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CARGO ON WHEELS – MEDIEVAL CART COMPONENTS FROM GRANARY ISLAND, GDAŃSK

ABSTRACT

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This text discusses the remains of a late medieval cart with a partial cargo recovered on Granary Island during the 2024 excavation, along with their historical context. The wooden components found have been technically described and compared to the limited archaeological database. They are furthermore considered in the context of the construction details of other medieval carts. The discovery is dated to the beginning of the 15th century, based on artefacts found in layers containing the cart fragments and supported by ^{14}C analysis. The construction of the cart has been analysed with the aid of historical depictions from the period and undertaken in the spatial and functional context of the Granary Island. Although the formal constraints on the investigation limit the interpretation, the discovery is considered unique in Europe.

Keywords: archaeology, medieval, carts, wheels, Gdańsk
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INTRODUCTION

As a result of archaeological research in 2024 conducted on Granary Island in Gdańsk, elements of a wooden cart from the late medieval period were discovered. The find is unique on the European scale due to the recovery of large quantities of elements related to the construction of the cart, as well as its partial cargo. An additional feature of the find is its context, being found on Granary Island, a late medieval storage area.

ARCHAEOLOGICAL CONTEXT

The cart components were discovered during archaeological excavations on Granary Island in Gdańsk in 2024. The research was carried out in the area of the plots on today's Chmielna and Spichrzowa Streets within the historical plots of 1-4 Judengasse (Fig. 1).

The research carried out in 2024 was a continuation of the excavations undertaken in 2006 and 2007 by the Archaeological Museum in Gdańsk. A major issue affecting the possibility of a more complete interpretation of the find is the degradation of the site during the period 2008-2022, when rubbish was illegally dumped in the area, and the site was overgrown with lush vegetation. The re-clearing of the site has significantly constricted the opportunity to trace the continuation of the historic land use. In addition, previous archaeological work has been carried out partly down to the undisturbed soil level, thus detaching a small part of the 2024 study area from the broader context. The collaborative

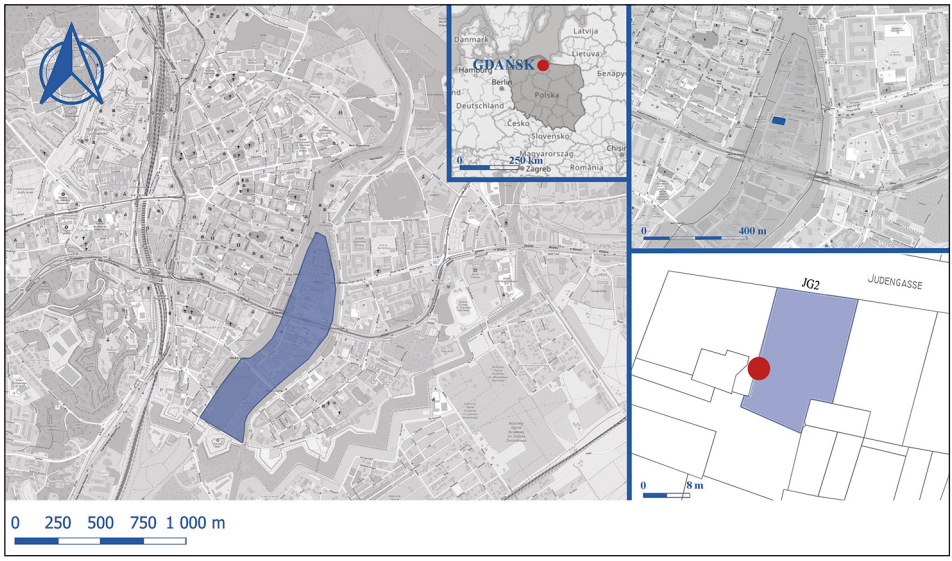

Fig. 1. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. Site location

effort to assemble data from the two seasons (2006 and 2024) enabled some of the information to be merged. However, due to site degradation, not all the data could be integrated. Because of these interpretational limits, detailed documentation of the find, its context, and additional analyses were undertaken to confirm its chronology and the nature of the raw materials used in its manufacture.

The components of the cart and probable cargo (construction: K115) were discovered in an area of approximately 8m² at the back of the historical plot Judengasse 2, about 15 metres from the contemporary line of Spichrzowa Street (Figs 1-3). The wooden elements

Fig. 2. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets:
1-2 – Cart components *in situ*, 3 – Wheel 1, 4 – Wheel 2. Photo: T. Widerski, J. Dąbal

were unearthed beneath the building layer (No. 168), from which the 2024 exploration began. The extent of the exploration on the south side was limited by the test trench from the 2006/2007 season, to the north its extent was determined by the area explored to the undisturbed soil in the previous excavations, to the west by the course of the wall (M86) and to the east by the continuation of the test trench from the 2006/2007 excavations. Elements were recorded at depths ranging from approximately 0.2 m to approximately

Fig. 3. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets.
1 – Cart components *in situ*. Photo J. Prager; 2 – Bodyshell plank. Photo: J. Dąbal

0.64 m below sea level. The surface was more than 0.6 m above the undisturbed soil layer (No. 173), which is homogenous peat (-1.27 m ASL). The excavations were held under challenging conditions in a waterlogged terrain.

Three layers were identified as the proximate context of the discovered timber elements:

1. A dark grey layer, 13 to 20 cm thick, of fine to medium-grained sands with inclusions of fine charcoal and organics, within which elements of the vehicle structure were embedded (Layer 170);

2. A deteriorated functional layer in the context of the structure visible only behind the main extent of the structure in the form of a level of wood shavings approximately 5-7 cm thick (Layer 169),

3. A dark brown layer containing a large amount of shavings, fine sand and other organic components, including a lot of offcuts and small wooden elements, the accumulation of which was noted around and above the elements of the structure (Layer 171). This last layer was interpreted as an accumulation layer associated with the cart's destruction.

The components of the vehicle were very poorly preserved, most of them lacking their original form and damaged by subsequent construction actions on the site.

A small number of artefacts (24) were recovered from Layer 170. These are represented by pottery (4 examples), one leather item, and 19 metal objects.

The pottery is represented by small fragments of grey pots, including a vessel 14 cm in diameter with the body surface covered with grooves (Fig. 4). Similar examples have been dated to the second half of the 14th century (Starski 2015, 94).

