

THE HISTORICAL WATERFRONT REVETMENTS OF RĪGA IN THE LIGHT OF DENDROCHRONOLOGICAL DATING

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Abstract

In the course of archaeological excavations and supervision work in the historical centre of Rīga (Old Rīga), revetments built at various times along the former River Rīga or Rīdzene have so far been discovered in at least 11 sites, and revetments along the bank of the River Daugava have been found in at least three sites. The absolute age of stretches of revetment along both banks of the River Rīga (Rīdzene) and along the right bank of the River Daugava, discovered in the course of recent archaeological excavations, has been determined using the dendrochronological dating method. This article brings together the results obtained thus far in the dating of these structures. Although only some of the discovered stretches of historical waterfront have been dated, this information has given a significantly more precise picture of the building history of the waterfronts along the banks of both rivers, and thus also of the development of the historical ports of Rīga. This indicates the importance and necessity of continuing this research.

Key words: Old Rīga, River Daugava, River Rīga or Rīdzene, waterfront revetments, dendrochronological dating.

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Introduction: The waterfront revetments in Old Rīga and the importance of dating them dendrochronologically

In the central part of Rīga, the waters of rivers and canals, along with the moats of the city's defences and various ponds, formerly covered much of the area that is nowadays dry land. Most of the area that several centuries ago lay under water was in fact taken up by the now filled-in near bank zone of Latvia's largest river, the Daugava (formerly known as the Duna or Dyna and Western Dvina), as well as by the bed of a former tributary of the Daugava, the River Rīga (Rīga, Ryga, Rige, Righe or Ryge), which in the 14th and 15th century became known as the Rīdziņa or Rīdzene (Rissing, Rüssing, Rising, Rießing, Riesing or Rysing), while its upper course was referred to as the Speķupe (Speckup, Speckuppe or Speckhupe), and by the moats that were in later times (early 17th century) created in front of the earthworks (Fig.1) (Caune 1992, p.32; Miklāva, Štrauhmanis 2003; Caune 2007a, p.25; Caune 2007e, p.192; Šterns 1998, p.343).

Apart from the Daugava, the only watercourse still in existence in Old Rīga, as the historical centre of the city is known, and in its immediate environs, is the City Canal, created at the time when the defensive moats were partly filled in.

Initially, however, the most important watercourses for the residents of Rīga were the rivers Daugava and

Rīga. Archaeologists have discovered within the limits of Old Rīga the remains of two 12th-century Liv villages that covered relatively small areas. One of these was located next to the bank of the Daugava, while the other was adjacent to the lowest bend in the River Rīga (Caune 2007c, p.82). The native population, which had settled part of the naturally delimited area of land between the River Daugava and the meandering lower course of the River Rīga, was subsequently forced to make space next to the villages for a fortified settlement of German merchants and crusaders (Caune 1992, p.32). By the beginning of the 13th century, as the newly established settlement merged with the villages, the medieval town of Rīga came into being in the area between the two rivers (Caune 1985, p.38).

As the town developed, the significance of the two rivers, especially the Daugava, also increased. This is convincingly demonstrated by written sources, and by the wooden structures uncovered in the course of archaeological excavations in Old Rīga: the remains of former waterfront revetments, wharves for ships and boats, ramps leading down to the water, ships, etc. Particular facts about the construction of the former waterfronts and their practical use are mentioned by various scholars studying Rīga and its building history. This information has been brought together most comprehensively in publications by the well-known Latvian archaeologist and historian Andris Caune.

Caune mentions evidence indicating that even before the arrival of the German merchants and crusaders, the



Fig. 1. Former watercourses and archaeological sites in Old Rīga where stretches of riverbank revetment have been discovered (after A. Caune 2007e, p.193 and M. Zunde): 1 present-day watercourses; 2 former watercourses; 3 excavation areas with stretches of riverbank revetment that have not been dendrochronologically dated; 4 excavation areas with dendrochronologically dated stretches of riverbank revetment.

bend in the River Rīga next to one of the Liv villages was used as a natural harbour (Caune 1994, p.32). Along this stretch of the river, immediately upstream of its inlet into the Daugava, the River Rīga flowed along the bed of a wider former channel. Here, the river, about 50 to 55 metres wide, and about four metres deep, offered protection from the wind and waves, as well as from the ice floes on the Daugava during the spring floods, and thus provided a very suitable harbour (Caune 1992, p.47ff.; 2007e, p.195). That this wider reach of the River Rīga was navigable is indicat-

ed by the remains of three ships that were discovered on the former riverbed in 1554, 1938 and 1939 (Caune 1992, pp.67ff.; 2007f). The clearest reference to a harbour, already in 1201, which is regarded as the year when Rīga was founded, is an entry in the 13th-century ‘Chronicle of Henry of Livonia’: ... and that same year on a wide field, next to which there could be a harbour for ships, the town of Rīga was built’ (Indriķis 2001, V.1, p.60). However, the most definite proof of the former existence of two ports, on the River Rīga and the River Daugava, and of the associated waterfront

revetments, is nowadays provided by the material evidence uncovered in the course of archaeological excavations.

Archaeologists have established that in the period up to the 13th century, the rivers Rīga and Daugava were not continuously embanked next to the villages existing at that time. The first to be built were revetments along the bank of the River Rīga. This took place in the early 13th century, soon after the arrival of German traders and crusaders. Archaeological excavations have produced evidence that these were built at the same time as the town wall, or soon afterwards (Caune 2007e, p.197). Most scholars studying the historical topography and history of Rīga agree that stretches of the town wall, delimiting the area of land between the two rivers, were built along the River Rīga, as well as along the Daugava, in the period approximately from 1201 up to 1210, and that by about 1230 the town of Rīga had definitely been completely enclosed within walls (Caune 2007d, p.184; 2007e, p.198). This suggests that the earliest revetments, on the right bank of the River Rīga, might also have been created in the first decade of the 13th century.

