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## THE SIEGE MACHINES DURING THE BALTIC CRUSADES

The constant competition between attack and defence can be studied in many fields during the Baltic crusades. For the Sword-Brothers and the knights of the Teutonic Order in Prussia and Livonia it was always a battle against time to maintain their advantage in technique, hardware and horsepower, because the heathen were eager to learn and adopt innovations<sup>1</sup>. There is however an important difference between the “target areas”, because Finland, Livonia, Estonia and Prussia had been integrated in Latin Europe at the end of the thirteenth century, whereas Lithuania was never conquered and colonised by the military orders<sup>2</sup>. Real war and crusading against these “last heathens of Europe” began much later, around 1300, after the subjugation of the others. For that reason the Lithuanians had much more time to get acquainted with and to adopt western warfare and technology. The typical long-range weapon of the crusader’s forces, the crossbow, soon became the most common long-range weapon also among them<sup>3</sup>, and the Lithuanians applied the whole scale of the crusaders own experience of warfare when laying siege to the Order’s castles. Before the Estonian and Livonian tribes were defeated, they too had learned to build and to operate war machines, which, according to the chronicler

Henry of Livonia (Heinrich von Lettland), had remained unknown to them until the Christians arrived<sup>4</sup>. We also know that the rebellious heathen (“apostate”) Prussians in 1261 laid siege to the Order’s castle Heilsberg with three trebuchets and other instruments for war<sup>5</sup>. The Russians preferred their traditional bows for a long time<sup>6</sup>, but apart from that they were keen to adopt innovations. As demonstrated by the Finnish scholar Kalervo Huuri<sup>7</sup> and by Witold Świątosławski<sup>8</sup>, their knowledge of advanced technique (stone-throwing machines) was transferred to them by the Mongols, who for their part had learned much from the Chinese and other Asian peoples. The Poles used

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<sup>4</sup> Heinrich von Lettland, *Livländische Chronik*, neu übersetzt von A. Bauer (hereafter cited as Heinrich von Lettland), Darmstadt 1959, XIV, 11 (pp. 126–127) and passim.

<sup>5</sup> Peter von Dusburg, *Cronica terre Prussie* (hereafter cited as Peter von Dusburg), ed. M. Toppfen, [in:] *Scriptores rerum Prussicarum. Die Geschichtsquellen der Preußischen Vorzeit bis zum Untergange der Ordensherrschaft*, ed. Th. Hirsch, M. Toppfen, E. Strehle (hereafter cited as SRP), I, Leipzig 1861, pp. 3–20 (introduction), pp. 21–219 (edition); here pars III: 94 (p. 101): *Non longe postea Prutheni cum tribus exercitibus et tribus machinis et instrumentis aliis bellicis castrum Heilsbergk episcopi Warmiensis obsederunt*. Also see *ibid.*, III: 117 (p. 110). — Translation of the chronicle into German: Peter von Dusburg, *Chronik des Preußenlandes*, übersetzt und erläutert von K. Scholz und D. Wojtecki, Darmstadt 1984.

<sup>6</sup> Heinrich von Lettland, X, 12 (p. 58): *Rutheni quoque, qui artem balistarum ignorant, arcuum consuetudinem habentes, ...* (1206). Also passim.

<sup>7</sup> K. Huuri, *Zur Geschichte des mittelalterlichen Geschützwesens aus orientalischen Quellen*, “*Studia Orientalia*”, ed. Societas Orientalis Fennica“, IX, 3, Helsingforsiae [Helsingfors/Helsinki] 1941, pp. 180–206.

<sup>8</sup> W. Świątosławski, *Arms and Armour of the Nomads of the Great Steppe in the Times of the Mongol Expansion (12<sup>th</sup>–14<sup>th</sup> Centuries)*, “*Studies on the History of Ancient and Medieval Art of Warfare*”, III, Łódź 1999, pp. 67–71.

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<sup>1</sup> S. Ekdahl, *Horses and Crossbows: Two Important Warfare Advantages of the Teutonic Order in Prussia*, [in:] *The Military Orders, 2: Welfare and Warfare*, ed. H. Nicholson, Aldershot 1998, pp. 119–151, at pp. 120–121.

<sup>2</sup> S. Ekdahl, *Crusades and Colonisation in the Baltic: A Historiographic Analysis*, “XIX Rocznik Instytutu Polsko-Skandynawskiego 2003/2004”, ed. Eugeniusz S. Kruszewski, Copenhagen 2004, pp. 1–42; also see a shorter version *Crusades and Colonization in the Baltic*, “*Palgrave Advances in the Crusades*”, ed. H. J. Nicholson, Basingstoke and New York 2005, pp. 172–203.

<sup>3</sup> G. Rackevičius, *Arbaletas ir lankas Lietuvoje XIII–XVI a.*, Vilnius 2002.

war machines during internal fights in 1376, as described by Marian Głosek<sup>9</sup>, but they of course were acquainted with them long before that<sup>10</sup>. When the Polish king Władysław Łokietek in 1329 besieged the Prussian castle of Leipe, he used catapults as well as battering rams and siege towers<sup>11</sup>.

Firearms were known by the Teutonic Knights at a rather early stage<sup>12</sup>. When describing the siege of the Lithuanian castle of Kaunas in 1362, the Order's chronicler Posilge stressed that besides mechanical war machines, only smaller firearms (*Lotbüchsen*, shooting arrows and lead balls) were used, and "not the big cannons throwing stones (*Steinbüchsen*)"<sup>13</sup>. The Order was thus probably in possession of bombards by that time, even if the Knights did not use them until besieging another Lithuanian castle in 1380<sup>14</sup>. Two years later, bombards were brought into action by the Lithuanians against the Order's fortress Georgenburg, situated on the river Memel<sup>15</sup>. Firearms in Poland are first recorded in 1383, and refer to siege artillery<sup>16</sup>.

<sup>9</sup> M. Głosek, *Artyleria przedogniowa*, [in:] *Uzbrojenie w Polsce średniowiecznej 1350–1450*, ed. A. Nadolski, Łódź 1990, pp. 153–165, at p. 154.

<sup>10</sup> M. Głosek, *Organizacja produkcji i ceny uzbrojenia*, [in:] *ibid.*, pp. 208–342, at pp. 284–286.

<sup>11</sup> Wigand von Marburg, *Cronica nova Prutenica* (hereafter cited as Wigand) ed. Th. Hirsch, [in:] SRP II, Leipzig 1863, pp. 429–452 (introduction), 453–662 (edition), at p. 473.

<sup>12</sup> V. Schmidtchen, *Die Feuerwaffen des Deutschen Ritterordens bis zur Schlacht bei Tannenberg 1410. Bestände, Funktion und Kosten, dargestellt anhand der Wirtschaftsbücher des Ordens von 1374 bis 1410*, "Schriftenreihe Nordost-Archiv", 10, Lüneburg 1977.

<sup>13</sup> [Johann von Posilge], *Johann's von Posilge, Officials von Pomesanien, Chronik des Landes Preußen, (von 1360 an, fortgesetzt bis 1419)* (hereafter cited as Posilge), ed. E. Strehlke, [in:] SRP III, Leipzig 1866, pp. 13–57 (introduction), pp. 79–388 (edition), at p. 82: ... *unde stormethin das hus tag unde nacht mit blyden* [i.e. stone-throwing machines working on the principle of leverage] *unde tumelern* [i.e. battering rams]; *dennoch woren nicht die grosin steynbüchsen, sunder alleine lothebüchsen*.

<sup>14</sup> Wigand, pp. 599–600.

<sup>15</sup> *Ibid.*, p. 613.

<sup>16</sup> J. Szymczak, *Siege artillery in Poland in the fourteenth and the fifteenth centuries*, [in:] *Architecture et guerre*, ed. T. Poklewski-Koziełł, "Fasciculi Archaeologiae Historicae", XVI–XVII, Łódź 2003/2004 (2005), pp. 111–120, at p. 111.

This paper will leave the firearms aside and concentrate on describing the mechanical engines used by the military orders and their adversaries during the Baltic crusades. Special attention will be paid to those devices hurling missiles such as stones, arrows and spears. There is considerable literature in German<sup>17</sup>, English<sup>18</sup>, French<sup>19</sup>, Danish<sup>20</sup> etc.<sup>21</sup> on siege weapons in general, including their history and their use during antiquity and the age of the crusades in the Mediterranean<sup>22</sup> and in Western Europe. However, siege warfare in the Baltic crusading region is still rather unknown to

<sup>17</sup> An extensive and well-known piece of German scholarship is B. Rathgen, *Das Geschütz im Mittelalter*, Berlin 1928 (repr. Düsseldorf 1987 with an introduction by V. Schmidtchen, *Büchsen, Bliden und Ballisten. Bernhard Rathgen und das mittelalterliche Geschützwesen. Ein Beitrag zur historischen Waffenkunde*, pp. V–XLVIII). Also see V. Schmidtchen, *Kriegswesen im späten Mittelalter. Technik, Taktik, Theorie*, Weinheim 1990, and M. Feuerle, *Blide — Mange — Trebuchet: Technik, Entwicklung und Wirkung des Wurfgeschützes im Mittelalter. Eine Studie zur mittelalterlichen Innovationsgeschichte*, "Veröffentlichungen des 1. Zentrums für experimentelles Mittelalter, Vechta", I, Diepholz 2005. There is an internet article (without references) by S. Grathoff, *Belagerungsmaschinen*.

<sup>18</sup> See, for instance, D. J. C. King, *The Trébuchet and Other Siege-Engines*, "Chateau Gaillard", 9–10, 1982, pp. 457–469. An internet article by P. Vemming Hansen, *War Engines of the Middle Ages* deals almost exclusively with trebuchets. See also the following translations: Ph. Contamine, *War in the Middle Ages*. Transl. by M. Jones, Oxford and Cambridge, Mass., 1990; J. Liebel, *Springalds and Great Crossbows [Espringales et grandes arbalètes]*. Transl. by J. Vale, "Royal Armouries", Monograph 5, Leeds 1998. Further literature will be mentioned below.

<sup>19</sup> Ph. Contamine, *La guerre au moyen âge*, Paris 1980. The French manuscript of J. Liebel, *Espringales et grandes arbalètes* was translated into English (see note 18). Nicolas Prouteau of the University of Toulouse-Le-Mirail prepares a book on trebuchets.

<sup>20</sup> A useful survey on siege machines in Scandinavia is provided by the Danish historian A. Bruhn Hoffmeyer, *Belejringsmaskiner*, [in:] *Kulturhistoriskt lexikon för nordisk medeltid från vikingatid till reformationstid*, I, Malmö 1956, columns 432–442. On *Blide* (stone-throwing machines working on the principle of leverage) *ibid.*, columns 679–686.

<sup>21</sup> For references to Russian literature, see the works by K. Huuri and W. Świętosławski (notes 7 and 8).

<sup>22</sup> For Arab warfare technology and influence, see the richly illustrated handbook and catalogue to the exhibition "The Crusades" in the Cathedral Museum in Mainz, Germany (1 April to 30 July 2004): *Die Kreuzzüge. Kein Krieg ist heilig*, ed. H.-J. Kotzur, with B. Klein and W. Wilhelmy, Mainz 2004.

west European historians<sup>23</sup>. Archaeological and historical research in the former “target areas” is of course important, but books and articles are mostly published in the languages of these countries and therefore are not always easily accessible to western scholars. To get a full picture it would be necessary to pay attention to research produced for example by Anatolij N. Kirpičnikov and S. A. Shkolyar in Russia, Ain Mäesalu in Estonia, Evalds Mugurčvičs in Latvia, Albinas Kuncevičius and Gintautas Rackevičius in Lithuania as well as many others. That, however, is not possible here. Instead, another and easier way has been chosen for this short survey: simply to take a look at the pertinent chronicles to see what they tell us.

The most important Livonian chronicles are the *Chronicon Livoniae* by Henry of Livonia (Heinrich von Lettland)<sup>24</sup> and the *Livländische Reimchronik (Livonian Rhyme chronicle)*<sup>25</sup>. The chronicles of the Teutonic Order in Prussia are collected in *Scriptores rerum Prussicarum*<sup>26</sup>. Of greatest interest to us are those by Wigand of Marburg<sup>27</sup>, Peter of Dusburg<sup>28</sup>, Hermann of Wartberge<sup>29</sup>, *Annalista Thorunensis*<sup>30</sup> and Posil-

ge<sup>31</sup>. Three administrative books of the Prussian branch of the Order, *Das große Ämterbuch*<sup>32</sup>, *Das Marienburger Ämterbuch*<sup>33</sup> and *Das Marienburger Tresslerbuch*<sup>34</sup> deserve mention. Useful information can also be found in the correspondence of the Teutonic Order<sup>35</sup>.