Fig. 4. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. Grayware. Photo: J. Dąbal

Fig. 5. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. Patten. Photo: J. Dąbal

Among the leather goods, a well-preserved patten with a double vestment, on a wooden tapered sole raised in the heel part, was registered (Fig. 5). The elements of the vestment were attached to the sole by rivets with rectangular heads preserved on the edge. They were fastened with an eight-sided, bipartite tin-lead buckle with a floral-decorated frame. Pattens were a protective element of the footwear. Their chronology has been determined to be late 14th to early 15th century (Ceynowa 2004; 2020, 550-552).

The 19 metal objects included a ring brooch, ten buckles, two folding clasps, three pilgrim badges, a bell, a pendant(?) and a coin. Amongst these, the only artefacts dated only to the 14th century were the ring brooch and the coin.

Ring brooches in a similar decorative form have been discovered in the Gdańsk area earlier and are generally recognised as distinctive Baltic region products (Trawicka 2010, 112). Nevertheless, the piece obtained as a result of the 2024 excavations differed from the one indicated from the 2004 season (Trawicka 2010, 112) and was made using the casting technique (Fig. 6: 2). Its frame, 35 mm in diameter, is decorated with an engraved herringbone motif and rosettes made using the *niello* technique. Their dating in Scandinavia is determined to the first half of the 14th century, while for the coastal areas of present-day Germany and Poland, they were in use around the second half of the 14th century (Polak 1998a, 219; Søvsø 2009, 185-187, 198; Wojciechowska 2022, 77, 90).

The coin found was a firchen ('kwartnik') of Winrych von Kniprode of the Teutonic Order, dated (in terms of the date of issue) to 1364-1379 A.D. and providing a late 14th century *terminus post quem* for the layer (Paszkiewicz 2013, 218).

The remainder of the collection is represented by buckles, mostly pewter with octagonal bipartite frames and decorative ears, and two of coloured metal single-divided with asymmetrical form (Fig. 6: 1, 4). Artefacts in this category have been dated over a wide range, most commonly from the second half of the 14th century (Whitehead 1996, 52-55; Trawicka 2010, 113, 114). Pewter shoe buckles from the 2024 excavations have been dated to the second half of the 14th to the early 15th century (Egan and Pritchard 2002, 22). Two other buckles have their parallels in material from Gdańsk (Trawicka 2010, 114, 115), with their chronology indicated to the 15th century.

Folding clasps made of non-ferrous metals were also distinguished (Fig. 6: 3). They are preserved in the form of plates and plates with frames. The examples are decorated using a carving technique with simple geometric patterns. Their chronology has been established as between the second half of the 14th and the early 15th centuries (Egan and Pritchard 2002, 117-120; Trawicka 2018, 353, 378).

The finds assemblage also contains three pilgrim badges; these have numerous analogues in material from Gdańsk, and these forms (GPPM variety 2) are defined as Pomeranian products (Paner 2013, 94-113; Dąbal and Borowka 2024, 358-381). The badges are rectangular with a triangular finial. In two situations, the pinnacles in the form of crosses are preserved. On the reverse of the badge, a very distinct regular diagonal grid is embossed (Fig. 6: 6, 7). The obverse schematically depicts Mary, facing left, wearing a crown

Fig. 6. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets:
1, 4 – Buckles, 2 – Brooch, 3 – Folding clasps, 5 – Bell, 6-7 – Pilgrim bages. Photo: J. Dąbal

surmounted by three lilies and holding an apple in her right hand. The throne is schematically depicted as a belt, filled with a diagonal grille. The head of the child standing to the left is encircled by a cross without a nimbus surround. Above the heads of both figures is a six- or five-pointed star. Of the examples found so far in Gdańsk, the most significant number are from Granary Island (Paner 2013, 107; 2016, 489). They have also been singly recorded in the Long Gardens area (pl. Długie Ogrody) (Paner 2013, 107; 2016, 489; Wołyńska 2021, 129, 130). Only several analogies are known from Europe. These include badges from Amsterdam and Dordrecht (van Beuningen *et al.* 2001, 343, figs 1429 and 1430). Additionally, a fragment of a lead frame with pseudo-filigree decoration was discovered, interpreted as a pendant or an unspecified part of a badge.

A category of finds that correlate with both pilgrim badges and are attributed to other spheres of life, such as entertainment, transport, or epidemic phenomena, includes bells, such as the one found in Layer 170. They were used for several different activities, including marking lepers and serving as accessories at dances (Egan and Pritchard 2002, 336, 337, 339, figs 220 and 221; Janowski 2016, 298). Another interpretation is that parents put them on their children to control their whereabouts (Egan 2005, 57, fig. 43: 246). The bell is made of a copper alloy and is preserved in its complete spherical form, with a diameter of 18 mm and a height of 17 mm (Fig. 6: 5). No mounting lug was preserved. The item was interpreted as a sound-emitting component. The artefact was dated to the late 14th-early 15th century (Trawicka 2018, 383, fig. 26: 388).

The recovered artefacts are dated to a very consistent range from the second half of the 14th century to the early 15th century and provide one element in determining the chronology of the cart components (K115). The chronology of the artefacts was completed with the dendrochronology and ^{14}C dating. Two samples were selected for dating using the dendrochronological method, while foreseeing the limited possibilities of their precise dating (the results are: after 1275 and after 1315) due to the state of preservation, samples were also taken for ^{14}C dating. In contrast, the result obtained using the C14 method indicates 1410 AD as the date of the wood used in making the object (wheels). The date obtained corresponds with the artefacts found in the archaeological context of the vehicle remains. Based on all the data, the cart's chronology was determined to be the early 15th century.

The chronology of the cart corresponds with the oldest phase of development of today's Granary Island, broadly defined as the 14th to early 15th century. This is the period about which we still have insufficient information in the context of the investigated area. This period has often been mistakenly identified with the full development of the area in question as a granary. Given the scarcity of historical data for this period, it can be inferred that this marks the beginning of the parcelling out of city plots. Wooden storage buildings may have been built on the plots, but they were not fully developed in terms of both architectural and spatial design at this time. The layout of the buildings also did not continue into the modern period, when the 15th-century layout of the plots was altered at the end of this period and at the beginning of the 16th century due to the construction of partially brick

walled granaries (fire walls) with fairly regular forms within regular plots (about 24 m long for the study area) (Volkholz 1922, 29). Based on historical data, the bare fact is that in the 15th century, the plot under analysis was delimited, but there is no information about its owner (Volkholz 1922, 52). The plot was used as a storage yard until the early 17th century. There is no historical data about its development during this period (Volkholz 1922, 52). The results of the excavations conducted in both 2006/2007 and 2024 confirmed the absence of timber construction within the plot. The results of both archaeological surveys were compared with the help of the Archaeological Museum in Gdańsk, which provided complete digital and photographic documentation to verify this data.