The earliest waterfront revetments along the River Rīga served several purposes. Initially, the most important buildings in the town of Rīga, namely the first bishop's palace, the castle of the Order of Brothers of the Sword, and possibly also the first cathedral, were built very close to the River Rīga. Accordingly, the revetments were intended not only to enable boats and ships to moor, but also to facilitate the convenient loading and unloading of goods, and embarkation and disembarkation. In addition, these revetments served to protect the sandy bank of the river and the foundations of the town wall from erosion during the spring floods. Moreover, by infilling the gently sloping natural near bank zone of the river, up to the wall of piles built further out in deeper water, an additional belt of dry land was created, which could be built up or used as a space for storing goods (Caune 1994, p.32ff.). Accordingly, waterfront revetments were built along the whole length of the town wall facing the River Rīga, almost one kilometre. According to written sources, three new wharves for ships were built next to these waterfront revetments: next to the settlement of German immigrants, by the bishop's palace, and by the castle of the Order of Brothers of the Sword (Pope 2000, p.22).

Likewise serving a variety of purposes were the revetments that were subsequently built along the River Daugava. We may conclude from written evidence that work on the Daugava waterfront began in about 1297 (Von Bunge, Hildebrand 1853, No. DLXVII). The revetments along the Daugava had even greater practical

importance, which increased still further in later years. In the first place, it should be noted that during the 13th century, the River Rīga harbour began to decline in importance. For various reasons, both the cathedral and the bishop's palace were moved to new buildings erected on the bank of the Daugava in the first half of the 13th century, and the castle of the Livonian Order was also relocated there in the first half of the 14th century. Secondly, the revetments built here had to protect the town wall from floodwaters, and from the spring meltwater, which was much more rapid on the Daugava, and thus also much more dangerous and destructive, than on the River Rīga. Thirdly, it is possible that by the late 13th century, and certainly by the 14th century, the new, relatively large cargo vessels for long-distance trade began to moor along the bank of the Daugava. The port in the River Rīga was becoming too narrow, and was possibly also too shallow for convenient navigation and manoeuvring. This problem was exacerbated by the practice among the townspeople and mariners of dumping all manner of domestic rubbish into the river (Caune 1992, p.36; Pope 2000, p.28).

Although the harbour in the River Rīga began to decline in importance after the 13th century, for the reasons mentioned above, it continued to function for some centuries, mainly as a port for barges and flat-bottomed local craft, in addition to serving as a winter harbour for smaller ships and a refuge in times of military conflict (Caune 1994, p.32; Pope 2000, p.30). The latest written evidence of the use of part of the lower course of the River Rīga, then known as the Rīdzene or Rīdziņa, is preserved from 1710 (Caune 1992, p.50). By that time, the harbour itself had been very significantly reduced in extent. Mainly in order to enable boats and small ships to moor right alongside the riverbank, something that had become problematic or even impossible over the course of time, owing to the accumulation of sand and rubbish. In the period between the 13th and 18th century, new waterfronts were repeatedly built on the bed of the River Rīga, gradually advancing towards to the middle of the river, while the zone between the previous and current waterfront was filled in. Accordingly, the bed of the river progressively narrowed, until it was enclosed within a wooden canal, initially an open canal, and subsequently covered over. In this way, during the mentioned period, the River Rīga in the widest part of its course was gradually narrowed from an initial width of about 50 to 55 metres to just one to 1.5 metres (Zunde 2009).

During this period of about five centuries, just like the waterfronts along the River Rīga, the waterfronts along the Daugava within the area of the old town were also repeatedly replaced, gradually advancing further out

into the river. Of course, the much more important waterfronts along the right bank of the Daugava, i.e. next to the town centre, were created at an earlier date, and saw more frequent rebuilding work. It has been established that, up to the present day, through the continual advance of the waterfront, the width of the river channel has been reduced on the right bank alone (facing the old town) by about 65 to 70 metres (Caune 2007b, p.55).

At several locations within Old Rīga, archaeologists have succeeded in uncovering stretches of the waterfront revetments that were built in various periods, along both banks of the River Rīga (Rīdzene), and along the right bank of the Daugava. Stretches of the former revetments along the Rīdzene have been identified in at least 11 archaeological sites. Right up to the end of the 20th century, archaeologists could only provide approximate dates for the uncovered waterfront revetments. Their dating relied mainly on information about the approximate ages of the artefacts and other finds recovered from the infill dump between the previous waterfront and the new one. Apart from this, the sequential arrangement of the various stretches of waterfront revetment has been considered, in conjunction with an assessment of the structural techniques, also taking into account the information provided by written historical sources and illustrations. However, the published information was not always sufficiently detailed. For example, there are documents indicating the amounts of money allocated by Rīga town council in particular years of the 15th century to the repair or the rebuilding of the revetments along the River Rīga, but the documents do not contain precise information about the location where this work was to be undertaken.

This means that as recently as about 15 years ago, the archaeologists who had discovered the remains of historical wooden waterfront revetments in the cultural layer of Old Rīga could not answer several important questions, namely:

- Precisely when and in what sequence were the stretches of revetment built along the banks of the two rivers?
- How long did particular stretches of waterfront revetment remain in use?
- Were repairs or additional reinforcements to the revetments carried out, and if so, when?
- Are there any specific events at the corresponding time in the history of the town of Rīga, or natural events, that could have promoted or hindered the alteration of the revetments along the banks of the rivers Rīga and Daugava?

- Are there any stretches of revetment that were built in a year for which we have definite evidence that the Rīga town council provided money for such work?
- From approximately what area were the timbers for the construction of waterfront revetments supplied, i.e. where was the timber felled?

Since the time that dendrochronological dating of timber from historical wooden structures began in Latvia, it has gradually become more and more realistic and easier to answer these and similar questions of a specific nature concerning historical revetments along the banks of the rivers Rīga and Daugava. For some time now, the Dendrochronological Laboratory of the Institute of Latvian History at the University of Latvia has been undertaking this kind of work in Latvia.

So far, the laboratory has performed dendrochronological dating of revetments of the bank of the River Rīga that were uncovered in three archaeological sites in Old Rīga, and revetments along the right bank of the Daugava that were uncovered in two sites. The remaining part of this article discusses and compares the results of the dating work on the historical waterfront structures.