## I. Non-Shooting Machines

### Battering Rams

The battering ram (Lat. *aries* etc.; Ger. *Tümmeler*, *Tümmeler* etc.) was used to destroy walls and open castle gates<sup>36</sup>. It consisted of a heavy trunk, which could be of a considerable length, and which had a solid iron head. There were several different types. The ram was mostly suspended in iron chains in a stand and was thrust against the wall by several soldiers alongside the trunk (Fig. 1). The whole construction was protected by a wooden frame covered in wet hides or earth and fascines. Often moats had to be drained and ditches filled and boarded over before the ram could be wheeled right up to the wall. It was a very effective machine since no wall could withstand its rhythmic blows if these went on for days or even weeks. The defenders of castles or towns therefore dreaded battering rams and were eager to destroy them (as well as other siege machines) by throwing stones at them, setting fire to them or by making surprise attacks through the gates to wreck them. Also other methods were invented in order to soften the blows or to topple the ram by employing large grappling hooks that were lowered from the wall.

<sup>31</sup> See note 13.

<sup>32</sup> *Das große Ämterbuch des Deutschen Ordens*, ed. W. Ziesemer, Danzig 1921 (repr. Wiesbaden 1968).

<sup>33</sup> *Das Marienburger Ämterbuch*, ed. W. Ziesemer, Danzig 1916.

<sup>34</sup> *Das Marienburger Tresslerbuch der Jahre 1399–1409*, ed. E. Joachim, Königsberg 1896 (repr. G. Knieß, Bremerhaven 1973).

<sup>35</sup> GStA PK, XX. HA StA Kbg. (Geheimes Staatsarchiv Preußischer Kulturbesitz, Berlin. XX. Hauptabteilung Historisches Staatsarchiv Königsberg), OBA (Ordensbriefarchiv) — Hereafter cited as OBA. — Also see OF (Ordensfolianten) *ibid*.

<sup>36</sup> When besieging the city of Brest in 1329 the Teutonic knights used *duas machinas, cum quibus percuciebant ad civitatem, et unum aliud instrumentum dictum tumlar ad destruendum muros civitatis* (according to a Polish testimony of 1339). SRP II, p. 721.

<sup>23</sup> As for the Teutonic Order there is an article in English by A. R. Chodyński, *The Preparations for War Expeditions to Lithuania and Samogitia According to the Chronicle by Wigand of Marburg*, [in:] *Le convoi militaire*, ed. T. Poklewski-Kozieł, “Fasciculi Archaeologiae Historicae”, XV, Łódź 2002 (2003), pp. 39–46, especially at pp. 43–45. Also see D. Heckmann, *Kriegstechnische Innovationen in den mittelaltelichen Deutschordenslanden Preußen und Livland*, [in:] *Kriegführung und Kriegsdeutung im Mittelalter*, ed. M.-L. Heckmann and P. Thorau, “Militär-geschichtliche Zeitschrift”, 65, 1, Munich 2006, pp. 113–129. More references are provided by S. Ekdahl, *Warfare in Baltic Crusades*, [in:] *The Crusades: An Encyclopedia*, ed. A. V. Murray, 4 vols., Santa Barbara, Calif., 2006.

<sup>24</sup> See note 4.

<sup>25</sup> *Livländische Reimchronik, mit Anmerkungen, Namenverzeichnis und Glossar*, ed. L. Meyer, Paderborn 1876 (repr. Hildesheim 1963).

<sup>26</sup> SRP, I–V, Leipzig 1861–1874 (repr. Frankfurt am Main 1965). Cf. note 5.

<sup>27</sup> See note 11.

<sup>28</sup> See note 5.

<sup>29</sup> Hermann von Wartberge, *Chronicon Livoniae* (hereafter cited as Hermann von Wartberge), ed. M. Toeppen, [in:] SRP II, Leipzig 1863, pp. 9–21 (introduction), pp. 57–116 (edition).

<sup>30</sup> *Franciscani Thorunensis Annales Prussici (941–1410)* (hereafter cited as *Annalista Thorunensis*), ed. E. Strehlke, [in:] SRP III, Leipzig 1866, pp. 13–22 (introduction), pp. 57–316 (edition).

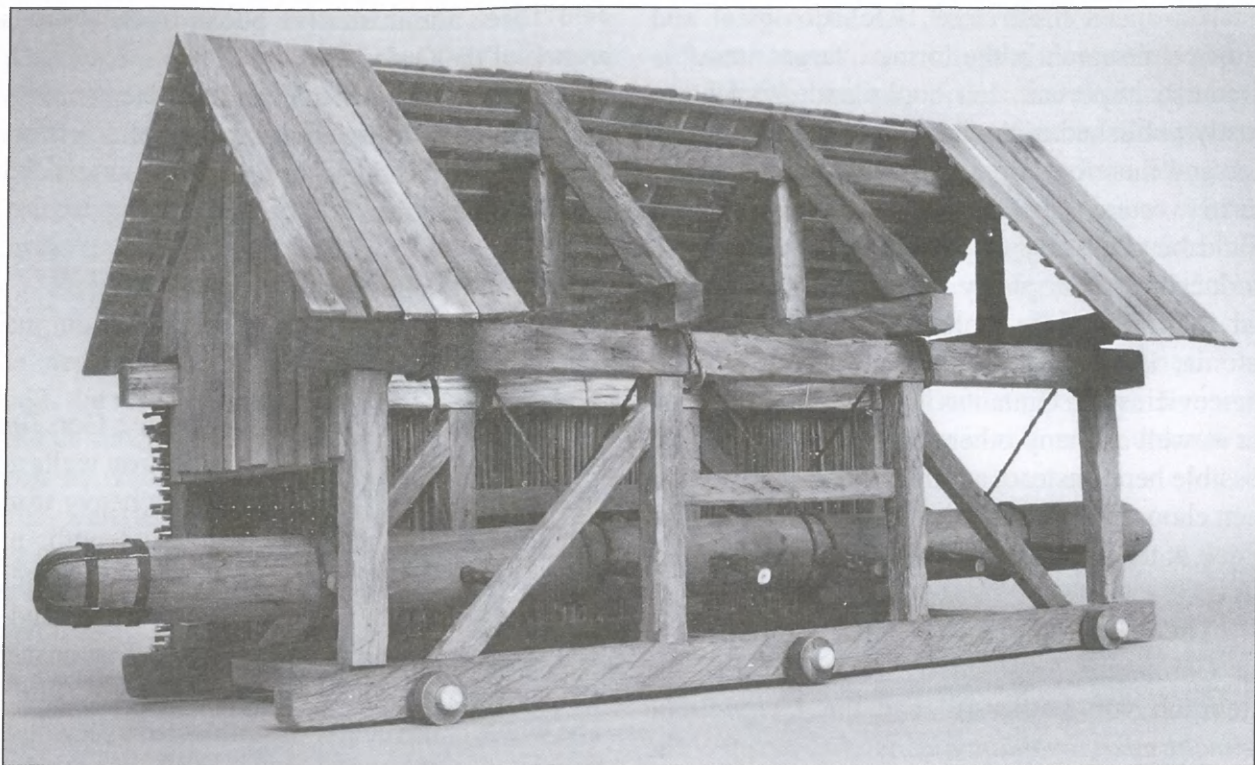


Fig. 1. Battering ram. Replica in scale 1:8 (Length 140 cm; Height 62 cm; Width 58 cm). Courtesy Bischöfliches Dom- und Diözesanmuseum Mainz. Inv.-Nr. V 5871.

Sometimes an iron hook was mounted on the iron head of the ram for drawing out stones and trunks from the wall. It may be that the contemporary German name *huke*, which is used by Hermann of Wartberge when describing a siege in 1377, refers to either a ram or another machine with such a hook<sup>37</sup>. Moreover, hooks for drawing out big trunks from the wall are mentioned by Henry of Livonia in 1227<sup>38</sup>.

Battering rams belonged to the “standard” siege engines during the Baltic crusades, even if they are not explicitly mentioned in the chronicles and only are designated as “other war machines” (i.e. except for the *machinae*, which mostly refers to stone-throwing engines). Hermann of Wartberge describes how the Lithuanians in 1369

<sup>37</sup> Hermann von Wartberge, p. 113. The Teutonic Order’s Master of Livonia laid siege to a Russian castle at the Dūna (Daugava, Dvina) river in 1377 and thereby used *quatuor machinas cum duobus aliis instrumentis bellicis dictis ‘huke’*.

<sup>38</sup> Heinrich von Lettland, XXX, 4 (p. 332). The Christians conquer a castle of the heathen Estonians at the island of Ösel in 1227: ... *primo mane magis invaluit pugna, ut etiam ferro recurvo vel unco ferreo iam infringerent munitionem, detrahentes singillatim ligna queque maxima, per que munitio tenebatur, ut aliqua pars munitionis iam ad terram usque veniret.*

besieged and conquered the Teutonic Order’s castle Gotteswerder with *XVIII machinas preter alia instrumenta bellica*<sup>39</sup>. Thanks to the *Annalista Thorunensis* we know that these “other war engines” were *tomeler*, battering rams<sup>40</sup>. During the war between the Teutonic Order and Poland in 1329 the Knights attacked the city of Brest with two stone-throwing engines and “another machine called *tumlar*, to destroy the walls of the town”<sup>41</sup>. Sometimes the word *aries* is used<sup>42</sup>. It is helpful to compare the Latin and German terms of *Annalista Thorunensis* and Posilge, who both relate the conquering of the Order’s castle Marienwerder on the river Memel by the Lithuanians in 1384. The Latin sentence *cum machinis, tumelariis, pixidibus et sagittis*<sup>43</sup> in Posilges chronicle reads in German: *mit bliden, tumelern unde buchsen und geschosse*<sup>44</sup>.

<sup>39</sup> Hermann von Wartberge, p. 94.

<sup>40</sup> *Annalista Thorunensis*, p. 88: *Habuerunt in obsidione XV machinas et V tomeler.*

<sup>41</sup> SRP II, p. 721: *habebant ante [civitatem Brestensem] duas machinas, cum quibus percuciebant ad civitatem, et unum aliud instrumentum dictum tumlar ad destruendum muros civitatis.*

<sup>42</sup> See note 49.

<sup>43</sup> *Annalista Thorunensis*, p. 135.

<sup>44</sup> Posilge, p. 135.

Wigand of Marburg provides a vivid description of how the Teutonic Knights conquered the large and sturdy Lithuanian castle of Kaunas in 1362<sup>45</sup>. He thereby stresses the importance of the battering rams and other war machines that helped destroy its towers and walls. It was, in fact, a remarkable siege, comparable to those that enveloped the castles of Vilnius in 1390<sup>46</sup> and of Marienburg in 1410<sup>47</sup>. However, by contrast, the castle of Kaunas was conquered<sup>48</sup>. Wigand records the names of three master craftsmen in the army of the Order, who played an essential role in that successful undertaking. Marquardus of Marienburg was a *magister carpentariorum* or *lignarius*. It was he who built a battering ram that caused a tower at the river Memel to collapse<sup>49</sup>. It was also he who erected a siege tower as tall as the castle<sup>50</sup>. Magister Mattias of Königsberg, a *faber lignorum*, constructed a battering ram which totally destroyed another tower at the river. The same machine was used for heavy attacks on the walls of the castle<sup>51</sup>. Magister Matthias of Elbing erected a siege tower at the castle's east side<sup>52</sup>. Also other machines are mentioned<sup>53</sup>. It is obvious

<sup>45</sup> Wigand, pp. 531–539.

<sup>46</sup> During the Lithuanian civil war Vilnius was besieged by three armies in 1390. The first army consisted of Livonian troops, the second of Samogitian and Lithuanian troops under the command of Grand Duke Vytautas, and the third by Prussian troops including 300 Englishmen under Lord Bolingbroke. Of Vilnius's three castles only the wooden one was conquered. For different reasons, the two more stoutly built castles withstood their sieges.

<sup>47</sup> After the battle of Tannenberg (Grunwald, Žalgiris) in 1410 the Poles and Lithuanians laid siege to the Teutonic Order's main castle Marienburg, but they could not conquer it.

<sup>48</sup> For a summary of the events in English see A. R. Chodyński, *The Preparations ...*, pp. 43–45.