CART COMPONENTS AND CARGO

Wooden elements interpreted as components of a cart and its probable cargo (K115) were discovered in an area of 8 m^2 (Figs 7-9). The condition of the preserved components did not allow a clear interpretation of all the parts and their construction; therefore, no attempt was made to reconstruct the entire vehicle. However, their dispersion and the remains unquestionably identified as components of a cart make it possible to attempt to characterise and determine the probable size of the vehicle.

In the uppermost part, probable body components have been identified. Their disintegration could indicate the destruction of the body shell. The most important element is the side body panel (or a box board) (Fig. 3: 2). This is the only element preserved in its entirety, allowing for the identification with certainty of its location or how it was set in the context of other components. The side panel is made of pine wood and measures 190 × 42 cm; its width is 45 mm (Fig. 8: 4). The two sides have a symmetrical slot 26 cm wide and 1.5 cm deep. The panel has four 35 mm diameter holes spaced 16 cm (from the diameter) apart in two sequences every 40 cm. One vertical plank was attached to the slots in the central plank, with a groove beneath that protruded beyond the central plank's line. Such a component could only be located longitudinally on the stile and mounted to the base. Based on construction details, the plank is considered the longer part of the body shell, and the holes are interpreted as rope mounting to hold the cargo. A second similar element was also discovered in the trench profile (Fig. 3: 2; 8: 5). It had been partially destroyed. This is an analogous panel, preserved to a length of 67 cm with an original width of 42 cm. It also has retained two 35 mm-diameter holes, spaced 25 cm apart. Due to the different hole spacing, assuming the symmetry of the element, its full length could have been in the range of 90-112 cm. Very indicatively, this was taken as a reference point for visualisation as the shorter side of the body shell.

The formwork/lower body components were four pine planks, 28 to 30 cm wide and 84 to 106 cm long (Fig. 7). Their thickness was 45 mm. All components were severely damaged, and their dimensions are close to the presumed body width. The planks were laid

side by side transversely, with one of them overlapping the wheel (Wheel No. 1). In the context of the bodywork, two scantlings for the straight overlay joint were also discovered (Fig. 8: 2, 3). These, too, may have been part of the body frame or chassis, and, again, their condition does not allow structural details to be indicated. The size of the body can tentatively be estimated in the range of approximately 1.9 × 0,9-1.2 m and its height at 0.42 m. All components were made of pine wood.

Elements that could be identified as a cart chassis were not unquestionably recognised. These could potentially have been two components measuring 116 × 26 × 6 and 92 × 10 × 6 (Fig. 7). In addition, very poorly preserved pieces of studded scantlings were recovered (Fig. 8: 6). The holes were drilled through and studded halfway. It was not possible to determine how they were connected or how they would have been securely fitted into the cart's structure. The stubbing of one side of the surviving piece indicates that it was rather

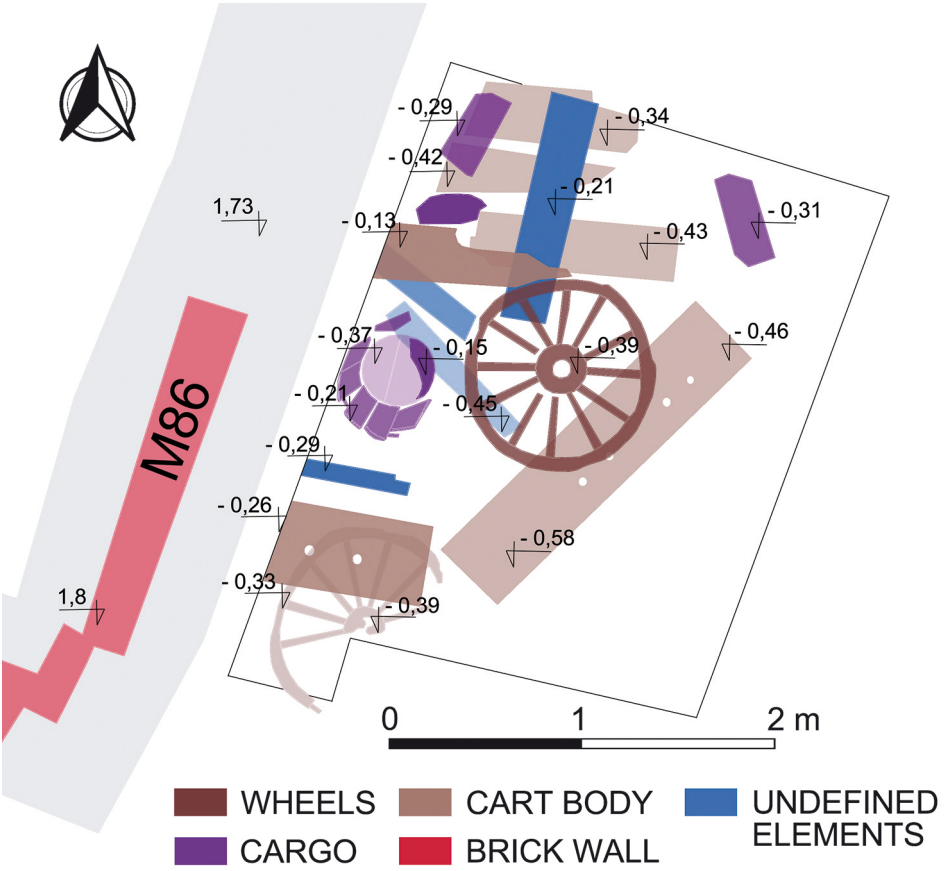

Fig. 7. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. Cart components and cargo dispersion, with elevation data. Prepared by J. Dąbal, T. Widerski and D. Borowka

attached horizontally. Elements were found folded perpendicular to each other under the wheel (Wheel No. 1) and body components. Their state of preservation did not allow any structural details to be identified.