It should be explained from the start that because of limitations of space, no detailed description will be given of the various stretches of revetment along the River Rīga mentioned in the text. Instead they will be equated with one or another of the characteristic forms of such structures in the particular historical period. Based on written evidence and material from archaeological excavations, A. Caune (2007e) distinguishes four main periods in the history of the embankment of the River Rīga, although, in fact, one more period, a fifth, should be distinguished:

1. natural shoreline without continuous revetments (up to the 13th century);
2. the first revetments along the harbour waterfront (13th century). The sections of revetment were built of closely spaced oak piles, or oak piles placed at intervals in a row, behind which, on the landward side, a wall of unconnected horizontal oak, pine or spruce logs was built up. There was no use of additional supporting timbers of the kind known as ‘anchor timbers’;
3. revetments of the harbour waterfront (15th to 16th century). These generally consisted essentially of a wall of horizontal pine logs, reinforced on the landward side with anchor timbers, and possibly also supported on the river side by piles driven in at intervals. The timbers of the wall were generally fastened vertically by long rods passing through

- several logs along vertical recesses cut opposite one another;
4. an open canal about two to five metres wide along the former course of the River Rīdzene (17th century). Each side of the canal generally consisted of two parallel horizontal walls of planks or boards, either fastened on either side of a single row of pine piles placed at intervals, or else only on the landward side of piles of pine arranged at intervals in two rows. In the second case, horizontally arranged boards were also attached in some places on the opposite side of the piles, i.e. facing the canal.
 5. the closed Rīdzene canal, one metre wide on average (1730s). Essentially a large plank-built drain with a cover of boards that could be lifted, placed over short transverse pine logs, and supported from the sides by pine piles. In earlier times, it was visible at ground level in some places, while in other stretches, it ran underground. In 1861, at the time when the earthworks surrounding Old Rīga were demolished, it was filled in completely (Straubergs 1951, p.20).

The revetments along the right bank of the Daugava have so far not been grouped in this way, because stretches of revetment have only been uncovered in a small number of excavations, and accordingly definite types or periods of construction have not yet been distinguished. The dendrochronological dating of the revetments along the bank of the Daugava, and individual structural elements belonging to them, permits us to begin to establish a scheme of this kind. The dates obtained for the revetments and structural elements belonging to them along the banks of the River Rīga may be used to check and correct this scheme.

It should also be added that in the course of excavations, above the former bed of the River Rīga and the infill zone of the former near bank zone of the bed of the Daugava, archaeologists have uncovered timber bases of later structures, along with other kinds of structural remains. Most of these structures have also been dated precisely, but will not be discussed in this article.

Dendrochronological dating of the riverbank revetments discovered in Old Rīga and the main results obtained

The first archaeological investigations along the former channel of the River Rīga (Rīdzene) were undertaken in 1938. As has already been mentioned, at least

11 stretches of revetment have been archaeologically excavated up to the present day. At one of these sites (between Kalēju iela and 13. janvāra iela), excavations in 1970 brought to light the remains of what is thought to have been a wooden jetty, built by the natural bank of the River Rīga. This simple structure, built directly adjacent to the ancient Liv village in the bend of the river, could have served for mooring boats or ships. The remains consisted of the decayed tips of piles in two parallel rows leading from the bank out into the river. The rows of piles were separated by a distance of 1.5 metres. Some of the decayed ends of the piles were found beneath a layer of filling between the bank and the waterfront built in the early 13th century, indicating that the piles predate this structure (Caune 1992, p.52ff.). It is likely that this possible jetty, built in about the 12th century, was not the only structure of this kind adjacent to the built-up area on the bank of the River Rīga. It is possible that the inhabitants of the adjacent village could also have built such jetties by the bank of the Daugava in spring after the floods, perhaps for use during a single season, but this cannot yet be proven.

Neither this structure nor various waterfront structures along the River Rīga uncovered in later years have been dendrochronologically dated. The dendrochronological dating method began to be employed for the absolute dating of the historical waterfront revetments discovered in the cultural layer of Old Rīga only after 1990. Wood samples from archaeological excavations in Old Rīga were in fact collected for the purpose of the dendrochronological dating of wooden structures from 1969 onwards (Zagorskis 1970; Caune 2007e, p.194), but these were all lost in the early spring of 1990, along with samples from other historical wooden structures.

The three archaeological sites excavated most recently in Old Rīga after 1990, which at least partially included the former channel of the River Rīga, referred to below as the Rīdzene, along with waterfront revetments dated by dendrochronology, are: a) Teātra iela 2/4; b) the block between Kalēju iela, Teātra iela, R. Vāgnera iela and Audēju iela; and c) the block between Rīzēnes iela, 13. janvāra iela and Vaļņu iela (Fig.1). These archaeologically excavated areas in Old Rīga and the results obtained so far in the dendrochronological dating of the uncovered stretches of wooden waterfront revetment are discussed below, described in the order in which they were investigated.

In the spring of 2004, when a foundation pit was excavated for two new buildings at Teātra iela 2/4 in Rīga, the foundations of previously unknown masonry buildings were uncovered, along with the remains of some historical wooden structures. These included footings for the foundations of a masonry building, a

wooden structure of unknown function, possibly an outbuilding, and the covered wooden channel of the River Rīdzene (Tilko 2006; Zunde 2006). A total of 17 samples of pine timber were obtained from the structural elements: a) short logs placed at intervals on the ground, overlaid by a spread of tongue-and-groove planks; b) piles providing lateral support for the structure; and c) a short, straight row of piles driven in side by side along the east bank of the canal. Placed at the base of the uncovered stretch of the wooden canal were transversely arranged horizontal logs 30 to 38 centimetres in diameter, while the short, straight row of piles consisted not only of round logs, but also of logs hewn flat on two faces, and squared timbers 25 to 35 centimetres in diameter. Dendrochronological dating reveals that the timbers for the covered Rīdzene canal and the short row of piles were cut at approximately the same time, in the second half of 1734, or early in 1735 (Zunde 2006). The date corresponds with the evidence in historical sources indicating that construction of the covered Rīdzene canal began in the town in 1733 (Caune 2007e, p.192; 2007f, p.209).

The area at Teātra iela 2/4 where construction was planned had formerly been traversed by the bank of the open channel of the Rīdzene, and possibly also by the latest waterfront. It seems that these stretches of waterfront structures were demolished in the course of later construction work, or else they remain undiscovered in the deeper part of the cultural layer, which has not been excavated. Thus, for example, the structure of a possible outbuilding, discovered some metres from the covered Rīdzene canal, incorporated not only piles made from spruce trees felled in 1741–1742, but also three piles of pine wood of greater diameter (30 to 37 centimetres), with two faces hewn flat. The relatively early date of the outer rings of these piles, preserved on the round sides (1607), is essentially identical to a date obtained for at least a couple of timbers from a stretch of the wall of the Rīdzene waterfront discovered in 2005 near Audēju iela in Rīga (see below). Did these three piles used for the outbuilding come from the timbers of the former waterfront revetment? Archaeological excavations have demonstrated that wood can be preserved in anaerobic conditions even for several centuries.

