for production purposes, developed so late, and partly because of a conflict between the common people and the town authorities, could be compared to the 14th-century already well-developed networks in Lübeck, Gdańsk and Wrocław.

It was often declared that the construction and functioning of water supply systems was *pro bono publico*. Watching the history of the Kraków network, one can observe that this *public good* was actually the good of the town's patriciate. In this context, one has to think about the fact whether the lack of decorative fountains in Kraków in its golden age was the sign of the domination of the king residing at the Wawel Castle, or rather the lack of interest of the town's elite in this form of manifestation of the municipal authority. The deplorable condition of Kraków infrastructure in 1533 would rather indicate the second reason, which factors together would testify to the fact that the members of this group did not identify themselves with the town. Ensuring for themselves the most comfortable living conditions in impressive houses-residences, the German and Italian elite treated the town only as a convenient place for commerce between East and West, for activity in the neighbouring steelworks and mines, or for making profits on transactions in Kraków real estate or on their own profitable facilities, e.g. mills and fish ponds, and aimed at being ennobled and at leaving bourgeoisie.

However, an indisputable merit of the Kraków elite was promoting the Central-European pattern of water supply system construction methods, including water-works designed similarly to drainers used in mines. This was the earliest known example of such a promotion in the Kingdom of Poland of those days. However, neither the analyzed sources nor the hitherto prevailing literature presented convincing evidence for using this pattern soon also in other towns. It is not shown in the few 15th-century records of establishing water supply systems in towns. It becomes visible only from the beginning of the 16th century – at the time of the establishment of the Wawel water supply system. On the Wawel Hill however, the initiators were the Jagiellonian kings together with their advisers: King Aleksander, or maybe even Jan Olbracht (who granted the first privilege to establish a water supply system in Płock in 1498, wanting this way to acquire the town's approval), and surely King Sigismund I.

In contrast to the Wawel water supply system, the unsuccessful attempts to establish water supply systems in Kamieniec Podolski (1507) and Płock (1509–1511) could result mainly from the difficulties being too big in relation to the technical abilities of that time and/or insufficient capabilities of the master fountain-builders.

The professional knowledge of the Bohemian constructor of the Wawel installation, Jan of Dobruska, proved sufficient to such a degree that not only did he fulfil the difficult enterprise, but he also later successfully took care of it for over 40 years as the royal master fountain-builder. Besides, he must have contributed to the good opinion about Bohemians as his brothers in profession that the Polish King Sigismund I held, because during his entire reign the King consequently made use of their services to establish water supply systems in various towns, e.g. in Opatów, Wiślica, Sandomierz or Vilnius. At least in the two latter centres they were water supply systems with the water-work (Wasserkunst). Jan of Dobruska enjoyed higher social and economic position among the Kraków bourgeoisie (which stratum he entered) than other town master fountain-builders, who did not match his standing (judged mainly on the basis of economic activity of their wives). However, in other, smaller towns, constructors of water supply systems could occupy important positions in the town social hierarchies; the example of the master fountain-builder from Krosno can serve to illustrate this point. However, the high status of the brothers master fountain-builders in Sandomierz resulted primarily from the fact that they were royal master fountain-builders.

The contractors of the network were the people thanks to whom the direct transfer of techniques of the water supply system construction took place. It is, however, always worth looking also from this angle for the initiators of the investment, as was done for Kraków of the end of the 14th century. The construction of the Wawel water supply system at the beginning of the 16th century was surely witnessed by Erazm Ciołek, who shortly after, already as the Bishop of Płock, acted as manager of the project of the water supply system with the water-work in Płock (his role can be compared with that of the papal legate and Archbishop Georges d'Amboise, thanks to whom the water supply system Carville was created in Rouen in 1500). In the 1530s in Płock at another attempt to establish a network there, this role was assumed by Jan Alansee, the Kraków apothecary of the Polish Queen Bona Sforza and burgomaster of Płock, who introduced Mikołaj Łuszczek from the mining town of Bochnia as the contractor, who shortly before had been mentioned in Kraków as the town master fountain-builder. The fact that for the difficult case of the Płock construction master Łuszczek chose the "Paternosterwerk", i.e. a "chain pump", and not suction and force pumps, can testify to the lower efficiency of the latter still in the 1530s.

During this research, the presence of water-works (Wasserkunst) in Greater Poland towns documented in sources was not ascertained. It is impossible, however, to establish the reasons: was it caused by the lack of such a vision among the initiators and the absence of suitable contractors, or simply by the lack of such a need, because natural conditions did not require the construction of water-works.

The latter seems, however, less probable if we consider the example of Kościan, where in the 16th century water was carried gravitationally from sources situated at a distance from the town, and only in the end of the 18th century a water-work was installed on the neighbouring river as a complete novelty.

Besides the above-mentioned reasons, Renaissance currents and opinions played a very important role in the proliferation of water supply systems in towns in the Polish lands. The awareness of the dependence of human health on clean water used to appear and disappear from the times of Aristotle, but now became highlighted. It was clear in the Pilzno praise of water supply system from 1488, and in some of King Sigismund I's documents, which might have been written at the dictation of the King's physician, Piotr Wedelicjusz, an advocate of Hippocrates's views, including the one concerning the dependence between bad water and diseases. The matters were far worse when it came to the social understanding (also accompanying the organization of the work space) that working water supply systems should not be polluted either by their intake (by throwing organic and production sewage to the river) or along their course. However, this always resulted from the ambivalent attitude towards the problem of water pollution: canals for wastewater were built, but sewage from these canals was carried to rivers, because people believed in the purifying force of rivers.