The most interesting components seem to be the two wheels. They were found about 60 cm apart. One of them (Wheel 1) lay over the longer body shell panel, the other (Wheel 2) under the shorter one (Fig. 7). Both have been found with the inner side facing the ground (*i.e.*, the axle would have been mounted from the bottom in both cases). The circumference of the first wheel was preserved relatively completely. However, it was but damaged and with a destroyed hub (Fig. 2: 3). The second wheel is preserved in three sections, with the central section badly damaged (Fig. 2: 4). In addition, an adjacent section was uncovered in the earlier test trench, which appeared to have been better preserved (Fig. 8: 1). After measuring it, it was found that its diameter and width matched perfectly with Wheel No. 2. Its height is within the original parameters of the wheel, but the sections discovered *in situ* are more damaged. The internal spoke spacing also differs by 1 cm. Due to the convergence of certain features, the item was interpreted as part of a damaged wheel (Wheel No. 2).

Both uncovered wheels are of analogous design and have a diameter of 1 m (1.03 m). The hub is 31 cm high, 15 cm in diameter, and the widest point of the hub measures 22 cm (Fig. 8: 1; 9: 2, 3). It extends to 12 spokes, approximately 47-48 cm long, the upper part of which is jammed round and fits into the wheel. The lower part of the spokes fits squarely into the hub (Fig. 9: 4, 5). The spokes are offset about 7 degrees outwards (Fig. 8: 1). The wheels are made of six felloes joined together by pins, with two spokes embedded in each one (Fig. 8: 1; 9: 1). On the running side of one of the wheels (Wheel 2), reinforcements were made by studding. They took the form of symmetrically placed dowels located in the space between the spokes. Interestingly, no such reinforcement was noted on the other wheel.

The wheel components were made entirely of beech wood (Table 1). No traces of metal rim/tyre attachment were registered on the running surfaces of the wheel, but the pegs and spokes have small stones heavily indented into them, indicating that the wheel was at some stage used without a cover (Fig. 9: 1b, 1c). The hub on the bottom side is finished smoothly. The upper part of it is badly damaged.

Table 1. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. Wheel components wood identification. Author M. Krąpiec

Sample No.	Historical plot No.	Element specification	Raw material
P66	JG2A	K115/wheel_1/hub	*Fagus silvatica*
P67	JG2A	K115/ wheel_1/felloe	*Fagus silvatica*
P68	JG2A	K115/ wheel_1/spoke	*Fagus silvatica*
P69	JG2A	K115/wheel_2/felloes dowel	*Fagus silvatica*

The weight of the cart body, based on data from exposed components and raw material analysis, was estimated at 90 kg (for wood with a moistness of 15%). Based on similar characteristics, the wheels' weight was estimated at 20 kg. It is not possible to determine the weight of the chassis and body frames, but it would have been more than 15 kg. Thus, the total weight of the cart would have been between 125 and 160 kg.

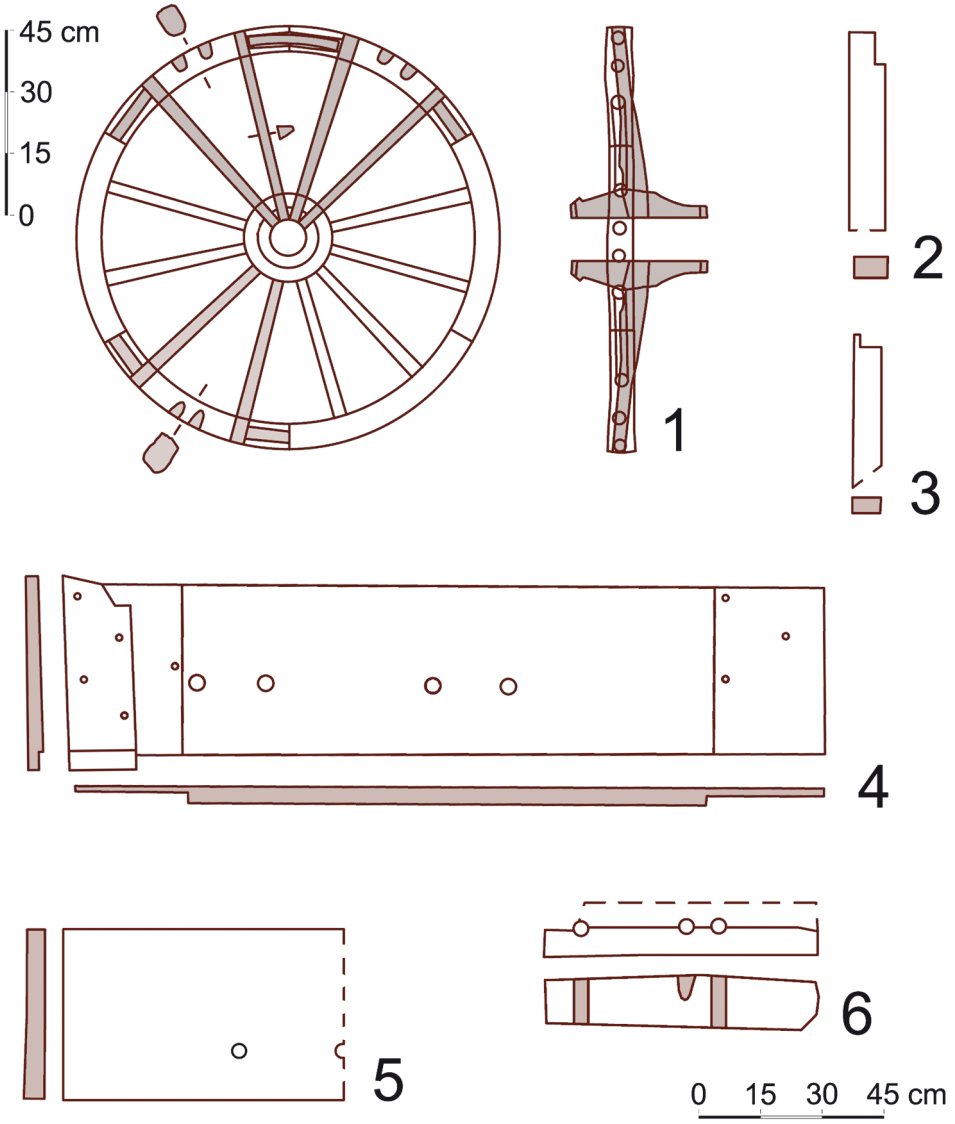

Fig. 8. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets.
1-6. Cart components. Drawn by J. Dąbal

Based on all the data relating to the discovered components, it was assumed that this was the remains of a two-wheeled cart. It should be noted, however, that approximately 4 m² on the western side of the find is covered by the wall. The possibility that the object was larger cannot, therefore, be confidently dismissed. A point that lends credence to the concept of a two-wheeled cart is the fact that the real extent of the find was defined by a line about 1 m wide, and no structural elements were discovered beyond this range. Nevertheless, the aforementioned doubts and the condition of the cart components prevented a final visualisation of the object.