In 2005, archaeological supervision was conducted in the block between Kalēju iela, Teātra iela, R. Vāgnera iela and Audēju iela, very close to the site described above. Here, in an excavated area of 1780 square metres, archaeologists uncovered stretches of both the right-bank and left-bank revetments of the Rīdzene (Lūsēns 2009). Along the left bank of the former river channel they uncovered what were apparently stretches of the four oldest revetments. The oldest stretch of revetment consisted mainly of shallow, relatively short

pine piles without pointed ends, dug in at a relatively shallow depth (20 to 30 centimetres). Several of these timbers had a recess cut near the end, such as were formerly cut in the side logs of rafts for the purpose of fastening the logs together. In the course of archaeological excavations, it was established that this structure had been built above a cultural layer that contained manure, woodchips and bark, along with several sherds of pottery deriving from glazed tripod cooking vessels (Lūsēns 2009, p.75). Knowing that the earliest revetments built along the River Rīdzene, as discovered in all other sites, had oak piles driven into the ground, side by side or at intervals, it seems doubtful that this structure actually belonged to one of the earliest historical waterfront revetments.

Dendrochronological dating carried out by the author (Zunde 2010) indicated that the structure had probably been built contemporaneously with the next wooden structure, located further out towards the middle of the channel, which was considered at the time of the excavations to be a stretch of the second phase of the waterfront revetment. In terms of its construction, this resembled the previously discovered stretches of 15th and 16th-century waterfront revetments.

However, so far it has not been possible to establish the precise time of construction of the two wooden structures by using dendrochronology. The dates of the last, i.e. the youngest, ring for individual timbers of the two structures, chosen for dating because the wood was better preserved, were different in almost all cases. For example, the dates of the last rings of two timbers from the first structure are 1498 and 1523, while timbers of the second structure gave dates of 1426, 1498 and 1504. Thus, it has so far not been established in which year timber was felled in a large quantity specifically for the construction of a particular structure. However, the provisional results of dendrochronological dating do at least confirm that the first of the two wooden structures cannot be regarded as a stretch of the oldest waterfront along the left bank of the Rīdzene. It seems unlikely that this stretch of the left bank could have been reinforced for the first time in the late 15th or even the early 16th century, since it has repeatedly been established in other sites that the earliest revetments along both banks were built in the 13th century, and moreover that oak piles driven into the ground were used for this purpose (Apinis 1939, pp.5ff.; Caune 2007e, pp.197ff.).

The next revetment along the left bank of the Rīdzene was built closer to the middle of the channel, at a distance of five to 5.5 metres from the previous waterfront (Lūsēns 2009, p.76). A more solid structure than the previous ones, in terms of construction, this stretch of

revetment resembled the previously discovered 15th and 16th-century revetments. Five wood samples for dendrochronological dating were obtained from the timbers of the uncovered river wall. The outer part of the sapwood of these logs had seriously decayed, or had been destroyed completely, in consequence of which the absolute dates of the outer ring varied between the timbers. Thus, the last rings on these five logs had formed in 1554, 1552, 1512, 1546 and 1551. These dates indicate that the revetments were built in about 1554 to 1556. This date is confirmed by the absolute age determined for the timber footing of a building foundation. This was built on top of the infill on the newly reclaimed belt of land, more than five metres wide, in about 1557, i.e. very soon after the construction of the waterfront described above.

The youngest stretch of left-bank revetment of the Rīdzene uncovered in the 2005 excavations was located behind the structure described above, some three metres further towards the middle of the channel. In terms of construction, this structure also corresponded to the forms of 15th and 16th-century waterfront described by Caune. Characteristically, the timbers of the river wall, 30 to 45 centimetres in diameter, had been carefully joined together not only in a vertical direction, but also horizontally (with dovetail joints). It should be added that a smaller structure, designed to retain the filling, not structurally connected with the timbers of the waterfront, but presumably contemporaneous with it, was found within the filling on the landward side of the waterfront.

Wood samples were obtained for dating only from the timbers of the main revetment structure: three pine timbers from the log structure of the wall, and four anchor timbers, one of which was pine, the other three being spruce. So far, it has been possible to date four logs from the river wall, as well as the sole pine anchor timber. It has been established that the last preserved rings of the dated wall timbers were formed in 1649, 1645, 1648 and 1648, while the outer ring of the anchor timber probably corresponds to 1606. It is possible that the anchor timber has been re-used, or else the sampled part of the timber has lost a four to eight-millimetre-thick outer layer of sapwood, with about 40 very narrow rings. However, the date of the wall timbers indicates felling in the winter of 1649/1650. This revetment was probably built a couple of years later, i.e. in 1651 or even 1652, a hypothesis suggested by the comparison of tree-ring series and absolute chronologies for various geographical regions. This indicates that the structure was made of timber probably felled in the Dnieper basin, rather than the Daugava basin. In this case, the timber would have taken some

time to arrive in Rīga, approximately two years (Dunsdorfs 1973, p.478ff.).

In the course of the archaeological supervision work in 2005, several stretches of revetment from various times were also discovered that belonged to the right-bank waterfront of the Rīdzene. Uncovered closest to the original riverbank were the remains of a waterfront structure, the upper part of which came to light about three metres from the present-day street Kalēju iela. This structure consisted of two parallel log in walls. Part of the wall, at least two logs high, was exposed, but its continuation deeper in the cultural layer was not traced (Lūsēns 2009, p.77). This was initially regarded as a stretch of revetment of the right bank of the river, perhaps the earliest one, but because no wood samples were obtained from this partially exposed timber structure at the time of excavation, this hypothesis could not be verified by dendrochronological analysis.

The remains of what in chronological terms represents the next stretch of revetment after the one described above were discovered about five metres closer to the middle of the former channel. Only a very short fragment of a wall of horizontal logs was preserved within the excavated area, along with an anchor timber fixed within it at an oblique angle, and in this case, too, it was possible to record archaeologically only the upper part, uncovered from above (Lūsēns 2009, p.78). The anchor timber that was discovered could indicate that the structure corresponds to one of the forms of 15th or 16th-century waterfront revetment, but because of the absence of wood samples, the date of this structure could neither be dendrochronologically verified nor established more precisely.