<sup>49</sup> Wigand, p. 532: *Tunc magister carpentariorum de Marienburg Marquardus confixit et construxit unam machinam sive arietem, [vulgariter tūmeler], quo mediante ejecit unum propugnaculum de acie castris contra Mimelam.*

<sup>50</sup> Ibid.: *Consequenter dicti magistri lignarii, Marquardus scilicet de Marienburg, erexit structuram equalis altitudinis domus ad fossam domus, magister Matthias similiter de Elbingo ad orientem, ...*

<sup>51</sup> Ibid.: *Similiter magister Mattias, faber lignorum de Kongisberg, fecit omnino parem, cum quo disjecit propugnaculum usque ad fundum, quod stetit prope Nergam; similiter graviter impugnavit murum castris cum eodem instrumento.*

<sup>52</sup> See note 50.

<sup>53</sup> Wigand, p. 532: *Et Strosburgenses cum structuris suis graviter murum dirumpunt.*

that these men were skilled artisans, probably specialists from the war production factories, i.e., the workshops (*Schnitzhäuser*) in Prussia<sup>54</sup>.

### Wall Drills

The chronicles do not produce evidence for the use of wall drills during the Baltic crusades, but that is not definite proof for their non-existence. In modern German the name of this sophisticated war machine is *Mauerbohrer*; in the Middle Ages it appears to have been called *Krebs* (“cancer”) or other terms. It consisted of a long and heavy trunk with a sharp drill at its head. The trunk lay in a groove. It was pushed against the wall and was made to drill by ropes twisted around it. The drill thus penetrated into the joints between the stones, so that these could be loosened and removed.

### “Hedgehogs” and “Sows”

It is not always possible to tell exactly which function the war machines had, but the names of some of them allude to what was viewed as the typical behaviour of the animals mentioned. Thus *ericus* (“hedgehog”; Ger. *Igel*), *porcus* and *sus* (“pig”, “sow”; Ger. *Schwein*) were machines for rooting, i.e., undermining the walls<sup>55</sup>.

### “Cats”

To protect the battering rams and similar war machines as well as the soldiers operating them, strong roofs and shelters were built. Wooden constructions were also used for sheltering the soldiers who were digging under the walls in order

<sup>54</sup> See the map “Workshops (Schnitzhäuser) in castles of the Teutonic Order in Prussia during the first half of the 15<sup>th</sup> century“ in: S. Ekdahl, *The Strategic Organization of the Commanderies of the Teutonic Order in Prussia and Livonia*, [in:] *La Commanderie, institution des ordres militaires dans l'Occident médiéval*, ed. A. Luttrell, L. Pressouyre, “CTHS, Archéologie et d'histoire de l'art”, 14, Paris 2002, pp. 219–242, fig.10 at p. 233.

<sup>55</sup> Heinrich von Lettland, XXIII, 8 (p. 242): *... alii edificant ericios, de subtus fodere vallum incipiunt, ...*; ibid., XXX, 4 (p. 332) : *... porcum fingunt, sub quo castrum fodiunt, donec ad medium vallum perveniunt.* Also see ibid., XXVIII, 5 (p. 308): *..., terrores multos castrensibus incutiunt, eo quod alii instrumenta, que ericios et porcos vocant, preparant, ...* With respect to the various types and names of war machines see Ph. Contamine, *War in the Middle Ages ...*, pp. 102–103.

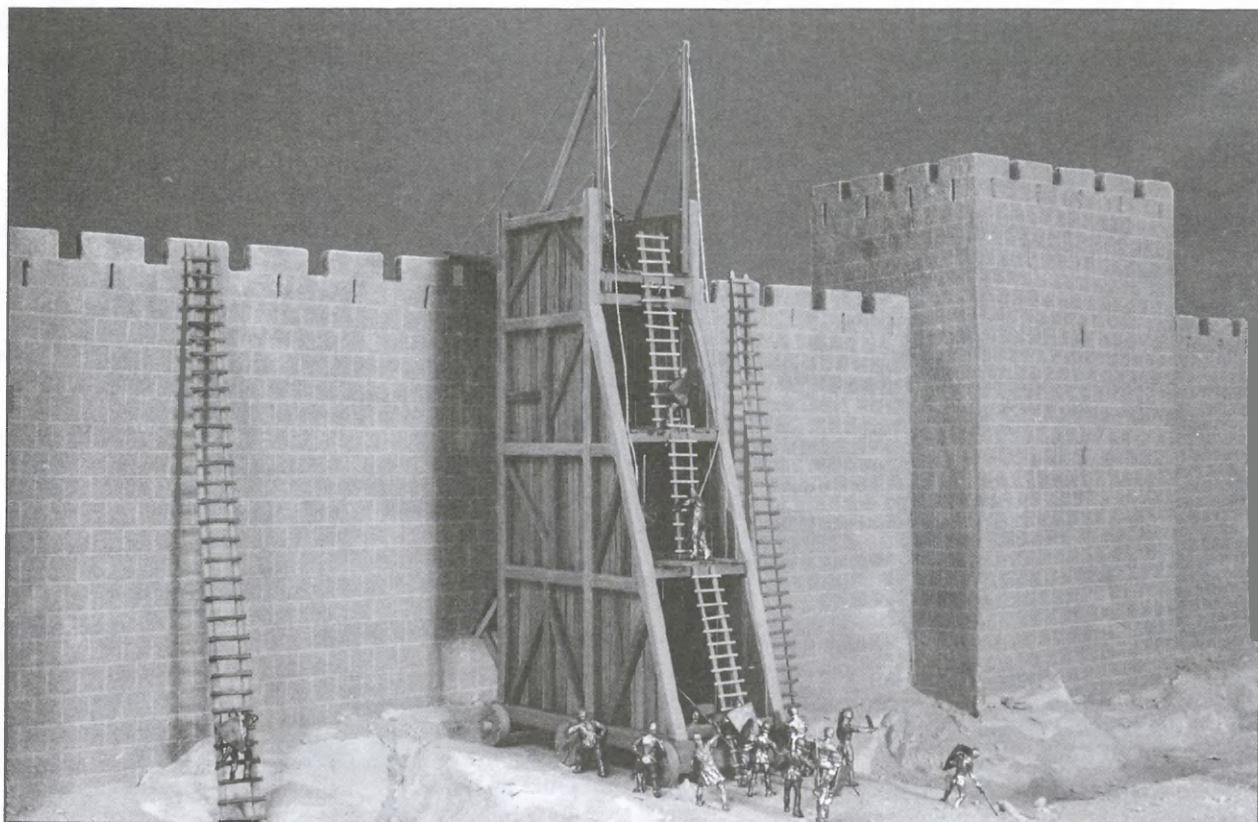


Fig. 2. Siege tower. Replica in scale 1:8 (Height 220 cm; Length ca 134 cm; Width ca 60 cm). Courtesy Bischöfliches Dom- und Diözesanmuseum Mainz. Inv.-Nr. V 5863.

to cause their collapse. Such machines, called “Cats”<sup>56</sup>, were surely used, even if this exact name does not occur in the Livonian and Prussian chronicles. Inside the “cat” expert soldiers destabilized the wall with iron instruments.

### Siege Towers

The siege tower figured among the most important war engines (Fig. 2). It was supposed to be as high as or higher than the walls of the besieged castle and was preferably built of long and strong trunks of firs and pines that were brought in from nearby forests<sup>57</sup>. A siege tower was a complicated piece of construction, and it took a long time to erect<sup>58</sup>. Then, it had to be pushed laboriously over the filled-in moat or ditch to the wall, a dif-

ficult undertaking<sup>59</sup>. In Latin chronicles the siege tower is often called *propugnaculum*<sup>60</sup>, but sometimes also — if its height actually matched that of the castle walls — *structura eque alta*<sup>61</sup>. Sources in German in that case use the designation *Ebenhöhe* (“equally high”). That is the term frequently employed in the Livonian Rhyme Chronicle<sup>62</sup>.

From the top of a proper siege tower, soldiers could surmount the walls over a drawbridge. The bigger towers had two or more floors to stabilize the construction and to shelter soldiers preparing for assault. It might also have been possible to operate smaller war engines from those same plat-

<sup>56</sup> Ibid., p. 102.

<sup>57</sup> Heinrich von Lettland, XXX, 5 (p. 334): ... *et maximas arbores abiernas et terebinthinas ad faciendam turrim contra munitionem castris* (1227).

<sup>58</sup> When laying siege to the Estonian castle of Dorpat (Tartu) in 1224, it required eight days for the Germans to build such a strong *propugnaculum sive turrim ligneam fortissimam*, which was built of many mighty and high trees; *ibid.*, XXVIII, 5 (p. 306).

<sup>59</sup> Ibid.

<sup>60</sup> Ibid., XXIII, 8 (p. 242): *Quorum alii propugnaculum edificant, [...] alii lignorum comportationibus fossatum implent, et propugnaculum desuper impellitur, sub quo ab aliis foditur*

<sup>61</sup> Wigand, pp. 532 and 561: *machinam eciam eque-altam rex adduxit, fossam equavit*. (The Lithuanians besiege and conquer the Order’s castle Gotteswerder 1369.) Also see note 50.

<sup>62</sup> Livländische Reimchronik, 5382–3 (p. 124): *doch wurden ebenvôe rîch [i.e. mighty] / gebûwet und zû getriben*. Also see *ibid.*, 9580–3 (p. 219); 9647–8 (p. 221).

forms. On the ground under the siege tower and protected by it, other soldiers could batter the walls or undermine them by digging<sup>63</sup>.

When the time came for assault, long scaling ladders (*scalae*)<sup>64</sup> were thrown against the walls at strategic places to surmount them from different directions. Many types existed. Most of them were made of wood, others could be dismantled and had big hooks at the upper end. Such ladders have not been preserved. However, an iron ladder from the end of the 15<sup>th</sup> century is kept in the arsenal of the Art Museum in Vienna. It is 8.30 m long and, when dismantled, consists of 17 parts<sup>65</sup>.

The defenders possessed various means for warding off attacks, for instance by using engines and hooks from above to try to topple the machines placed near the wall, or by swinging heavy tree trunks close alongside the siege apparatus. The Russians employed an extraordinary method when successfully defending Novgorod against a Lithuanian army in 1401. They erected a giant net normally used for hunting wild animals above the wall, and when it dropped and unfurled it netted 60 of the best attackers who seemed to be lost for good. However, at the last moment a foreign knight among the Lithuanians succeeded in saving the trapped besiegers by cutting the lines of the net with his sword. Such a trick had never been seen before, Posilge writes<sup>66</sup>.

## II. Missile-Throwing Engines

There were three basic categories of missile-throwing mechanical engines, depending on which type of propulsion hurled the stones, arrows, darts, spears, incendiaries and other projectiles: tension, torsion and leverage. This definition, made by the Danish scholar Ada Bruhn Hoffmeyer, seems to be the best when describing the many different machines<sup>67</sup>. All three types were represented during the Baltic crusades, but there are still many uncertainties and questions to be discussed. This is the consequence of the ad-

mittedly laconic designations and descriptions in the sources, which in consequence allow differing interpretations.

### Tension

#### Personal Crossbows

The history of the crossbow as well as its construction and handling is well known and need not be repeated here<sup>68</sup>. It was a typical long-range weapon of the crusaders, well suited during sieges to attack and defence alike. The military orders had brought it to the Baltic region, were the heathen eagerly adopted it. By contrast, the orthodox Russians still preferred their traditional bows. One incident, told by Peter of Dusburg, proves that it was a modern weapon, which was unknown in the Baltic until the arrival of the Christians. During a Prussian attack against the castle of Königsberg about 1262, a Teutonic knight had to leave his tightly drawn crossbow on the ground in front of the castle and run away to save his life. There it was found by the heathens. One man picked it up and hung it around his neck. Others came to take a look at it and accidentally released the trigger so that the string cut the throat of the man, and he died. "Therefore the Prussians since then feared the crossbows very much", Peter of Dusburg writes<sup>69</sup>.

The Latin name of the crossbow is *bal(l)ista*<sup>70</sup> and that of the crossbowmen *bal(l)istarii*<sup>71</sup>, as recorded, for example, in the chronicle of Henry of Livonia. The corresponding German name is *Armbrust*, but in the inventories of the Order a more

<sup>68</sup> A current and comprehensive book on this subject is V. Serdon, *Armes du diable. Arcs et arbalètes au Moyen Âge. Préface de Philippe Contamine*, Rennes 2005. Also see S. Ekdahl, *Die Armbrust im Deutschordensland Preußen zu Beginn des 15. Jahrhunderts*, "Fasciculi Archaeologiae Historicae", V, ed. A. Nadolski, Łódź 1992, pp. 17–48. Cf. Ekdahl, *Horses and Crossbows ...*, G. Rakevičius, *Arbaletas ...* and J. Liebel, *Springalds ...*

<sup>69</sup> Peter von Dusburg, III:105 (p. 107).