Partially preserved elements of a barrel were found in addition to the above-mentioned components (Fig. 2: 1, 2; 7; 10). They were located on a piece of wood interpreted as part of the chassis (undefined element), at a distance of about 17 cm from the wheel and about

Fig. 9. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. 1-5 – Cart components details: 1 – Felloe, 2-3 – Hub, 4-5 – Spoke (ending from the hub side – 4; ending from the felloe side – 5). Photo: J. Dąbal

30 cm from the planks interpreted as the bottom of the body. The barrel was not preserved in its entirety – only the bottom, five staves and the barrel clamp were found *in situ*. A single stave and a fragment of the bottom were also located a short distance away. The barrel's elements were made of oak. The bottom, 36 cm in diameter, was made of two elements joined by pegs (Fig. 10). The barrel was initially made of 9 or 10 staves (circumference at the bottom 113 cm), of which five (preserved circumference 58 cm), 10 to 15 cm wide and 16 mm thick, were discovered *in situ*. The staves are preserved to a height of 29-33 cm. The triangular bevelled croze is approximately 5 cm high. In addition, wooden hoops approximately 3 cm high have been preserved in the context of the barrel (Fig. 10). Traces of a dark substance, presumably used for sealing, are visible on the inner surface and bottom of the barrel. Based on the preserved planks' dimensions and shape, it was

Fig. 10. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. Barrel elements and capacity reconstruction. Photo: J. Dąbal

determined that the barrel was originally 63-73 cm high and had a capacity of at least 65 litres. The weight of the empty barrel was approximately 14 kg. The barrel was secondarily damaged by the building level directly above the structure (layer no. 168) and subsequent construction activities at this location.

Barrels were excellent containers for liquids, loose substances, and other goods due to their resistance, ease of movement, and transportability (Świderski 1953, 13, 14). On late medieval sites, only their components are usually found (Polak 1998b, 253, 254; Starski 2015, 184; Uciechowska-Gawron 2019, 123, 124; Bobik 2023, 347). On urban sites, particularly in Pomerania, more of the better-preserved examples are known through having been secondarily used as drainage structures. Among the analysed examples, metrically and structurally similar barrels were recorded in Kołobrzeg (Polak 1998b, 254). In Gdańsk, the features of the barrels discovered so far indicate that they were used to store liquid substances (Kasprzak 2010a, 152; 2010b, 172, 173).

LATE MEDIEVAL TRANSPORTATION

Research into medieval transport in Poland has so far been addressed primarily in studies of the construction of tracks and spatial analyses, and of animal rigs and carts since the second half of the 20th century (Kaźmierczyk 1954; Matuszewski 1954; Rosset 1974; Kola 2000; Wrzesiński 2002; Niemiec 2011). Slightly older, dating back to the late 19th and first half of the 20th century, are studies of medieval transport in other parts of Europe (for example, Jusserand 1889; Salzman 1931). Due to the lack of relevant finds, studies of late medieval cart construction are even more sparse (see Willard 1932; Vermouzek 1983; Fansa and Schneider 1995; Haupt 1995; Ansorge 2005). At the same time, it was noted that the late medieval period was characterised by structural change in transport, including the technical development of land transport (Schreg 2003). During this period, communication in the Baltic coastal zone was mainly organised by sea. It was only with the development of the urban network that roads began to be built connecting port cities with inland centres. Research into the territories of Mecklenburg and Pomerania has shown that they were connected by a network of routes (Ansorge 2005, 153). Road usability was often disrupted by weather conditions. Often unpaved, the roads became impassable during the rains. The improvement of roads and developing their accessibility, as well as enhancing the durability and capacity of carts, were joint elements of the growth of the land transportation network.

The Granary Island in Gdańsk was designed to receive goods intended for transport from the hinterland, as well as to unload them from ships and transport them by cart. Loads must have arrived on the island in a variety forms of carts and wagons. Woodcuts and drawings of the 15th century present images of medieval porters with humped chests, wheelbarrows and handcarts, pack animals and two- and four-wheeled carts pulled by

draft animals (Vermouzek 1983, 319, 321; Ansorge 2005: 153, Abb. 1). Additional, relevant data on the type of late medieval carts and transport have come from details gleaned from medieval manuscripts. Although not including technical specifications, the medieval prayer books 'Books of Hours' and psalters introduce numerous pictures illustrating the variety of carts of the period. Based on these, only preliminary and tentative conclusions about the form of the cart's body, the type of harness or the construction of the wheels can be made. The details of the chassis, which are barely shown, are challenging to define. The chassis from the period is depicted on the drawing documenting the overturned carriage of Pope John XXIII (Baldassarre Cossa) in Arlberg while travelling to the Council of Constance in 1415. The chassis pictured is three-linked (Vermouzek 1983, 319).