The next riverbank revetment, the third one, counting in the direction of the middle of the channel, had narrowed the river channel by 12.5 to 13 metres in the excavated area (Lūsēns, 2009, p.78). Within this area, archaeologists were able to uncover three contemporaneously built stretches of the revetment from this time. In addition, three logs were uncovered from a separate short wall connecting the middle stretch of the wall with the one closest to Teātra iela. At the end of the revetment closest to Teātra iela, adjoining the connecting section, there was another wall attached perpendicular to the waterfront, the lateral wall of a ramp. Accordingly, archaeologists drew the logical conclusion that the above-mentioned connecting section had been built to close up the wall at a later time, when the ramp was no longer in use.

Judging from the relatively large dimensions of the horizontal logs of the uncovered river wall, and the manner in which they were joined, the whole structure seemed to correspond to the forms of 15th and

16th-century riverbank revetment that had previously been discovered, but unlike these, the wall only had supporting piles on either side, i.e. it lacked anchor timbers.

For the purpose of dendrochronological dating, a total of 16 samples of pine timber were obtained from all three stretches of this revetment structure (eight samples from the horizontal logs of the wall, and another eight from piles). A further three samples of pine timber were obtained from the logs of the probable closing wall of the ramp. It should be noted that most of the revetment logs were 38 to 40 centimetres in diameter, and had been hewn flat on two sides. The thickest of the dated logs of the closing wall of the ramp had a diameter of 56 centimetres, while a second log had a diameter of 47 centimetres. The dated piles had a relatively smaller diameter at the sampling location, between 27 and 36 centimetres.

The results of dendrochronological dating indicate that the last tree-ring of most of the timbers used for this right-bank revetment of the Rīdzene had formed in 1581. The timber was probably cut in the winter of 1581/1582, and the waterfront built in 1582 at the earliest. It has been established that the timber was cut that winter not only for this particular ramp, but also for the lateral wall of another ramp, discovered closer to present-day Audēju iela. However, some timbers of a later date were also found in the stretches of riverbank revetment. No such timbers had been used for the stretch of revetment closest to Teātra iela, but each of the remaining three stretches, including the section closing off the place of the ramp, included at least one log whose last ring had formed in 1587. At least two of the timbers incorporated into the stretch of revetment next to present-day Audēju iela had also been felled at a later date (1606 and 1607), and the middle stretch of the revetment, as well as the section closing the place of the ramp, were each found to include a log whose last ring had formed only in 1630. Evidently, the later dates indicate three occasions when timbers were added or replaced. This was probably necessary following damage to the revetment structure from the spring ice. However, there remains the unanswered question as to why the piles reinforcing the structure on the river side are made of timber obtained earlier, in the early 1580s, compared with several logs of the wall. It would seem that the piles should have sustained more damage from flowing ice, and accordingly should have been the first to be replaced. It should be noted that one of the piles supporting the wall closing off the place of the ramp was timber felled at this same time (1581). However, the oldest horizontal log of this structure was possibly taken from a different stretch of the revetment, since the last ring of this log formed in 1587, i.e. more than

40 years earlier than the youngest log identified in this structure (dated to 1630).

The last of the timber structures uncovered in the excavation area and dendrochronologically dated relates to the final phase in the existence of the Rīdzene open canal.

Samples for dating were obtained from seven piles with the best-preserved outer layer of wood. At the sampling location, the piles were approximately 27 to 35 centimetres in diameter. However, the last (i.e. the latest) tree-rings of most of the dated piles were no longer present. Accordingly, the date of the outermost preserved ring was different for almost every pile: 1665, 1666, 1680, 1685, 1687 and 1689 (the last date being determined for the last ring of two piles). These results indicate that the uncovered stretch of the right-bank revetment of the open canal of the Rīdzene was probably built in 1690.

Discovered at the very northeast edge of the excavation area within the foundation pit, facing Rīdzenes iela (actually beyond the limits of the area), was a short stretch of the remains of the covered Rīdzene canal. Since this structure was not uncovered to a greater depth, the timbers were not sampled for dating. The remains of this canal had previously been archaeologically excavated and dendrochronologically dated (see above on the site at Teātra iela 2/4).

The revetments along the Rīdzene discovered most recently in 2009 were located in the area of Old Rīga between Rīdzenes iela, 13. janvāra iela and Vaļņu iela, where a new hotel is currently being built. On this site, the cultural layer had been partially investigated in 1938, when a foundation pit was dug in approximately the same area for the Postal Savings Bank building that was planned at the time. Because of the Second World War, construction was interrupted, and did not resume after the change of political regime.

In the course of archaeological supervision in 2009, in addition to wooden piles from before the war intended to support the foundations of the planned Postal Savings Bank building, some short stretches of the Rīdzene waterfront revetment that had previously been only partially unearthed or had not been excavated at all were identified and recorded. These remained only in certain places along the edges of the foundation pit. Dendrochronological dating was carried out, with the aim of identifying and dating these structural remains more precisely. For this purpose, the archaeologists took a total of 179 wood samples from the uncovered structural timbers.

Thirteen of these samples were obtained from oak piles, which had been driven in side by side in a single

row, an indication that they could indeed derive from the earliest revetment structure along the left bank of the Rīdzene. The results of dendrochronological dating, confirmed by the Lithuanian dendrochronologist Adomas Vitas (A. Vitas 2014, personal communication), indicate that the outermost ring of most of the nine dated piles was probably formed in 1388. Two of the dated piles had been driven in later: their outermost rings were formed in 1406 and 1407. These figures have so far not been confirmed, because it is possible to compare the tree-ring data series for the piles only with a small number of absolute reference chronologies for oak, and perhaps for this reason the similarity of the tree-ring series in the presumed synchronous arrangement was not very pronounced. However, if these dates are correct, then we may conclude that the row of piles discovered here probably does not belong to an original part of the first revetment along the bank of the Rīdzene, but rather to a rebuilt stretch.

At the time of the archaeological excavations, several piles, as well as a block of wood chopped from a pine trunk with a biological age of at least 245 years, were considered as belonging to the second waterfront along the left bank of the Rīdzene. In the cases of four out of five of the piles, which included samples from pine and spruce, the number of rings was too small to permit dating. The outermost preserved ring of the fifth pile, made of pine, and the block, were dated to 1617 and 1619 respectively. This date seems rather too late for the second waterfront of the Rīdzene.