<sup>70</sup> Heinrich von Lettland, XXVI, 8 (p. 286): ... *dividentes balistas fratrum milicie quam plurimas inter se, quas rapuerant*. (The heathen of the island of Ösel in 1223 shared the many crossbows, which they had captured from the Sword-Brothers.)

<sup>71</sup> *Ibid.*, XV, 3 (p. 132): *Et occurrunt eis balistarii in campum, qui a Riga missi castrum cum Lyvonibus custodiebant, ...*

<sup>63</sup> Cf. note 55.

<sup>64</sup> Peter von Dusburg, III: 177 (p. 132); *Annalista Thorunensis*, p. 136.

<sup>65</sup> V. Schmidtchen, *Kriegswesen ...*, p. 211.

<sup>66</sup> Posilge, p. 250.

<sup>67</sup> A. Bruhn Hoffmeyer, *Belejringsmaskiner*, columnns 435–437.

subtle classification was often used, mostly depending on how the bow was bent, i.e. drawn<sup>72</sup>.

### Non-Personnel Great Crossbows

Among the many different types of crossbows are non-personnel and more or less stationary *Bankarmbrüste* and *Wallarmbrüste*, used mainly for the defence of towers and walls. One example for this is the well preserved “Wallarmbrust Baumkircher” of the fifteenth century in the Hofjagd and Rüstkammer of the Museum of Art History in Vienna (Fig. 3)<sup>73</sup>. This single-arm bow was made from many layers of horn and wood and is covered by parchment. The crossbow’s weight is 8.6 kg, it is 110 cm long, 95.5 cm broad, and 11 cm high<sup>74</sup>. It is thus much smaller than the common *Bankarmbrust*, which is depicted in most detailed fashion in the famous medieval Löffelholz manuscript in the library of the Jagiellonian University in Cracow (Fig. 4)<sup>75</sup>. The sheer size of that great crossbow can be gleaned by comparing it with the man at the spanning stand. As the illustration demonstrates, the bow is spanned, i.e. drawn taut, by using the principle of leverage<sup>76</sup>.

Even larger were the mounted (horn) crossbows with a span of as much as 1.6 and even 2 m. Jean Liebel has compiled detailed information

<sup>72</sup> S. Ekdahl, *Die Armbrust ...*, pp. 26–28.

<sup>73</sup> The author thanks Dr Matthias Pfaffenbichler from the Directorate of the Hofjagd und Rüstkammer for detailed information and also for the permission to use a photo of the crossbow.

<sup>74</sup> Because it is bigger than a personal “one-foot”, but smaller than a “two-foot crossbow” (*Bankarmbrust*), its size, according to Liebel (p.51), “could qualify it for the name ‘bastard’”.

<sup>75</sup> Biblioteka Jagiellońska, Ms Germ. Qu 132 (“Abbildungen und Beschreibungen von allerlei Handwerkszeugen, Folterinstrumenten, Jagdgeräten, Waffen... und anderen Unterhaltungsaufgaben, aus der ehem. Preussischen Staatsbibliothek zu Berlin, gegenwärtig in der Biblioteka Jagiellońska”) fol. 20r. The author thanks vice-director Dr Andrzej Obrębski of the Jagiellonian Library for permission to reproduce this picture.

<sup>76</sup> For more information see the study of Jean Liebel, in which another illumination in the Löffelholz manuscript of such a great crossbow and its spanning stand is also reproduced (Biblioteka Jagiellońska, Ms Germ. Qu 132, fol. 19v.). J. Liebel, *Springalds ...*, pp. 43–48, at p. 44. The contemporary German text under this picture reads as follows: *ein panckarmprüst* (i.e. “Bankarmbrust”), and not “*ein pauckarmprust*” (cf. Liebel, p. 43).

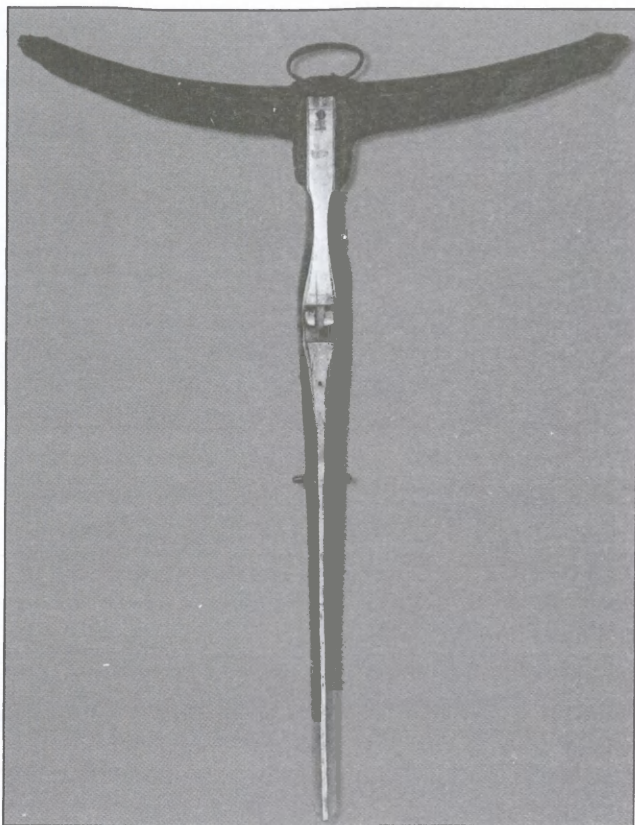


Fig. 3. Wallarmbrust Baumkircher. Length 110 cm; Width 95.5 cm; Height 11 cm; Weight 8.6 kg. Courtesy Kunsthistorisches Museum Wien. Inv.-Nr. HJRK A 108.

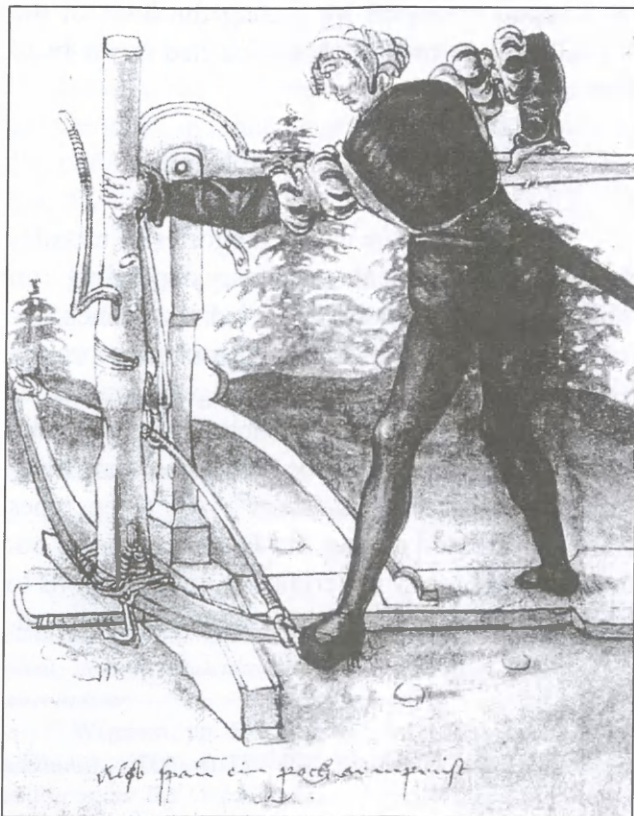


Fig. 4. Bending a great crossbow in a spanning stand. Courtesy Biblioteka Jagiellońska, Cracow. Ms. Germ. Qu. 132, fol. 20r.



about such great machines<sup>77</sup>. One of them has been preserved to the present today in the castle museum of the old German city of Quedlinburg. It is a single-arm mounted composite bow, 1.62 m long<sup>78</sup>, which is said to have been captured by the burghers of Quedlinburg at the castle of Gersdorf, which belonged to their adversary, count Albrecht II of Regenstein. That feat happened during a war in the 1330s. Thereupon, the victors triumphantly displayed their war trophy in the town hall of Quedlinburg. In 2003 it was “found” in the museum by Danish experts on medieval weapon from the Medieval Centre in Nykøbing (Nykøbing) Falster. The bow is fixed to a mount (Fig. 5). A dendrochronological investigation dates the machine to “about 1335–37”. The mount is made of oak from southern Lower Saxony (Süd-nieder-sachsen). The Danes also had the bow internally examined using a computer tomograph performed at the Quedlinburg hospital. Results show that it consists of horn and sinews of stags and is covered by parchment (Fig. 6)<sup>79</sup>. Even the spanning stand was found in the loft of the castle museum.

Of great interest is also a Mongolian siege machine, depicted in Russian<sup>80</sup> and Polish<sup>81</sup> literature on the basis of an old Russian miniature. It had a strong composite bow made of horn, sinew and wood, which is said to have shot a sturdy dart or a 11 kilogram heavy stone in a flat trajectory about 140 m<sup>82</sup>. The length of the machine seems to have been about two metres (Fig. 7).

The inventories of the Teutonic Order’s castles in Prussia often mention *Bankarmbrüste* and their large arrows, used for defence<sup>83</sup>. However,

<sup>77</sup> J. Liebel, *Springalds ...*, p. 25.

<sup>78</sup> The bow may originally have been 20 cm longer. Cf. M. Jähns, *Handbuch einer Geschichte des Kriegswesens von der Urzeit bis zur Renaissance. Technischer Theil: Bewaffnung, Kampfweise, Befestigung, Belagerung, Seewesen*, Leipzig 1880, p. 761.

<sup>79</sup> The author thanks Mrs Brigitte Meixner of the City Museums of Quedlinburg and Dr Peter Vemming Hansen of the Medieval Centre in Nykøbing Falster (Denmark) for this information.

<sup>80</sup> S. N. Syrov, *Stranicy istorii*, Moscow 1979, p. 45.

<sup>81</sup> H. Kotarski, *Zagadnienie wiarygodności informacji o mongolach w „Historii Polski” Jana Długosza*, [in:] *Jan Długosz. W pięćsetną rocznicę śmierci. Materiały z sesji (Sandomierz 24–25 maja 1980 r.)*, ed. F. Kiryk, Olsztyn 1983, pp. 153–190, at p. 159 (fig. 3).

<sup>82</sup> *Ibid.*

<sup>83</sup> See, for instance, *Das große Ämterbuch ...*, pp. 219, 366 and 367.

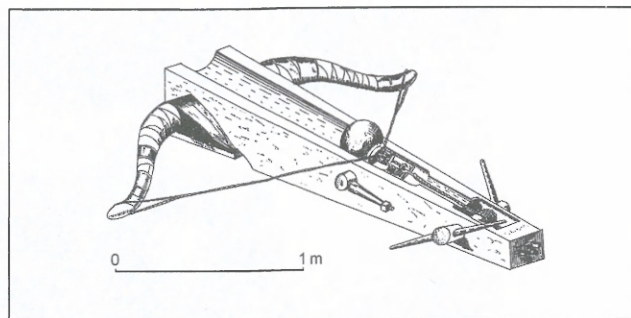


Fig. 7. Mongolian medieval great crossbow. Length ca 2 m. After H. Kotarsky (Syrov).

occasionally heavy crossbows shooting oversized darts and spears could nevertheless be used as anti-personnel weapons in field battles or during sieges. They were then attached on a movable construction which could be wheeled, a cart for instance. If wooden, the bows could be up to 3–5 m long<sup>84</sup>.

The Livonian Rhyme Chronicle mentions a siege machine *ribalde*, which was often built by the Lithuanians and driven to the moat in front of the besieged castle of the Order<sup>85</sup>. It was obviously of rather simple construction, because sometimes many of them had to be built. Wood from nearby forests was required for that<sup>86</sup>. The author of the chronicle makes a difference between siege towers and *ribalde*<sup>87</sup>. He notes that once the heathen had made many big *ribalt* in ten days<sup>88</sup>. Perhaps it was just another type of a moveable tower or shelter (*Schirm*), but it might also have been a giant single-armed wooden crossbow which was sheltered and could be wheeled or pushed to the moat. A composite hornbow made of billy-goat horn, sinew and wood is in this case out of question, because that type of bow was very complicated to build, a process which required special equipment

<sup>84</sup> K. Huuri, *Zur Geschichte ...*, pp. 6–7.