The cart from Granary Island is considered a two-wheeled vehicle. In the studied sources including the 14th century 'The Romance of Alexander, Livre de la chasse', and 15th century 'Book of Mendel, Book of the Treasure', carts of this type appear to be the dominant mode of transport alongside four-wheeled carts (Fig. 11). Their bodies came in a variety of forms along with baskets, braids, platforms or ladders (see Fig. 11). The form of the body in the case of carts of the simplest design (Fig. 11: 1, 2, 6) may have been subject to change, and their owners probably altered them according to the loads. Carts with more advanced body designs probably did not have similar advantages. The wheels on the two-wheeled carts were presented as proportionally larger than those on the four-wheeled counterparts. In terms of capacity, they had to handle a heavier cargo. Just as in the example from Granary Island, the wheels were made of wood and frequently had metal tyres studded with what appear to be iron studs (Fig. 11: 4, 5). In the more detailed depictions, the wheels' division into felloes is discernible. Wheels were generally presented with fewer than ten spokes. However, this was probably not due to the actual construction of the wheels but to artistic convention or simplifications used by the artists making the drawings. At times, however, we find a 14th-century depiction of wheels with 12 spokes (Fig. 11: 5), similar to the ones from Granary Island (see above). The number of horses in the harness varied depending on the amount of goods being transported and the size of the cart itself. However, a disproportion is evident in the depictions; most often, the two-wheeled carts were pulled by a single animal, while carts pulled by more than two horses are relatively rare. An interesting aspect of the depictions is the cargo carried by the two-wheeled carts. As it turns out, it included both the transport of goods and people. Among the goods transported, valuable items are present, but commodities predominate. Present are depictions (Fig. 11: 3, 6) of carts carrying barrels, so important in the context of the find in question. The barrels were placed vertically on the wagon's body or laid on their sides. In both cases, their stability was probably provided by additional fastenings, which, however, are not visible in every depiction. They were depicted individually and with other goods to form a larger cart cargo (Fig. 11: 6). Other goods were also packed and fastened according to the carrying capacity of the respective cart. As the iconography from the turn of the 14th to 15th centuries indicates, two-wheeled carts were also used to transport people. Up to six adults

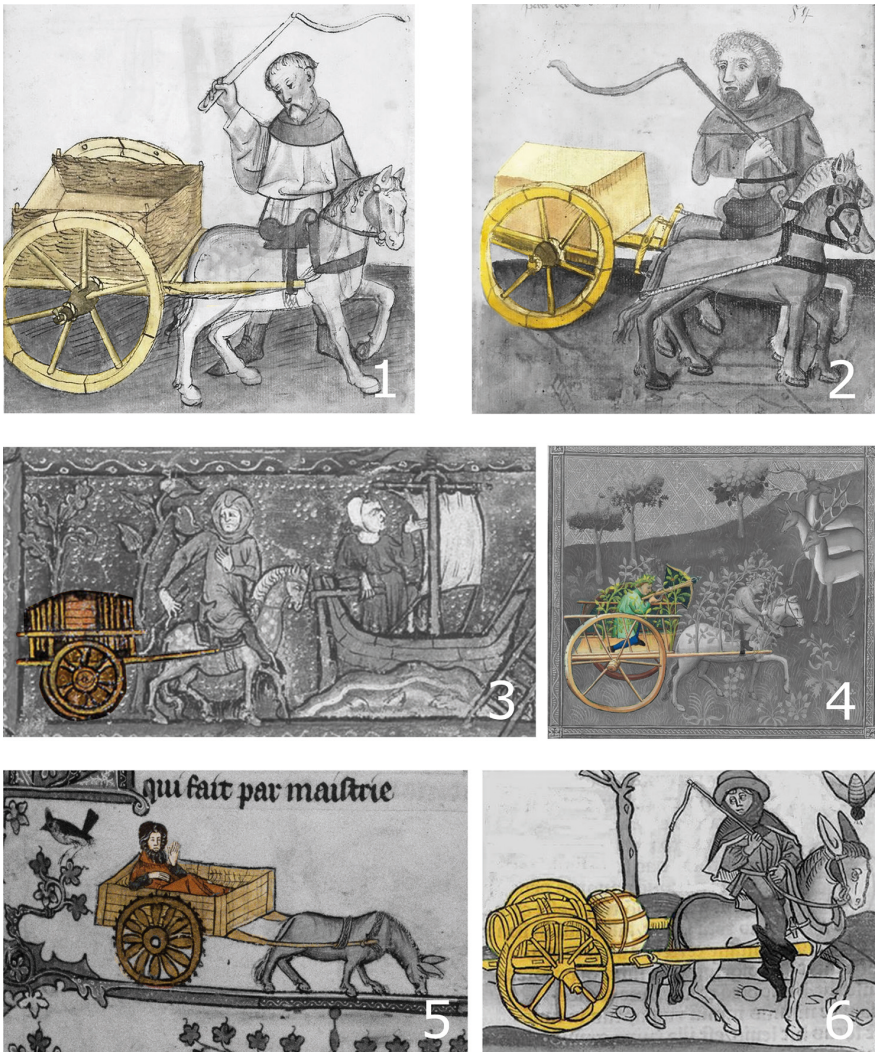

Fig. 11. Selected iconography of two-wheeled carts from the 14th-15th centuries A.D. 1 – *Book of Mendel*, 15th century, Stadtbibliothek im Bildungscampus Nürnberg, Amb. 317.2° Folio 27 verso (source: https://online-service.nuernberg.de/viewer/image/5d64f831-7a9d-47b4-9a01-d6a28f29ad99/57/LOG_0057/), 2 – *Book of Mendel*, 15th century, Stadtbibliothek im Bildungscampus Nürnberg Amb. 317.2° Folio 83 recto (source: https://online-service.nuernberg.de/viewer/image/5d64f831-7a9d-47b4-9a01-d6a28f29ad99/170/LOG_0170/), 3 – Brunetto Latini's *Livre du trésor, et autres traités,* ca. 1326 A.D., Bibliothčque nationale de France, département des Manuscrits, Français 571, fol. 66v. (source: https://classes.bnf.fr/ema/grands/ca001.htm), 4 – *Livre de la chasse,* 1406-1407 A.D., Pierpont Morgan Library, MS M.1044, fol. 103r (source: https://ica.themorgan.org/manuscript/page/75/77121), 5 – *The Romance of Alexander*, 1338-1344 A.D., Bodleian Libraries, University of Oxford, MS. Bodl. 264, pt. I fol. 109r. (source: https://digital.bodleian.ox.ac.uk/objects/8d17bc13-14b6-4a56-b3b5-d2e1a935c60d/), 6 – Ulm edition of Steinhöwel's collection of *Aesop's Fables*, ca. 1476/77 A.D., (source: https://de.m.wikipedia.org/wiki/Datei:Musca_et_mula-Ulm-1476_338516.jpg). Access: 05.10.2024. Modifications by the authors

are depicted on the back of this type of cart. For transporting a larger number of people, carts with more robust bodies and reinforced wheels were used. Most often, however, individuals were depicted as placed in a recumbent position (Fig. 11: 5), which may indicate that the carts were used to transport injured or sick people. Also characteristic is the depiction in the hunting treatise 'livre de chasse' (Fig. 11: 4), where a two-wheeled cart was adapted for deer hunting, and an archer was placed on its back.