A total of 15 wood samples were obtained from the timbers of a short row of piles that was initially regarded as belonging to the third phase of the waterfront revetment. One was spruce, and all the rest were pine. So far, 11 timbers have been dated absolutely: in five cases, the youngest preserved ring was formed in 1595, in five more cases it dates from 1596, and in one case it is from 1578. Disregarding the date of the outermost ring of the last-mentioned timber, we may confidently conclude that the structure was built in about 1596 or 1597.

Also possibly connected with waterfront revetments are the remains of two further structures. The first of these consists of three piles arranged in a row, the orientation of which suggests they could be the remains of the wall of a ramp. Dendrochronological analysis could not confirm this hypothesis, because the piles had an insufficient number of rings (varying from 18 to 32). Secondly, archaeologists completely uncovered stretches three to four metres long of two rows of piles arranged perpendicularly and joined together; these may possibly be regarded together as representing part of the join of the left-bank river wall and the wall of

a ramp. For the purpose of dating, 29 wood samples were taken from both rows of piles: 16 spruce piles, and 13 pine piles.

The outermost ring of most of the 12 pine piles that could be dated absolutely, belonging to the row parallel to the former river channel, formed in 1672, while the outer ring of one pile was dated to 1671. This means that the row of piles was probably built in about 1673. It could be that the row of piles perpendicular to the channel, possibly serving as the lateral wall of the ramp, was built five years later. This is suggested by the provisional date (1677) of seven spruce piles in this row. It should be noted that because of the lack of absolute chronologies for spruce, required for dating the tree-ring series, the date cannot yet be confirmed.

Groups of piles were discovered in the foundation pit beneath the remains of buildings that had served as footings for the building foundations, but the dates of these will not be discussed in this paper.

Revetments were also discovered for the first time in Old Rīga in the first half of the 20th century (the excavations were undertaken in 1938 and 1939) along the bank of the Daugava. Archaeological investigations were undertaken in the foundation pit of a building planned in the area between 11. novembra krastmala, Kaļķu iela, Rātslaukums and Grēcinieku iela. At that time, box structures built of piles and horizontal logs, and filled with unworked stone, were discovered running parallel to the bank of the Daugava, at a depth of about 3.5 metres in the cultural layer. Presumably, this structure had served to reinforce the riverbank revetment against the pressure of water and ice in the Daugava. At the time it was discovered, the structure was described as 'very old' (Apinis 1939, p.8), but not even an approximate date could be assigned.

The first stretch of revetment along the River Daugava to be dendrochronologically dated was actually discovered outside Old Rīga. The remains were uncovered in the spring of 1997 at the junction of Eksporta iela and Katrīnas iela, where underground utilities were being improved. The site lies about 400 metres from the present line of the right bank of the Daugava. It should be noted that the present-day bank of the Daugava corresponds to the western margin of a group of islands that formed in the 19th century, out of what had previously been a shoal in the river. This feature, which became Andrejsala or 'Andrew's Island', has long-since been joined with the former bank of the Daugava, so that it is actually a peninsula rather than an island.

The stretch of the former waterfront consisted of two walls of horizontal logs, supported on the side facing the Daugava by piles up to 40 centimetres in diameter,

placed at intervals in two rows. This double wall of logs was reinforced on the landward side by anchor timbers weighed down by the infill. Sherds of pottery and a coin of the Russian Empire dated to 1721–1724, found next to the wall in the very mixed cultural layer, indicated that the timber revetment structure may date from the first half or the middle of the 18th century.

Twelve wood samples were taken for dendrochronological dating: seven from the piles, and five from the horizontal logs. The tree-ring series for all seven piles could be synchronised, but synchronisation was possible for only two of the tree-ring series for the horizontal logs. Two of the dated piles still had all of their outer rings, and the outermost ring formed in 1745. Depending on the number of outer rings that have been lost, the outermost surviving rings of the remaining five piles have been given slightly earlier dates. Presumably, the two dated logs were replacement timbers: the preserved outer rings were probably formed in 1749 and 1750. Based on the similarity statistics of the ring-width series for the piles in relation to absolute chronologies for various geographical regions, it has been established that the structures were probably built of timber supplied from the area of present-day Belarus.

Dendrochronological dating of the timbers of historical waterfronts was undertaken for the second time after 2000. That year saw the most extensive excavation to date in the area of the former waterfronts of the Daugava. It was undertaken in the area between the end of Bīskapa gāte, the end of Jauniela and 11. novembra krastmala, where a multi-storey car park was originally planned (Lūsēns 2002, p.111). When the foundation pit for the car park was dug, covering an area of 3,000 square metres, the lower part of the 18th-century Triangle Bastion, part of the town's defences, was uncovered, along with the remains of revetments along the right bank of the Daugava built at various times (Fig. 2). As in the case of the former course of the Rīdzene, in each successive phase, the Daugava waterfront was placed further out from the bank (and thus also further from the Old Town of Rīga), and in the excavated area alone these waterfronts occupied a 40-metre-wide belt along the right bank of the river.

Altogether, archaeologists discovered stretches of six phases of revetment structures along the right bank of the Daugava, relating to different periods. All of the revetments discovered in the excavated area were log structures, consisting of timbers placed horizontally one above the other, and fixed together in a vertical direction. The earliest of the uncovered waterfronts, dated to the late 14th or early 15th century, had been reinforced only by means of anchor timbers buried in the infill layer, while the next (15th century) river

wall had anchor timbers on the landward side that had been placed in a fan-shaped arrangement and joined together. Starting from the 16th century, the river walls along the right bank of the Daugava in this area were supported not only by anchor timbers, but also by piles driven in at intervals along the wall. Initially, they were placed only on the riverward side, but the wall dating from the turn of the 17th century had been additionally reinforced with piles placed at greater intervals (every 3.5 to seven metres) on the landward side as well. A lateral wall of a heavy ramp structure was regarded by archaeologists as relating to the next right-bank waterfront, built in the mid-17th century. The waterfront revetment itself was not uncovered, since this was located outside the excavated area, to the west of the foundation pit, i.e. further out in the Daugava channel. The wall of the ramp consisted of three pine logs almost 60 centimetres in diameter, with hewn upper and lower faces. The logs were supported one over the other by means of piles driven in at intervals on the side facing the ramp, and by a simple arrangement of fairly short anchor logs. They were additionally fixed in place vertically by means of oak pegs passing through them.