<sup>85</sup> *Livländische Reimchronik ...*, lines 2504–2505, 9595–9603, 10021–10025, 10041–10046, 10051–10053, 10078–10084.

<sup>86</sup> *Ibid.*, lines 10021–10025: ... *sie liczen manchen heiden balt / nâch holtze varen in den walt; / sie brâchten holtz und delen wider / und legeten ûf dem velde nider. / Sie buweten ribalde grôz.*

<sup>87</sup> *Ibid.*, lines 9595–9603: ... *nû was die ebenhõe komen / als ir hie vor habt vernomen / mit manchem ribalde ûf den graben.*

<sup>88</sup> *Ibid.*, lines 10041–10046: *Der heiden arbeit lât ûch sagen: / sie hetten in zehn tagen / gemacht manchen ribalt grôz.*

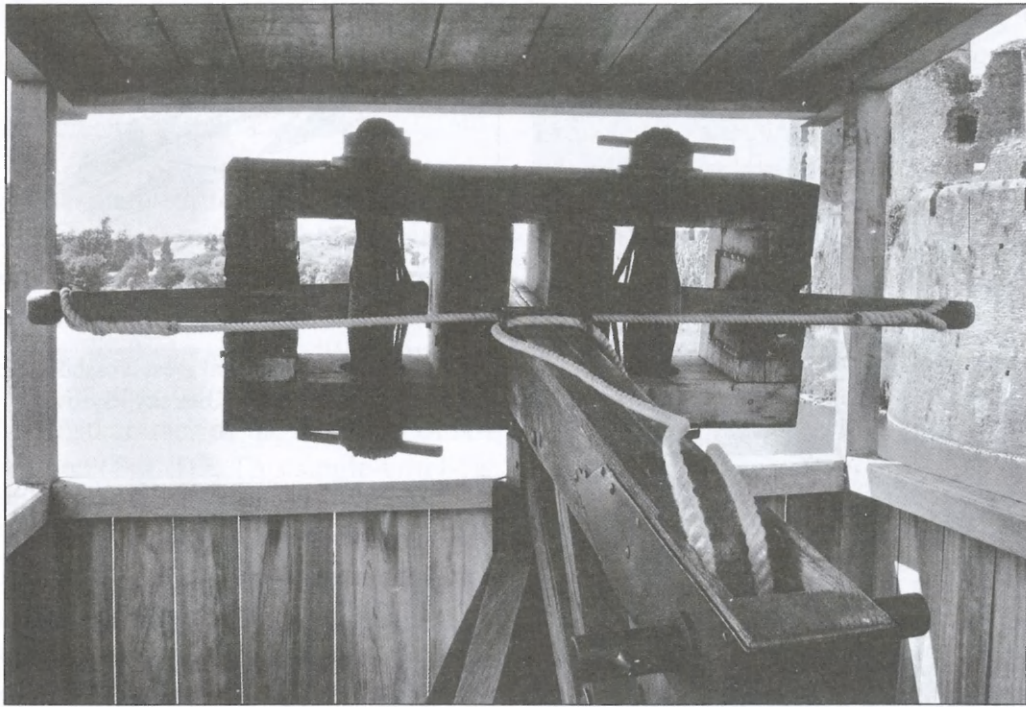


Fig. 8. Ballista (Springald). Replica in Caerphilly castle. Photo: S. Ekdahl.

and a lengthy construction schedule. According to the chronicle, Mindaugas (*Myndowe*) ordered his people to “cut ribalde” (*ribalde howen*)<sup>89</sup>, which might indicate that suitable trees were cut in the forest for this purpose. Preferred trees for wooden bows were especially yews and ashes. Oak, elm and fir also sufficed. This suggestion of definition of the *ribalde* in the Livonian Rhyme chronicle is, however, only a hypothesis by the author and invites further discussion<sup>90</sup>.

### Torsion

#### (Torsion-) Ballistas, Springalds

Another option when building large crossbows was to use torsion. In this case two strong wooden twin arms to the right and to the left of the stock were powered by torsion from skeins of twisted rope, horsehair, or sinew, fixed in frames. Nowadays, the word *ballista* mostly refers to this construction, whereas *ballista* in the Middle Ages also meant a common crossbow, as, for instance, demonstrated in the chronicle of Henry of Livo-

nia<sup>91</sup>. Such a torsion engine has been reconstructed at Caerphilly castle in Wales (Fig. 8)<sup>92</sup>. A windlass at the end of the stock is necessary for bending or stressing the twin arms. The construction is by nature more complicated than that of a single-armed wooden crossbow and is best suited for stationary use. It was therefore employed mainly by defenders, but it could also be used in the field as a powerful anti-personnel weapon. The Caerphilly replica shoots 1.5 m long arrows (darts) at a range of 100 m.

“Torsion-ballistas”, notable for their flat trajectory (i.e. high velocity), were common in Antiquity and were also used during the Middle Ages. The French designation is “Espringales”, the English “Springalds”<sup>93</sup>, whereas German sources use the words “Notstal”, “Springolf” and “Selbschoß”<sup>94</sup>. In Northern Europe, however, this construction may have been problematical because of the moist weather which affected the level of torsion. The large stationary machines

<sup>91</sup> See note 70.

<sup>92</sup> During an excursion to the Caerphilly castle on 9 July 2005 following a conference about mercenaries at the University of Wales (Swansea), this and other war machine replicas were demonstrated by professor John France. The photos from Caerphilly, which are reproduced in this study, were taken by the author on that occasion.

<sup>93</sup> J. Liebel, *Springalds* ..., pp. 2–22.

<sup>94</sup> B. Rathgen, *Das Geschütz* ..., pp. 578–593.

<sup>89</sup> Ibid., lines 2504–2505: *Myndowe hiez die sine gar / ribalde howen; ...*

<sup>90</sup> Cf. the French word *ribaudequin*, which means an armed cart of the infantry, i.e. the commoners who served in the train (*ribauds*). It was armed with spears and crossbows and later also with firearms.

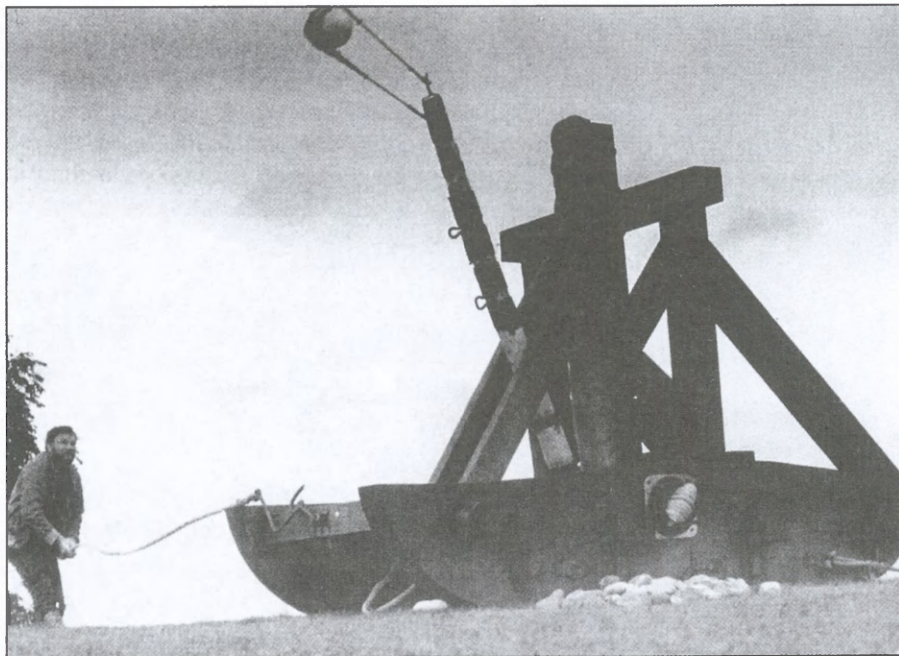


Fig. 9. Mangonel. Replica in the Medieval Centre, Nykøbing Falster. Photo: Middelaldercentret, Nykøbing Falster, Denmark.

*selb(ge)schos* and their big arrows (darts) *selbgeschospfle*, which are recorded in the inventories of the Teutonic Order's castles, belonged to this type<sup>95</sup>. It is noteworthy that the word *selbgeschos* (literally "self-shooting-machine") is used by Russian hunters to designate a crossbow — "samostrel" (самострел) —, whereas in Russian the name of a crossbow for war is "arbalet" (арбалет)<sup>96</sup>. It seems that the Russian hunters have translated the German designation, and not vice versa, as stated by Kalervo Huuri<sup>97</sup>. The Teutonic Knights only used *selbgeschos* to designate springalds and not crossbows<sup>98</sup>. According to the opinion of Rathgen, the original meaning was "sēlgeschos", i.e. in modern German "Seilgeschütz" or, more precise, "Seilbündelgeschütz"<sup>99</sup>. "Seil" is "rope", "Bündel" is "bundle" or "skein". In 1374 there was a *selbgeschos-*

*macher* Michel in the central command (*Komturei*) of Königsberg, i.e., a specialist who built springalds<sup>100</sup>.

### Mangonels

At Caerphilly Castle as well as at the Medieval Centre in Nykøbing (Nykoebing) in Denmark<sup>101</sup> another large siege machine using the principle of torsion has been reconstructed. It is the *mangonel* (or *mange*), developed from the well known *onager* ("wild ass") of Greek and Roman antiquity. It propels stones and other missiles from either a spoon-shaped end of its single throwing arm, or from a pouch, adapted to a sling which is released from an iron tip when the throwing arm is stopped in the upright position (Fig. 9). This type of machine is comparatively inefficient, because it has to be so massive relative to the missile it throws. The pressure from the skein is enormous (Fig. 10). The weight of the Caerphilly replica is three tons, that of the missile a mere

<sup>95</sup> S. Ekdahl, *Die Armbrust ...*, S. 28. In the inventory of *Das große Ämterbuch*, such a machine is mentioned for the last time in 1407 at the castle of Ragnit. By contrast, 360 "Selbstschusspfeile" (darts) were recorded at the castle of Tüchel as late as 1431 (*ibid.*).

<sup>96</sup> Information by Mr Yuri Klitsenko, Moscow.

<sup>97</sup> K. Huuri, *Zur Geschichte ...*, pp. 47–51, esp. p. 51, note 2.

<sup>98</sup> *Das große Ämterbuch ...*, pp. 125, 126, 376, 377, 613, 643, 644, 682, 688.

<sup>99</sup> B. Rathgen, *Das Geschütz ...*, pp. 589–593, at 589, note 27. Cf. J. Leibel, *Springalds ...*, pp. 4 and 6.

<sup>100</sup> *Das große Ämterbuch ...*, p. 2.

<sup>101</sup> The author visited the Centre on 28 July 2005 and on 10 August 2006. The replicas were demonstrated by the deputy director Kåre Johannessen. The photos of the engines in this paper were made by the author on these occasions. The author thanks its director, Dr Peter Vemming Hansen, for additional useful information and for permission to reproduce photos made by the Centre.

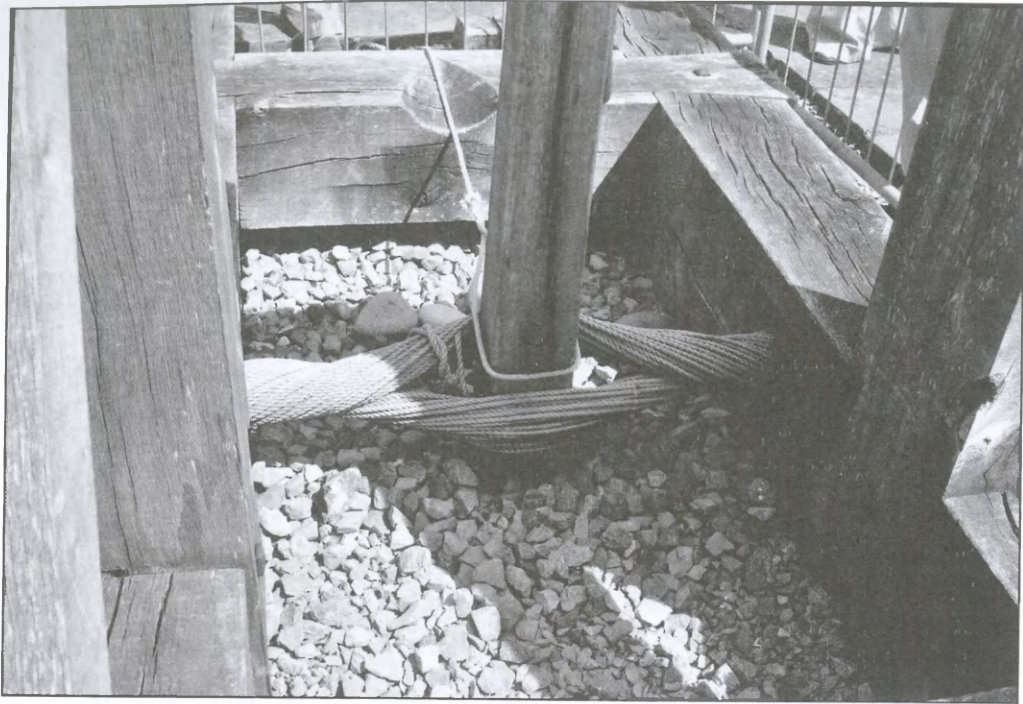


Fig. 10. Mangonel. Replica in Caerphilly castle. The skeins. Photo: S. Ekdahl.

five kg. The hurling range is approximately 110 m. Such machines were probably used mainly to hurl incendiaries etc. into the castles and towns, rather than to bombard the walls.