Abbreviations

BK	Biblioteka Krakowska.
EHGP	Encyklopedia Historii Gospodarczej Polski do 1945 roku, vol. I–II, Wiedza Powszechna: Warszawa 1981.
HKM	Historia Kultury Materialnej Polski w zarysie.
IHKM	Instytut Historii Kultury Materialnej.
KAU	Kwartalnik Urbanistyki i Architektury.
KH	Kwartalnik Historyczny.
KwHKM	Kwartalnik Historii Kultury Materialnej.
MA	Materiały Archeologiczne.
MEFRM	Mélanges de l'École Française de Rome. Moyen Âge. Temps Modernes.
MMÆH	Monumenta Medii Ævi Historica. Res gestas Poloniae illustrantia.
MPH	Monumenta Poloniae Historica.
PH	Przegląd Historyczny.
PSB	Polski Słownik Biograficzny.
PWN	Państwowe Wydawnictwo Naukowe.
RK	Rocznik Krakowski.
SMHKM	Studia i Materiały z Historii Kultury Materialnej.
SRS	Scriptores Rerum Silesiacarum.
TMHiZK	Towarzystwo Miłośników Historii i Zabytków Krakowa.

AGAD RK	Archiwum Główne Akt Dawnych, Rachunki Królewskie
Dok.dep./Dep.doc.	dokument depozytowy/ deposited document
rkps dep./Dep. MS	rękopis depozytowy/ deposited manuscript

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ADKr 449 – Akta różnych sporów konwentu krakowskiego z radą miejską o grunty, kanały i domy/ Documents concerning various disputes between the Kraków convent and the town council pertaining to lands, canals and houses: 1606–1637.

Kopiariusze dominikańskie/Collections of Dominican documents: from Łuck (Łc.1), Płock (Pd 4), Przemyśl (Pm.5).

LibAnt. (K.1) – Liber Antiquitatum et intercisarum Bullarum ac Privilegiorum Regalium et Censuum Inscriptionum atque Obligationum (anno 1530).

Prothocollon (Kr.3) – Prothocollon Privilegiorum, Fundacionum, Dotacionum, Inscriptionum, Censuum, Proventuum, Villarum, Domorum, Obligationuum, Literarum, Regalium, Commisionum, Decretorum, Transactionum, Concordiarum, Inventarium, Clenodiorum, Apparamentorum, Librorum, Choralium Ecclesiae et Conventus SS. Trinitatis Fratrum Predicatorum fideliter descriptum et consignatum per fr. Arnolfum Presinum St. Teologie Magistrum anno 1648; Prothocollon – – ex Antiquiori Protocollo per olim R.A.P.M. Arnolfum-Presinium in Anno 1648 conscripto -- postea – – de Verbo ad Verbum -- transcriptum et consignatum – – anno 1700 -- per P.F. Anselmum Dorecki--.

AGAD – Archiwum Główne Akt Dawnych w Warszawie/Central Archives of Historical Records in Warsaw:

Town archives:

Płock: Płock 3 – Księga wójtowska Płocka/ Book of the *advocatus* of Płock, no. 3: years 1522–1539.

Sieradz:

SCA I – Siradiensia Civilia Advocatialia, liber I: 1432–1457.

SCC II – Siradiensia Civilia Consularia, liber II: 1465–1539.

Warta: Warta 2 – Księga ławnicza miasta Warty/ Echevin book of the town of Warta no. 2: years 1532–1559.

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ASK: Rachunki królewskie/Royal accounts: 35, 64, 67, 88, 91, 140.

Biblioteka Baworowskich/The Baworowski Library 275.

CS-LibInscr. – Castrensia Siradiensia – Libri Inscriptionum 25.

CastrSirInscr. – Castrensia Siradiensia – Libri Inscriptionum 12.

Dokument pergaminowy/ Parchment document no. 3888.

MK – Metryka Koronna/ Crown Metrica: 16–24, 33–35, 37–39, 42–44, 47–51, 58, 61, 62, 70, 90.

AKMKr., Archiwum Kurii Metropolitalnej w Krakowie/ The Archive of the Metropolitan Curia in Kraków:

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AKS – Archiwum Kapitulne w Sandomierzu/ AKS – Capitular Archives in Sandomierz:

Rkps 84 – Acta Consularia Sandomiriensia: 1500–1535.

Rkps 85 – Acta Scabinalia Sandomiriensia: 1549–64.

Rkps 86 – Acta Advocatialia Sandomiriensia: 1560–1564.

Rkps 88 – Acta Scabinalia Sandomiriensia: 1562–1575.

Rkps 90 – Acta Consularia Sandomiriensia, 1554–1560.

Rkps 91 – Acta Consularia Sandomiriensia, 1559–1561.

ANK – Archiwum Narodowe w Krakowie/ The National Archive in Kraków:

Archiwa klasztorów/ Monastic archives:

Archiwum OO. Augustianów w Krakowie/ The Archive of the Augustinian Fathers in Kraków, no. 591.

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