Finally, at the very western side of the foundation pit, archaeologists discovered one more waterfront fragment, younger than the others uncovered in this area. This was the easternmost part of a structure built on the landward side of the river wall to reinforce it, consisting not of anchor logs and struts, but incorporating irregular-shaped box structures consisting of one or a few layers of horizontal logs joined together. These box structures, like the 'very old' ones discovered in 1938 (Apinis 1939, p.8), had been filled with fairly large boulders, along with building rubble and sand. Based on the finds in the adjacent cultural layer, the structure was dated by archaeologists to approximately the late 17th or early 18th century.

The rather approximate dates for the stretches of revetment described above were subsequently verified dendrochronologically, obtaining more precise dates (Zunde 2003).

Discs of wood cut as samples for dendrochronological dating were obtained from a total of 71 logs that had a relatively well-preserved outer wood layer, all of them from five revetments. No samples were taken from the oldest stretch of revetment discovered in the excavation, which had been partially revealed at the very edge of the foundation pit on the side facing the Old Town, and was not sufficiently exposed for lack of time and other reasons.

So far, absolute dates have been obtained for 59 timbers, belonging to five waterfront phases.

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Fig. 2. A view of the stretches of right-bank revetments of the Daugava uncovered in 2000 (photograph by M. Zunde).

The second-oldest stretch of revetment (15th century) was probably built in 1497. There are nine dated timbers from this structure, as well as one timber subsequently re-used in the revetment of the next phase. It has been established that the outer rings of four of the ten dated timbers formed in 1496, one formed in 1497, one in 1494, and a further four gave dates a few years earlier (datings explicable in terms of the loss of the youngest rings).

The absolute age of the third successive right-bank revetment of the Daugava uncovered in this foundation pit has been determined by the dating of 17 timbers from this structure. In almost all cases, the outermost, youngest preserved ring formed in the period 1509 to 1514; with only one timber with a relatively younger outermost ring, which in this case formed in 1518. There are grounds for considering that the wood for this waterfront was cut in the winter of 1514/1515, because the last rings of six of the timbers had formed the same year, 1514. (It should be added that the same date was obtained for one of the timbers from the next of the discovered waterfronts, i.e. the fourth one.)

Two more logs were uncovered above the logs of this structure. Dendrochronological dating indicates that they are not directly connected with the structure, and were evidently placed there at a later time. The last rings of these two timbers formed in 1546 and 1547. Timber felled at such a late date was not used even in the next, i.e. fourth, phase of the waterfront.

From this next phase, the fourth waterfront structure, there is a total of 12 dated timbers. With the exception of one log, which may have been re-used, since it gave a date of 1514, as mentioned above, the outer rings of all the other timbers formed during the period 1521 to 1542. The outermost rings of five of these timbers were found to have formed at almost the same time (1541 and 1542), while the rest gave dates some years earlier, probably due to the loss of the outer rings.

The wall of the ramp, regarded by archaeologists as relating to the time of the construction of the fifth phase of the waterfront, was built around 1596. This is indicated by the dating of the logs of the wall and the piles supporting it. The outermost preserved rings of all ten dated timbers from the wall of the ramp formed in the period 1591 to 1596. In the majority of cases (seven), the last ring formed in 1594 or 1595. It is concluded that the timber for this structure was felled mainly in 1595, possibly also in the winter of 1595/1596. The date obtained for one of the timbers (1596) indirectly confirms that the structure was probably built in 1596.

The sixth of the right-bank revetments of the Daugava, the youngest one of those discovered in 2000, of which

only a stretch of the supporting box structure was uncovered, was built more than 50 years later than those described above, in about 1650 or 1651. It has been established that the last preserved rings of six timbers from this structure formed in the period 1645 to 1650. Two further timbers, possibly not directly related to the structure, gave different dates for the final ring, 1614 and 1679 respectively. It could be that the first of these timbers is missing a large number of outer rings, or else the tree was felled and used earlier. The second of these timbers could have been used in later repairs to the structure, or for additional reinforcement.

Conclusions

Compared with the total number of stretches of historical waterfront structures of the rivers Rīdzene and Daugava from various periods that have actually been discovered, the number of structures definitively dated by dendrochronology is not very large, but the precise definitive dates obtained already permit us to expand on and refine the earlier conclusions regarding the waterfront revetments uncovered in Old Rīga (Fig. 3). Although the character of the revetment structures along the bank of the Rīdzene changed over the course of time, as outlined in the short descriptions that supplement the list of forms of historical waterfronts compiled by A. Caune (see above), the actual time of construction of a stretch of waterfront does not actually in all cases correspond to the period indicated in this description. We may conclude from the precise dating obtained so far for the stretches of revetment along the bank of the Rīdzene that the discrepancies may be explained by the fact that from the 15th century onwards, the construction of waterfronts along both banks did not take place simultaneously, or even closely follow one another, but rather was undertaken alternately, with interruptions of ten to 15 years. However, in the period from at least the 15th to the 18th century, we cannot identify any period lasting decades during which the waterfronts along the Rīdzene were not either built anew or repaired. For example, even in the mid-17th century, the period before the creation of the open canal of the Rīdzene, revetments were still being built along the banks, something that was not clearly known before. Evidently, distinguishing definite periods in the construction of the waterfronts of the Rīdzene, without additional information about the precise time of construction of the stretches of waterfront, is not a simple task.