Torsion catapults were known throughout the Middle Ages. European medieval drawings however show another type than the “classical” one, which has been reconstructed in Caerphilly and Nykøbing<sup>102</sup>. According to Kalervo Huuri, only this type is found in medieval manuscripts (Fig. 11)<sup>103</sup>. It was of a rather simple construction, easy to build and handle. As a matter of fact it might even have been possible to build such an uncomplicated machine with twisted ropes slung between two growing trees, but in that case of course the direction was fixed since, obviously, the catapult could not be moved.

The chronicler Henry of Livonia often mentions a war engine which he calls *pat(h)erellus*. We know that this was a stone-hurling machine, as it is frequently described in the chronicle, but did it work on the principle of torsion or lever-

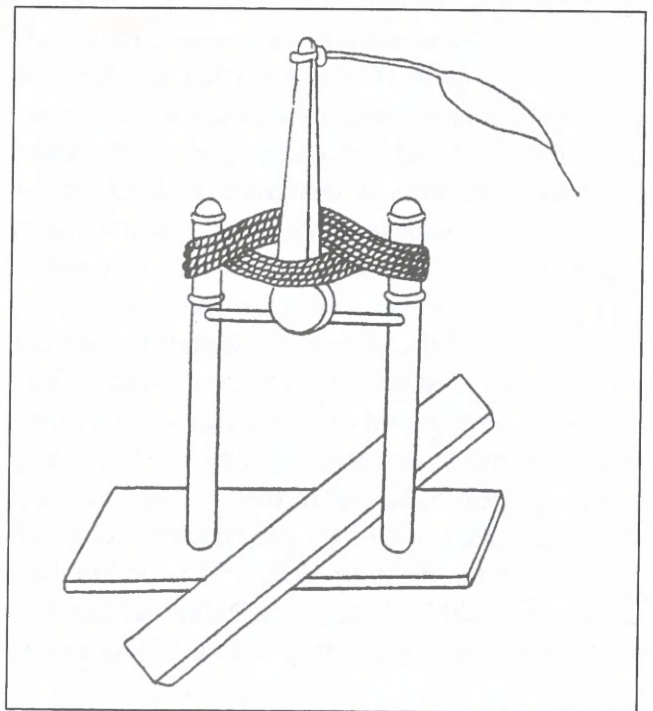


Fig. 11. Medieval mangonel (Mange). Contemporary drawing. After K. Huuri (Schneider).

age? At times, Henry calls it a small *machina*<sup>104</sup>, yet, he also repeatedly makes a difference not only between *machina* and *patherellus*<sup>105</sup>, also be-

<sup>104</sup> Heinrich von Lettland, XIV, 10 (p. 124): ... *ducentes secum machinam minoram sive paterellum* ....

<sup>105</sup> Ibid., XXVII, 2 (p. 294): ... *et patherellos et machinas edificaverunt contra machinas christianorum*, ....

<sup>102</sup> See, for instance, reproductions of mangonels from medieval manuscripts by V. Schmidtchen, *Kriegswesen* ..., p. 156 (fig. 19 right) and p. 160 (fig. 22).

<sup>103</sup> K. Huuri, *Das europäische Geschützwesen* ..., p. 54: „Auch dann nur einige Abbildungen [...], die alle in derselben Weise gezeichnet sind wie Abb. 8 dieser Untersuchung.“



Fig. 12. Chinese medieval traction trebuchet. After K. Huuri (T'u shu).

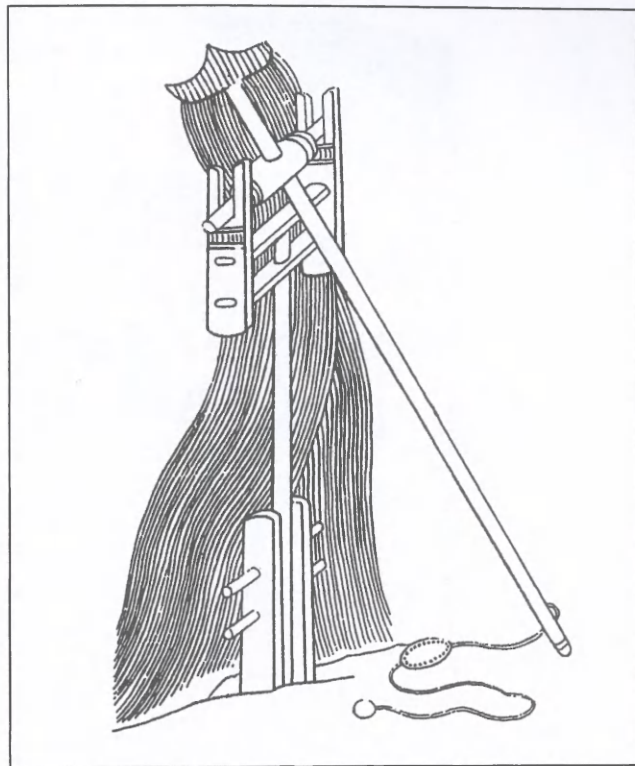


Fig. 13. Chinese revolving medieval traction trebuchet. After K. Huuri (T'u shu).

tween *machina minora* and *patherellus*<sup>106</sup>. This seems to indicate that it was not a hand-operated leverage machine, a traction trebuchet (see below). As it was used not only for throwing stones, but also red-hot iron and pots with fire into a besieged castle, it might have been a torsion catapult with a “spoon” at the end of the throwing arm<sup>107</sup>. A spoon was surely more suited for hurling red-hot iron than was a pouch. One may also ask if the name perhaps alludes to the Latin words *patella* or *patera* (pan or dish). However, this problem also requires further discussion.

Especially interesting is Henry's description of how the heathen Estonian inhabitants of the island of Ösel in 1222 conquered a stone castle, which had been built by the king of Denmark, thereby using no less than 17 *patherelli*. The Danes had given these weapons and other war machines as a gift to their Estonian subjects in other provinces. The knowledge of how to build and handle these was eagerly adopted by the re-

bellious fellow-countrymen of Ösel<sup>108</sup>. Over the course of five days, the 17 *patherelli*, built by the heathen, threw “many and big” stones at the castle, until the garrison surrendered. The victorious heathen then taught their fellow-countrymen in other provinces how to build different types of siege machines and how to use them against the Christians<sup>109</sup>.

### Leverage

There are three different main types of siege machines that work on the principle of leverage: (1) the hand-operated engine whose throwing arm is swung by human muscle-power, (2) the engine that combines muscle-power and a counterweight

<sup>106</sup> Ibid.: ... *machinas minores et patherellos edificant, ...*; XXVIII, 5 (p. 306): ... *machinas minores et patherellos construunt, ...*

<sup>107</sup> Ibid., XXVIII, 5 (p. 308): ... *et alios iactibus machinarum interficiunt, patherellis ferrum ignitum vel ollas igneas in castrum proiciunt, ...*

<sup>108</sup> Ibid., XXVI, 3 (p. 282): *Et quidam ex eis abierunt in Warbolam, considerantes artem patherelli sive machine, quam Dani Warbolensibus, tamquam subditis suis, donaverant. Et reversi in Osiliam ceperunt edificare patherellos et machinas et docebant alios. Et fecerunt unusquisque ex eis suas machinas. Et venerunt simul omnes cum decem et septem patherellis, iactantes lapides multos et magnos diebus quinque continue, et non dabant requiem illis, qui erant in castro, ...*

<sup>109</sup> Ibid., XXVI, 4 (p. 282): ... ; *et docebant eos machinas et patherellos erigere et cetera instrumenta bellica.*



Fig. 16. Traction trebuchets for defence and attack during a siege. After K. Huuri (Petrus de Ebulo, 1196).

and (3) the engine that uses a heavy counterweight as counterpoise. Among these three types there are numerous variants. In all cases the stone or other missile is propelled from a sling which is fastened at the end of the longer part of the throwing arm, the beam.

Conventionally all three types are denoted by the French term *trébuchet*, derived from the medieval Latin word *trabuchus* or *trabuca*. To draw a distinction among them, they are in modern Anglo-Saxon research called: (1) Traction Trebuchet, (2) Hybrid Trebuchet, and (3) Counterweight Trebuchet, as, stated, for instance, by Paul E. Chevedden<sup>110</sup>. In the following we will use this clear definition. For traction trebuchets the French designation *pérrier* is also used in English literature. Literature in German language calls this hand-operated engine *Ziehkraftblide* (B. Rathgen, K. Huuri and others).

In Germany and Scandinavia the common name for all types of leverage machines is *Blide* (*Blida*). In Latin sources from the time of the Baltic crusades they are simply called *machinae*, sometimes with the distinction “smaller” or “larger”.

<sup>110</sup> P. E. Chevedden, *The Invention of the Counterweight Trebuchet: A Study in Cultural Diffusion*, “Dumbarton Oaks Papers”, 54, Dumbarton Oaks 2000, pp. 71–116, at p. 74.

Unfortunately no example of such a machine has survived. An intact dismantled *Blide* was discovered in the loft of a medieval church in the small town of Liebenmühl in East Prussia about 1890, when the decrepit church was being pulled down. Alas, the unfamiliar wooden device found therein was immediately cut up for firewood<sup>111</sup>. Thus our knowledge of this type of siege machines is based mainly on accounts, descriptions and illustrations in old manuscripts, for instance in the famous *Bellifortis* by Conrad Kyeser<sup>112</sup>.

### Traction Trebuchets

This is the oldest and simplest type, well known in the Middle Ages<sup>113</sup>. It evolved in an-

<sup>111</sup> B. Rathgen, *Das Geschütz ...*, p. 613.

<sup>112</sup> Conrad Kyeser of Eichstätt, *Bellifortis* (ca. 1405). The best manuscript is preserved in the Niedersächsische Staats- und Universitätsbibliothek in Göttingen, Cod. Ms. philos. 63. On fol. 30 r a large counterweight trebuchet is depicted. Its main beam measures more than 15 m, the throwing arm (i.e. the longer part of the beam) more than 13 m. See P. E. Chevedden, *The invention ...*, fig. 3. Also see V. Schmidtchen, *Kriegswesen ...*, fig. 26 on p. 163. There is much literature on Conrad Kyeser and his *Bellifortis*.

<sup>113</sup> For the following K. Huuri, *Zur Geschichte ...*, pp. 13–16 (“Ziehkraftblide”) and passim. Also see other literature mentioned by P. E. Chevedden, *The invention ...*, p. 72, note 2.

cient China from the primitive hand sling probably between the 5<sup>th</sup> and the 3<sup>rd</sup> centuries B.C., then spread westwards in the 6<sup>th</sup> century, and was adopted by the Arabs via Persia and Byzantium. Two late medieval Chinese traction trebuchets, one of them capable of revolving, are depicted by K. Huuri (Fig. 12 and 13)<sup>114</sup>. Also see W. Świątosławski<sup>115</sup>. The Mongols learned this new technique and brought it to Russia. In the Middle East and the Mediterranean as well as in northern Europe it was being employed from the ninth century onwards.

There were many different types and sizes of this hand-operated leverage machine. The traction trebuchet (as well as the hybrid trebuchet) was easier to build, to transport and to operate than the “classical” type of mangonel. However, it carried a disadvantage in that the soldiers, who pulled the ropes hanging from the shorter part of the throwing arm, were exposed to fire from the long-range weapons of the enemy.