The wide variety of medieval depictions, although introducing the functional use of carts, did not lead to elucidation of the details of their construction. Research into the design and construction of medieval carts is augmented by a small number of archaeological finds and (to some extent) ethnographic data. For the time being, the material evidence of cart construction in the Middle Ages is very infrequent and mainly limited to discovered wheels and their components. In the case of finds from Poland, the data is very slender, even including sources dated to the early medieval period. The issue of medieval transport in Polish publications began with finds at the sites of Gniezno (Wielkopolskie voivodeship), Bródno Stare (Mazowieckie voivodeship) and Opole – Ostrówek (Opole voivodeship) (Kaźmierczyk 1954, 174, 175). The discourse undertaken by Kaźmierczyk, then, in the context of wheels and wheel elements, was developed using ethnographic data on carts used in the Wschowa, Międzyrzecz, and Kożuchów areas. In addition, in his work, he addressed considerations relating to the carrying capacity of carts (Kaźmierczyk 1954, 178). The structural angle from an ethnographic perspective was introduced by Kazimierz Moszyński in 1929 (1967, 649-653). The catalogue of archaeological finds, cart elements for the early medieval period, has expanded marginally from the early works dealing with transport issues (Kaźmierczyk 1954, 174, 175). The list of finds includes wheel elements from Bródno, Opole, Gniezno, Ostrów Lednicki, Szczecin and Wrocław (Kaźmierczyk 1995, 103, 104; Cnotliwy and Rogosz 1983, 149, 150; Kowalska 2003, 300). The summary, including the data list (Robak 2009), was revised by the authors in the context of finds from Ostrów Lednicki and Szczecin (Stępnik 1996, 286, 287; Łastowiecki 2000, 38; Kowalska 2003, 300). Archaeological sources relating to the late medieval period are even scarcer. Late medieval wheels or their components have so far been discovered in Kołobrzeg, Bydgoszcz, Bytom and Puck (Wójcik and Podyma 1997, 174, 175; Polak 1996, 331-335; Siwiak and Siwiak 2014, 52; Starski 2015, 178, 183; Bobik 2016, 157). The find from Bytom has been interpreted as a hoisting wheel based on the presence of spoke embedment (Wójcik and Podyma 1997, 174, 175). However, structurally, it is consistent with other late medieval finds, also presented in this article.

Nine finds are associated with the Gdańsk area. These include unpublished finds from Tandeta Street – a wheel and two hubs, dated in the range of the 15th to 18th centuries (Archaeological Museum in Gdańsk: SAZ 255/99/4, cat. no. 1345), the find of a hub from Site no. 1 (Archaeological Museum in Gdańsk: inv. 1950/4977) and a wheel and two hubs discovered in 1953 at Site no. 2 (Archaeological Museum in Gdańsk: inv. 1953/337; 1953/360; 1953/372). The objects listed are broadly dated to the medieval period. Published

examples include a 14th-century hub fragment and a hub with an axle from excavations at 43-46 Św. Ducha Street in Gdańsk (Kasprzak 2018, 455; Krzywdziński 2018, 110).

The comparison of early and late medieval finds allows a preliminary observation of the changes in the construction of spoked wheels across the periods in question. Early studies, including remarks on wheel-making, consider making wheels from the circumference, i.e., a single bent part, as an older practice. Next, felloes were to be introduced. It is difficult to confirm these data in the context of archaeological finds, notably when such information is lacking in publications or the wheels are in poor condition. The relatively small wheels, about 50 cm in diameter, discovered at Opole and Bródno and dated to the 10th and 11th-13th centuries, were made from a single part (Kaźmierczyk 1954, 175). On the other hand, wheel elements from Wrocław and Szczecin dated to the 11th and 12th centuries are made of tenon-jointed parts (Kaźmierczyk 1995, 103, 104; Kowalska 2003, 300). These are also followed by the reconstruction of the 12th-century Oldenburg cart (Fansa and Schneider 1995, 163, 166).

Finds of early- and late-medieval wheels can be distinguished by their diameters. For the known early medieval finds, the diameters are: 50 cm, 64 cm, 80 cm, 92 cm, 100 cm (Kaźmierczyk 1954, 175; 1995, 40; Kowalska 2003, 300). For late medieval wheels from Gdańsk, Kołobrzeg, and Bytom, the diameters are 103 cm, 110 cm, and 118 cm (Polak 1996, 335; Wójcik and Podyma 1997, 174; Bobik 2016, 157). However, it should be stressed that the number of finds is insufficient to provide a strong indication of broader conclusions. Another issue is the number of spokes, which is more closely related to the wheel's diameter and strength. It is still unclear at what period those with more than ten spokes appear. In addition, the number of spokes can be inferred from the elements preserved in a certain completeness. These are a hub, a whole segment of a bell or a felloe. These situations are a few among the Polish discoveries. Concerning early medieval finds, these are specified as eight- or ten-spoke wheels (Kaźmierczyk 1954, 175), while late medieval examples are twelve-spoke wheels (Polak 1996, 335; Wójcik and Podyma 1997, 174; Siwiak and Siwiak 2014, 52; Bobik 2016, 157; Kasprzak 2018, 450). From Gdańsk, information on two hubs has been published. A 14th-century chronology has been determined for the twelve-spoke axle (Krzywdziński 2018, 110, 115). Some indication of the construction changes (extending the number of spokes to twelve) about the 13th century is also provided by German ten-spoke finds dated from the 12th to the 13th century, and by reconstructions from Oldenburg, Woldegk, and Greifswald (Fansa, Schneider 1995, 163, 166; Ansorge 2005, 105). Another issue is the height of the hubs. For finds from the 10th to 13th centuries, we have information about long hubs with heights ranging from 36 to 47 cm (Kaźmierczyk 1954, 177; Kaźmierczyk 1995, 103, 104). For 14th- to 15th-century finds, these numbers range from 31 to 46 cm (Polak 1996, 335; Kasprzak 2018, 450; Krzywdziński 2018, 110).