The results of the dendrochronological dating undertaken so far have permitted the identification of several periods when the rebuilding of revetments also took place along the bank of the Daugava. In addition, it

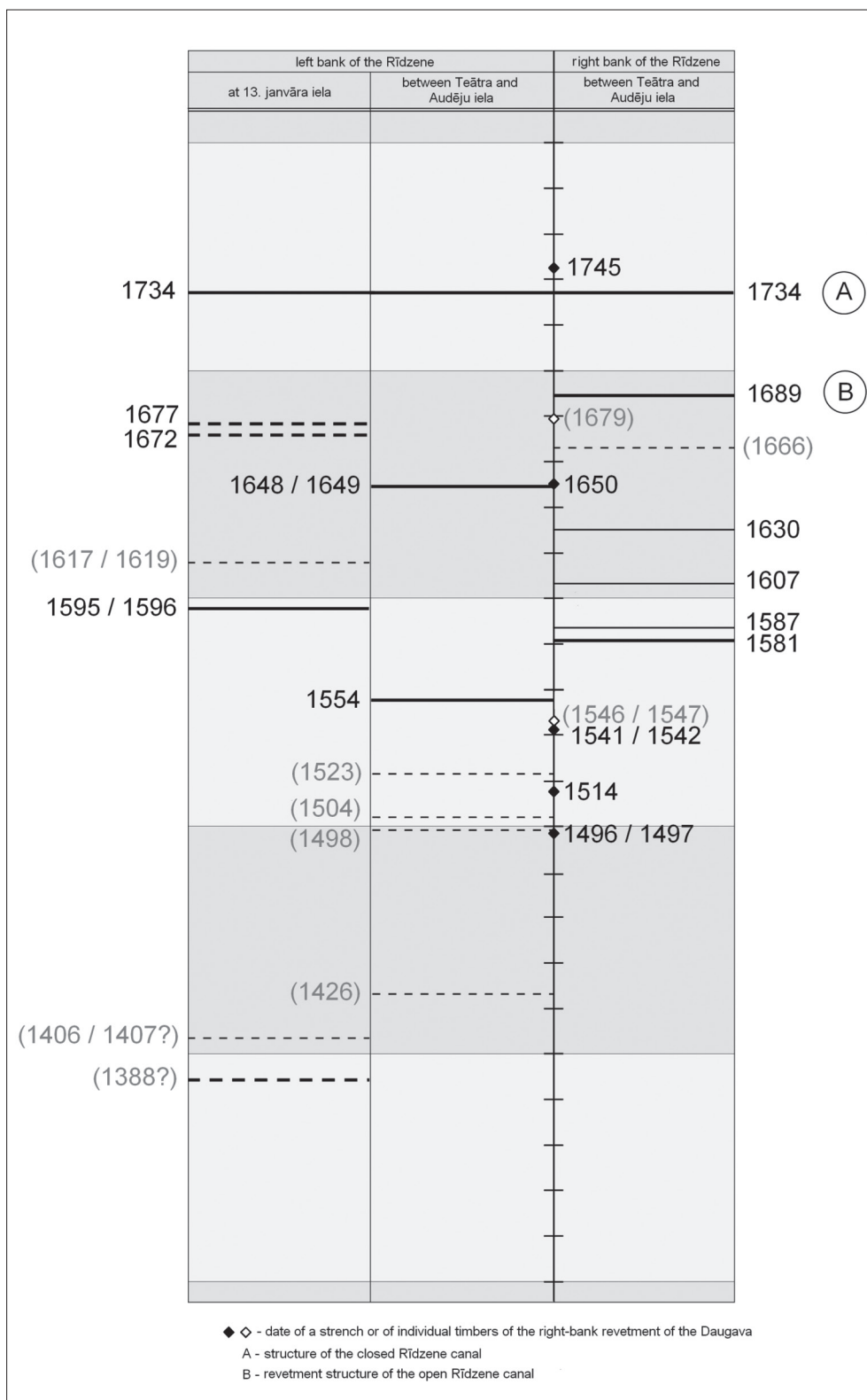


Fig. 3. A graphic comparison of historical riverbank revetments discovered in Old Rīga, and the dendrochronological dates of timbers from these structures (compiled by M. Zunde).

has been established that up to approximately the 15th century, mainly timber of local origin was used for this purpose, whereas in later centuries most of the required timber was floated down the Daugava, mainly from the basin of the upper course of the river and the area of present-day Belarus. This conclusion corresponds very well with the ideas put forward by the historian V. Pāvulāne (1975, p.63), based on written historical sources.

Thus, it has to be admitted that the accurate determination of the sequence of construction of riverbank revetments was hampered by a significant lack of information regarding the precise age of particular stretches and structural elements, which had been discovered but for objective reasons had previously not been dated. The information obtained thus far concerning the date of the uncovered waterfronts can be regarded as very fragmentary. In particular, we lack physical evidence of the earliest waterfronts, built prior to the mid-15th century. Concerning this particular period, there is written evidence allowing us to characterise the driving of piles along the banks of the Rīdzene and Daugava as a fairly frequent and also continuous process, in some cases lasting more than a decade (Straubergs [s.a.], p.21). Because such information has been lacking, it has so far not been possible to verify the written evidence indicating the intensive building of waterfronts, or to locate precisely the place to which this evidence relates.

It is hoped that the remains of historical waterfronts will continue to be discovered in the cultural layer of Old Rīga. The results of research undertaken so far demonstrate that the determination of the precise age of these structures, supplementing current knowledge, will make it possible in future not only to trace much more precisely and objectively the history of the former waterfront and port structures on the Rīdzene and Daugava, but also in this way to contribute to our knowledge of the general history of the urban development of Rīga.

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RYGOS ISTORINĒS KRANTINĒS DENDROCHRONOLOGIŅŪ TYRIMŪ DUOMENIMIS

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Santrauka

Rygos senamiesčio teritorijoje (Rīdzene), abipus Dauguvos upės, šiuo metu yra žinoma 11 senųjų krantinių, o palei dešinią Dauguvos upės krantą – dar trys. Medinės krantinės buvo aptiktos archeologinių tyrimų metu. Dendrochronologinių tyrimų metodu jos datuotos XV–XVII amžiais (1–3 pav.). Šie tyrimai padėjo nustatyti krantinių egzistavimo laiką, taip pat Rygos uosto raidą. Šiuo metu turimi archeologiniai ir dendrochronologiniai duomenys rodo, kad ankstyviausios Rygos senamiesčio teritorijoje aptiktos krantinės buvo statomos jau XV a. viduryje. Dendrochronologinių tyrimų duomenys buvo susieti su istoriniais rašytiniais šaltiniais. Su jų pagalba buvo nustatyta, kad mediena uosto ir Rygos senamiesčio krantinių sutvirtinimų statybai buvo atplukdyta Dauguvos upe iš jos aukštupio. Dendrochronologiniams medienos tyrimams buvo naudoti 179 mėginiai. Ankstyviausių statyboms naudotų medienos rievių susidarymo laikas fiksuojamas 1388 m. Tai yra metai, kai medis buvo nupjautas ir vėliau naudotas krantinių statybai.