Replicas of traction trebuchets can be studied at Caerphilly castle as well as in the Medieval Centre in Nykøbing. The Caerphilly version with a triple fork has four ropes attached for being pulled by man-power (Fig. 14). When manned by a crew of six men, the machine is capable of hurling a five kg heavy stone (in this case a cast cement ball) up to a range of about 110 m. The replica in Nykøbing is of a somewhat different (revolving) construction, but the principle is the same (Fig. 15). An interesting medieval drawing in the chronicle by Petrus of Ebulo (1196), reproduced by Huuri, shows a duel between two traction trebuchets during the siege of Naples in 1191 by the forces of Emperor Heinrich VI, one defending and the other attacking the city (Fig. 16). This and other drawings from the Middle Ages mostly depict a man pulling down the pouch in order to increase the tension of the tip of the throwing arm.

### Hybrid Trebuchets

The hybrid trebuchet was an advanced development of the old traction version, “a triumph



Fig. 17. Hybrid trebuchet. Replica in the Medieval Centre, Nykøbing Falster. Photo: S. Ekdahl.

of four civilizations” (Chevedden)<sup>116</sup>. During the Crusader wars of the 12<sup>th</sup> century in the Mediterranean area, it finally acquired recognition in Latin Europe. It reduced the amount of men who pulled the ropes, and it partially replaced muscle-power by gravitational energy, because a counterweight was attached to the shorter arm of the beam. Consequently, the muscular force of the pulling crew was thus considerably amplified. This can clearly be seen in a replica built in Nykøbing (Fig. 17).

### Counterweight Trebuchets

These gravity-powered engines were introduced in Europe around 1200 and must be regarded as the peak of mechanical invention within siege warfare in the Middle Ages. They were large, effective, and dreaded because they were technically far superior to any mechanical machine that had been built before. Because of their

<sup>114</sup> K. Huuri, *Zur Geschichte ...*, fig. 13 and 14 (both after T'u shu, 1726).

<sup>115</sup> W. Świątosławski, *Arms and armour ...*, plate XXII:1 (after S. A. Shkolyar). See the text on pp. 69–70 *ibid.*

<sup>116</sup> For the following see P. E. Chevedden, *The introduction ...*, pp. 75, 85, 91, 95 and *passim*; *idem*, *The traction trebuchet: a triumph of four civilizations*, “Medieval and Renaissance Studies”, 31, 2000, pp. 433–486.

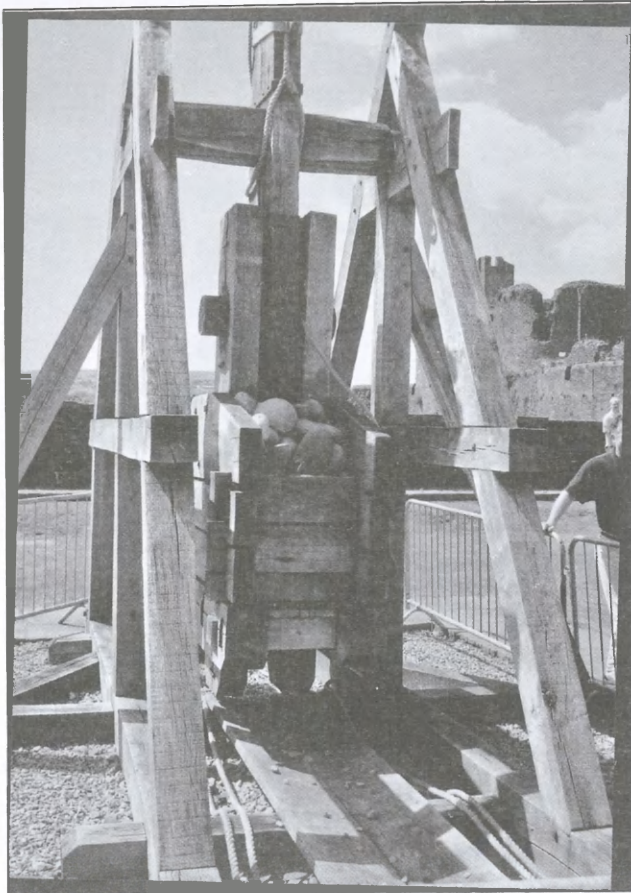


Fig. 18. Runway of the counterweight trebuchet (replica) in Caerphilly castle. Photo S. Ekdahl.

accuracy they could hit the same spot of the tower or wall again and again with heavy stones. Thus, they were capable of demolishing even the strongest castles. To quote Paul E. Chevedden: “The introduction of the counterweight trebuchet led to an increase in the scale of warfare and produced revolutionary changes in military architecture in order to encounter the greater destructive power of this new artillery.”<sup>117</sup>

One important innovation was the lengthening of the sling, which was made possible by the elimination of the pulling crew. As a result, more space was created under the beam and as a further result, a runway for the sling with the projectile could be placed there (Fig. 18). The longer sling with its greater mechanical advantage allowed hurling at a greater distance<sup>118</sup>. The counterweight was either firmly attached to the beam or moveable.

Many replicas of counterweight trebuchets have been built throughout succeeding ages, also

in Caerphilly (Fig. 19) and Nykøbing, where a smaller and a bigger one are demonstrated in the summer season (Fig. 20). When preparing the smaller machine for shooting, the throwing arm is drawn down by about ten persons using a system of pulley blocks. After shooting, the arm hurls into an upright position. The missile is a cast cement ball of about 16 kg. The weight of this machine is nine tons, the weight of the ballast two tons. The missile is thrown about 180 m, reaching an uppermost trajectory of approximately 50 m before descending on its target.

The largest replica in Nykøbing is a masterpiece of experimental reconstruction (Fig. 21)<sup>119</sup>. It is built of oak, has a weight of 21 tons (plus 4,5 tons ballast suspended), and hurls the 16 kg cement ball a distance of 250 m with an upper trajectory of 70–80 m<sup>120</sup>. For drawing the beam down, the two attached treadmills or a system of pulleys can be used<sup>121</sup>. Under favourable conditions a shot might be fired every ten minutes.

These figures from the Nykøbing replica are, of course, not applicable to other counterweight trebuchets. There is much information in medieval sources about huge machines that could hurl very heavy stones — even up to a weight of several hundred kilograms. We do not need to repeat these figures here. It should however be stressed that the effectiveness of the counterweight trebuchet was demonstrated mainly by throwing heavy projectiles over a shorter distance than smaller ones over a longer distance. Even dead horses etc. and human beings — dead or alive — were sometimes hurled over the walls into the cities and castles with the intention of demoralizing the defenders and causing diseases.

The initiator and constructor of the replicas in Nykøbing, Peter Vemming Hansen, has given a most informative and detailed description of this undertaking<sup>122</sup>. He had to answer many questions and solve numerous theoretical and practical

<sup>119</sup> P. Vemming Hansen, *Experimental Reconstruction of a Medieval Trébuchet*, “Acta Archaeologica”, 63, Copenhagen 1992, pp. 189–268. Also at the Internet: <http://www.middelaldercentret.dk/acta.html>

<sup>120</sup> Information given to the author in the Centre in July 2005.

<sup>121</sup> Pulleys work faster than treadmills, but the men in the treadmills are better protected than soldiers pulling ropes in the open.

<sup>122</sup> See note 110.

<sup>117</sup> P. E. Chevedden, *The introduction ...*, p. 76.

<sup>118</sup> *Ibid.*, p. 86.



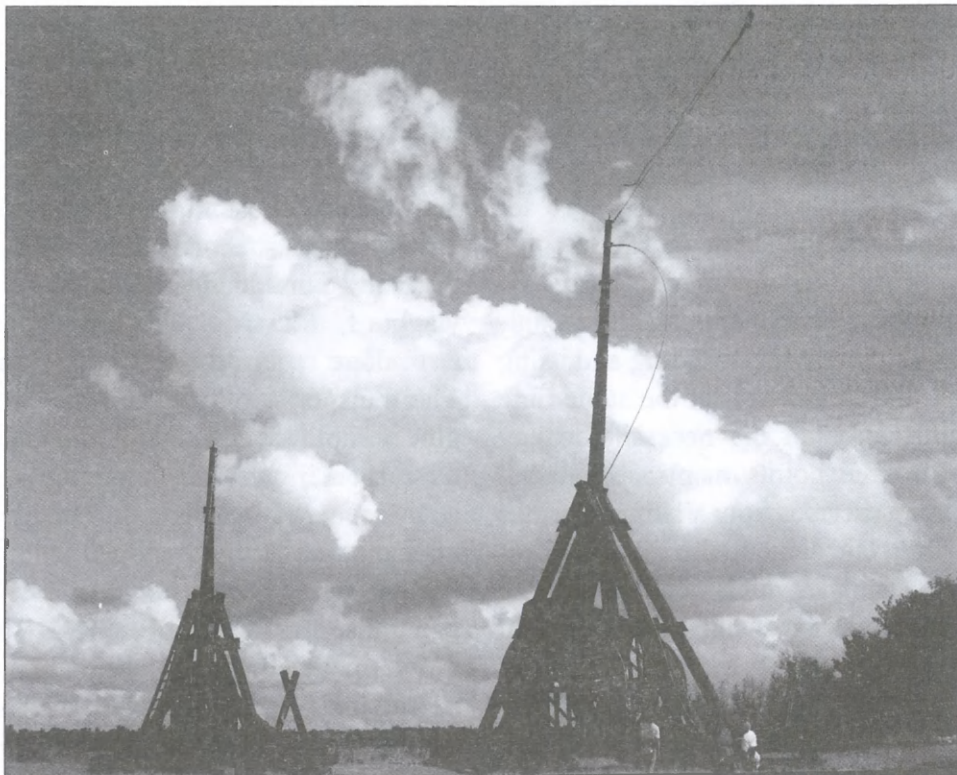


Fig. 22. Hurling with the large counterweight trebuchet in the Medieval Centre, Nykøbing Falster. The sling has just been released from the iron tip. Photo: S. Ekdahl.

problems, serious challenges he has successfully overcome. Some of his observations should be noted here. Reference is made to an article by D. J. C. King<sup>123</sup>, according to whom the following five points are essential to the performance of a trebuchet:

1. The size of the counterpoise and the way it is suspended;
2. The weight of the projectile;
3. The length of the throwing arm on either side of the axle;
4. The curvature of the iron point at the end of the throwing arm, from which the sling is released;
5. The length of the sling. (It must be proportional to the length of the throwing arm. The range can be altered by shortening or lengthening the sling, as well as by other measures.)<sup>124</sup>

These five points must be finely balanced against one another if a trebuchet is to work as intended (Fig. 22). The length of fall possible for the ballast (see point 1) also has to be noted<sup>125</sup>.

The longer this is, the more the throwing arm can accelerate before the shot is released.

It is noteworthy that a crucial part of the machinery is the iron tip at the end of the throwing arm from which the sling is released. Its curvature must be adapted precisely to the weight of the missile. If the curvature is too great, the missile may be discharged too late and in the worst case will be flung onto the ground in front of the machine. Too little curvature means that the missile will be released too early and the machine can actually fling its missile backwards<sup>126</sup>. As a matter of fact this happened a few times during the experimental phase in Nykøbing, fortunately without accidents<sup>127</sup>. Replaceable tips with varying amounts of curvature for different types of ammunition, lengths of slings, and weights of ballast were used. "Finer adjustments to the range could be made by regulating where the sling was placed on the iron tip. This was shortened by putting wooden rings on it. The range was reduced by about 5 m for every ring"<sup>128</sup>.

<sup>123</sup> D. J. C. King, *The Trebuchet* ... (note 18).

<sup>124</sup> P. Vemming Hansen, *Experimental reconstruction* ..., p. 7 (internet version).

<sup>125</sup> Ibid.; also see pp. 13–14.

<sup>126</sup> Ibid., p. 14.

<sup>127</sup> Information to the author (S. E.) in July 2005.

<sup>128</sup> P. Vemming Hansen, *Experimental reconstruction* ..., p. 14 (internet version).

### III. Trebuchets During the Baltic Crusades

The trebuchets, especially the complicated hybrid and counterweight machines, may be regarded as the peak of medieval mechanical siege engines. In that context, we will now take a closer look at their use during the Baltic crusades.