The comparison of the data led to a reflection on the proportions of the various elements. Early medieval wheels appear relatively low with massive hubs, while late medieval wheels seem to be taller with slightly less massive hubs. Despite the paucity of data, these

can presumably be completed using axle diameters, which for the early medieval period are reported as 4.5-5 cm. An exception is the 10 cm axle from Ostrów Lednicki (Stępnik 1996, 286, 287). Additionally, the inner diameter of the hub for the axle seating discovered in Gdańsk measures 9.8 cm. No further data was obtainable for comparison.

A supplementary issue is the material used to make the wheel components. The wood species were not identified in all cases. Available data indicate that for early medieval timber finds: oak, maple, birch, ash (Bukowska-Gedigowa and Gediga, 1986, 82, 149; Kaźmierczyk 1995, 39, 40; Stępnik 1996, 286, 287; Kowalska 2003, 300; Robak 2009, 185). Late medieval wheels were made of beech (Bytom), birch (hub from Kołobrzeg) and ash (also Kołobrzeg) (Polak 1996, 335; Wójcik and Podyma 1997, 174; Bobik 2016, 157). However, it should be noted that the material most often used probably resulted from the availability of a specific raw material at a particular time in certain regions, and, secondly, from craftsmen's preferences.

To date, interpretations of wheel element finds have been widely considered. Comparisons are made to carts known from iconography and developments taken from ethnographic data. Regarding the Gdańsk finds analysed here, the authors have not adopted such a broad interpretation. Despite known iconographic data depicting general features for visualising the body or wheels, the known parameters of vintage carts have so far not been considered in the broader context of their design-dependent purpose. The prevalence of two-wheeled carts in the late medieval period also seems to have been marginalised in the interpretive context. Furthermore, in the context of the discovery on Granary Island in Gdańsk, it can be presumed that the cart may have been dedicated to short routes for distributing loads within a limited area, rather than to longer destinations. As a result, its construction could be practically adapted to the condition of the area's tracks and the type of cargo.

Another element that has not been addressed to date is the type of cart-making techniques used, depending on the makers' origins and, essentially, the regions from which they drew their skills. Today's approach to understanding patterns drawn from specific geographical areas is bound to ethnographic analogies. This does not reflect the social image and the 'parcel of knowledge and patterns' of medieval makers or users in the discussed situation in medieval Pomerania.

Based on the state of preservation and the number of elements discovered on Granary Island in Gdańsk, the presence of two wheels was identified and the preliminary measurement of the components interpreted as the body and chassis were determined. All the components, together with the probable cargo in the form of preserved parts of a single barrel, co-occurred in one archaeological context (stratum). Details of the body and chassis construction have not been resolved based on the remains of the wooden components. The body dimensions (190 × 90 or 112 cm) were indicated based on the layout and metric parameters of the individual parts. An issue taken up extensively in the literature (Stępnik 1996, 286, 287) that the authors have been unable to address is the width of the wheel track and the resulting body width. The hub's inner diameter of 9.8 cm allows a robust,

long axle to be fitted. However, any strength calculations would have to be based on chassis data, which is missing. Known wheel axles from the early medieval period are approximately 105-115 cm with an estimated body width of 90 cm (Stępnik 1996, 287) and 206 cm with a reconstructed lower body base width of 116.5 (Fansa and Schneider 1995, 171).

However, these data were not adopted here as a reference due to the lack of precise data on the chassis design. The weight of the wood in the individual structural components, determined at over 125 kg, and the height of the wheels (103 cm) indicate that the cart potentially had a carrying capacity of over 300 kg (Kaźmierczyk 1954, 178). It could therefore have carried about five barrels of the dimensions of the excavated example. However, given the type of ground surface in the yard where the discovery was made (a sand-and-wood-shaving ground), the load could not have been much higher than the indicated amount.

Based on the collected data, these appear to be the remains of a two-wheeled cart, most likely discovered in situ in its original context of use. Its destruction must have occurred in a sudden accident. Within the small area excavated, there were no clear, tangible traces of, *e.g.*, fire other than charcoal flecks in the layer on which the components were discovered. The wood elements also bear no obvious signs of burning, but are mostly lacking in full dimensions. The secondary destruction of the context further limits interpretation through several building actions undertaken at the site (ground raising, pile structures, stone foundation). Nevertheless, the interpretation of destruction as a result of a sudden event is supported by the fact that the components were left together with a partial cargo. Better preserved barrels are only discovered on Granary Island in contexts of secondary use as drains or as parts of loads destroyed within the warehouses.

The context of discoveries of other Polish and European findings to date is varied, but none (except finds related to the craftsman's area) seem to have been discovered in the prime use context. An interesting and possibly originally deposited component may include the one discovered in the market of Bytom (Wójcik and Podyma 1997, 174). Interesting finds include a hub, interpreted as a wooden seating element discovered in Wrocław (Kaźmierczyk 1995, 103, 104) or a wheel discovered in a foundation in Greifswald (Ansorge 2005, 153-154). Another object worth noting is a hub embedded with its axle into the ground, found in the area of the butcher stalls in Gdańsk (Krzywdziński 2018, 110). Another category comprises single finds in the area of wheelwright activity (Kaźmierczyk 1995, 39-42). The context of discovery of the cart components on Granary Island in Gdańsk makes this find unique in Europe.

CONCLUSIONS

The cart components together with part of the cargo discovered during the archaeological excavations in Gdańsk on Granary Island, is a rather spectacular discovery due to their *in situ* context within the warehouse area. The precise dating of the find to 1410 AD,

based on ^{14}C analysis, is another asset of the data presented. Together with the dating of the cart components, the chronology of several categories of artefacts, including pattens, buckles, brooch and pilgrim badges, was also narrowed down, thus determining the potential time of their deposition.

The conditions and range of the excavations limited the interpretative possibilities of the finds, but allowed entirely new observations to be made in the context of medieval carts. An attempt was made to determine the dimensions of the body made of pine; the full structural parameters of the beech wheels were given, as well as the range of the weight of the cart and its carrying capacity. Because the organisation of the archaeological work depends on administrative decisions, the data contains gaps. However, it is the most complete material evidence of such an object from the late medieval period presented to date.

Cultural resource management issues arising from actions taken at the site should be the subject of a separate discussion. The interruption of continuity between the research seasons (2006-2007 and 2023-2024) led to the natural degradation of some of the data left behind, which, as a result, were only put into stratigraphic and chronological context with great effort. At the same time, with the cooperation between research teams and the exchange of documentation, some of the information was reconstructed, but not all the data were combined.

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