In the *Chronicon Livoniae* there is early evidence of the importance of handling the technicalities in the right way when building and using such machines. This account is at the same time a striking confirmation of the necessity to pay close attention to the points mentioned above. Henry of Livonia describes how Vladimir, prince of Polozk, in 1206, laid siege to the castle of Holme (Latvian: Salaspils), which belonged to the Bishop of Livonia. The Russians thereby built a "small machine" in the style of the Germans (*more Theuthonicorum*), but they had no experience and hurled the stones backwards, thereby causing severe casualties among their own people<sup>129</sup>. The incident indicates that this *machina parva* was not a mangonel with a "spoon", but rather a traction trebuchet with a sling that was released from an iron tip. As already mentioned, Henry as well as other chroniclers mostly differentiates between these two types of war engines, using the word *machina* for trebuchets<sup>130</sup>.

Another occurrence, which is told by Peter of Dusburg, is also interesting for different reasons. When the Order's castle Wehlau was besieged by Prussians, Sudavians and Lithuanians in 1263, a skilled German crossbowman killed a mighty leader of the latter and also succeeded in hitting a master craftsman, who had climbed onto one of the two besieging trebuchets in order to repair it. The crossbow bolt pinned his hand at the engine<sup>131</sup>. One may assume that the master had intended to do some work on either the sling or the iron tip for the purpose of achieving better results when hurling. The incident also reveals the fact that the machine was placed so near the castle that the serving crew was within shooting range of crossbows.

Trebuchets thus required skilled artisans and masters for being built and serviced in an effective way. The positive reputation of the *balistarius*, in German *Blidenmeister*, has been demon-

strated in a recent paper by Klaus Militzer, who also gives interesting details about the logistical problems concerning transport etc.<sup>132</sup>. When the large and somewhat precarious (counterweight) trebuchet of the city of Aachen in the Rhineland in 1385 was chosen to be used as a siege engine against the castle of Reifferscheid, it had to be dismantled and loaded onto no less than fourteen waggons, drawn by 61 horses<sup>133</sup>. The throwing arm alone required one waggon and six horses. The transport took four days whereupon the engine was put together again in two days by a master carpenter and his eleven journeymen as well as by an expert blacksmith. The biggest problem after that was to find enough suitable stones for hurling. They had to be quarried from far away and transported to Reifferscheid. When the expedition finally concluded, the same ponderous procedure had to take place, but this time in reverse: the cumbersome trebuchet was duly dismantled, transported back to Aachen and stored in the city arsenal where it was repaired.

During the Baltic crusades heavy transports of the kind used at Reifferscheid could hardly be performed over land except in winter, when the bogs and waterways were frozen over, allowing the use of sledges<sup>134</sup>. In the winter of 1220 Albert of Orlamünde, Count of Holstein, brought a counterweight trebuchet in the siege train of his Christian army which marched against the Semigallian castle Mesoten (Latvian: Mežotne)<sup>135</sup>. As demon-

<sup>132</sup> K. Militzer, *Stadt und Fehde: Das Kölner Beispiel*, [in:] *Le convoi militaire*, ed. T. Poklewski-Kozieł, "Fasciculi Archaeologiae Historicae", XV, Łódź 2002 (2003), pp. 87–92, especially at 88–91.

<sup>133</sup> These figures, although impressive, are nevertheless modest when compared with those compiled during the transport of giant trebuchets („Warwolf“ etc.) built by Edward I and other English kings for besieging castles in Wales and Scotland.

<sup>134</sup> In summer, boats were used for heavy transports on the larger waterways.

<sup>135</sup> Heinrich von Lettland, XXIII, 8 (p. 242). The count also brought smaller trebuchets and other instruments, which were necessary for laying siege to a castle: *ducentes secum machinam magnam et alias minores ceteraque instrumenta ad castrum impugnationem*. This "big machine" is obviously the same trebuchet which he had ordered to be built in 1218 to fight against the heathen on the island of Ösel. At that time of the year it could not be employed because the sea between the mainland and the island was not frozen, so that it was impossible to cross it. *Ibid.*, XXI, 5 (pp. 214, 216).

<sup>129</sup> Heinrich von Lettland, X, 12 (p. 60).

<sup>130</sup> See note 105 and 106.

<sup>131</sup> Peter von Dusburg, III: 122 (p. 112).

strated by Friedrich Benninghoven in his book on the Sword-Brothers, it was the true introduction of this highly effective new invention in the Baltic region<sup>136</sup>. Henry of Livonia describes how the count himself arranged and serviced the trebuchet in front of the castle. “He hurled the first stone and smashed the bay and the men inside; he hurled the second, and the planks and beams of the fortification crashed down; he hurled the third and broke three big trees of the fortification and creased them, wounded and smashed the men”<sup>137</sup>.

From this point forward the chronicles not only tell about “small machines” and “machines”, but also about “big machines”, that were transported dismantled by the armies or else built in front of the castle that was targeted to be conquered<sup>138</sup>. We may conclude that the *machina magna* (etc.) was either a heavy hybrid or else a counterweight trebuchet. It should be stressed however that trebuchets alone were no guarantee for success. In 1368 the bishop of Dorpat (Estonian: Tartu) laid siege to the Russian castle Isborsk with a big army “with trebuchets and other instruments for war”, but in spite of that he could not conquer it<sup>139</sup>. Already in 1343 Isborsk had been besieged by the Teutonic Knights with two trebuchets (*cum duabus machinis*) without success<sup>140</sup>.

In some places in the Baltic region it may have been a problem to find enough stones suitable for hurling. If they were not brought by the army, they had to be looked for and collected in the surroundings. With one exception, however, the chronicles do not touch this question. The Livonian Rhyme Chronicle tells that the Lithuanian “King Thoreiden” wanted to conquer the castle of Dünaburg (Latvian: Daugavpils) and ordered his men build four large trebuchets for that purpose. Then they hurled big stones at the castle day and night, and *die heiden vürten steine zū /*

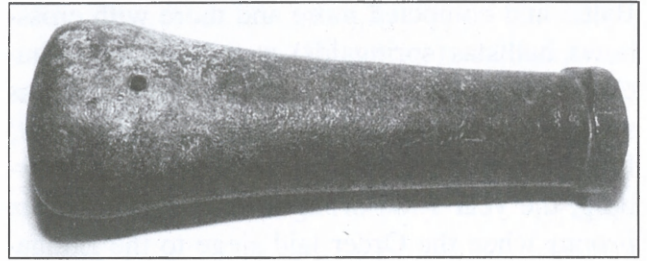


Fig. 23. The Loshult gun. Bronze. Length 30 cm; Calibre 36 mm; Weight 9.07 kg. State Historical Museum, Stockholm. After P. Vemming Hansen.

*beide spâte und vrū* (i.e. the heathen brought stones both late and early)<sup>141</sup>. Sometimes other projectiles like barrels with burning pitch and tar are mentioned<sup>142</sup>. Surely also waste, dead animals etc. and probably also enemies (dead or alive) were thrown into the castles to demoralize the defenders and to spread diseases. That was often the case in other parts of Europe<sup>143</sup>. Warfare in the Baltic was no less cruel.

During the spectacular siege of the Lithuanian castle of Kaunas in 1362 (described above), not only battering rams and siege towers were used by the Teutonic Knights, but also trebuchets<sup>144</sup>. One was built by brother Marquardus of Marienburg, the *magister carpentariorum* or *lignarius*, who had also constructed a highly effective battering ram: *Frater Marquardus novam machinam in primum erexit locum, qua mediante murum castris jactibus horridis disscidit, quod cepit cadera*<sup>145</sup>. One year before, in 1361, spies of the Order had been sent to Kaunas to determine the thickness, depth and height of the castle’s defensive structures. After their return, order was given to construct battering rams and trebuchets for the planned siege of Kaunas next winter<sup>146</sup>.

During succeeding decades, different types of firearms (sc. *Lotbüchsen* and other smaller firearms as well as *Steinbüchsen*, in Latin called *pixides* or *bombardae*) were introduced in the

<sup>136</sup> F. Benninghoven, *Der Orden der Schwertbrüder. Fratres milicie Christi de Livonia*, “Ostmitteleuropa in Vergangenheit und Gegenwart“, 9, Köln, Graz 1965, at pp. 161–162.

<sup>137</sup> Heinrich von Lettland, XXIII, 8 (p. 242).

<sup>138</sup> When armies returned from a siege (weather successful or not), they usually destroyed the trebuchets that they had built at or near the castle. In most cases it would have been impractical to dismantle and transport them.

<sup>139</sup> Hermann von Wartberge, p. 91 (*cum machinis et aliis instrumentis bellicis*).

<sup>140</sup> Wigand von Marburg, p. 502.

<sup>141</sup> *Livländische Reimchronik* ..., lines 8208–8232, quotation from lines 8231–8232.

<sup>142</sup> SRP II, p. 539 (Caspar Schütz; Siege of Kaunas in 1362).

<sup>143</sup> One example is given by Ph. Contamine, *War in the Middle Ages*, p. 104.

<sup>144</sup> For the following, see Wigand, pp. 532–534 (cf. note 49–50).

<sup>145</sup> *Ibid.*, p. 534.

<sup>146</sup> *Ibid.*, p. 530.

Baltic and competed more and more with crossbows, ballistas (springalds), mangonels and trebuchets. They were used by the Teutonic Order as well as by the Knight's Lithuanian and (later) Polish adversaries. According to Wigand of Marburg, the year 1380 brought *usus bombardarum primus* when the Order laid siege to the Lithuanian castle of Naupillen<sup>147</sup>.

The oldest small firearms, used during the siege of the Lithuanian castle of Kaunas in 1362, may have looked like the famous so-called Loshult gun, which was discovered in southern Sweden in 1861 and which is now preserved in the State Historical Museum in Stockholm (Fig. 23). It is cast in bronze, 30 cm long, has a distinct powder chamber and a slightly conical bore with a muzzle calibre of 36 mm. It weighs 9.07 kg<sup>148</sup>. Experiments with a cast copy in Denmark were surprisingly successful. It is likely that a gunner, given sufficient practice, would have been able to hit targets within a range of 200 to 300 metres with wooden arrows as well as with lead balls<sup>149</sup>.

The smallest calibre of a *Steinbüchse* was 12 cm. A replica of such a small bombard from the fourteenth century has been constructed and also demonstrated at the Medieval Centre in Nykøbing (Fig. 24).

From 1380 forward, the Prussian chronicles refer to firearms for attack and defence alike. In 1384 the Order's castle Marienwerder, which was situated on the river Memel near Kaunas, was besieged by the Lithuanians, who brought trebuchets as well as bombards. The defenders had a heavy bombard serviced by a Teutonic knight, Hermann, who was a *magister bombardarum*. With his second shoot he succeeded in smashing the throwing arm of a large trebuchet, which had been raised in front of the castle. The trebuchet was repaired by the Lithuanians, but then it was definitely wrecked by the bombard of master Hermann, who also caused much other damage among the besiegers during the following weeks. Subsequently, he too was killed, fittingly, by a stone-shot from a Lithuanian bombard. After having

destroyed the barbican with their trebuchets and firearms the Lithuanians at last succeeded in conquering the castle<sup>150</sup>.

At the beginning of the 15<sup>th</sup> century, *Steinbüchsen* were highly appreciated in Prussia and Livonia as well as in adjacent countries, but it did not mean that trebuchets had become obsolete. The presence of a *blydenmacher von Gotland* in Prussia in 1408 was surely not a coincidence<sup>151</sup>. The knowledge of how to build trebuchets may have diminished to some degree during the last decades of the 14<sup>th</sup> century, a trend which made it necessary to engage a specialist from the island of Gotland for just that purpose. The political situation between the Teutonic Order and Lithuania and Poland became more and more strained in these years and eventually led to the "Great War" of 1409–1411.

In any event, in 1408–1409 in all likelihood at least two trebuchets had been built in Prussia. It seems probable that they were hybrid engines, easier to transport than the larger counterweight machines. As evidence, we find references in the *Tresslerbuch* of the Order expenses for ropes for pulling (*blydenlynen*), slings (*zome*) and *schuwen zu blyden*, made of leather<sup>152</sup>. The use of the term *schuwe* is not clear, but it probably referred to the pouch. Of further interest is the fact that the ropemaker was paid for having provided "12 eyes at the ropes"<sup>153</sup>. Thus, it seems that each of the four ropes mentioned had been furnished with three "eyes". The meaning of this may cause further discussion among experts of warfare. As one point of such a future discussion it should be noted that perhaps further ropes might have been attached to these "eyes", so that each rope was pulled by four men. Bernhard Rathgen and Volker Schmidtchen state that the "eyes" were rings in the sling and not in the pulling ropes and that they were used

<sup>150</sup> Wigand, p. 629. A. R. Chodyński, *The preparations for war ...*, p. 45, gives a somewhat different interpretation.

<sup>151</sup> *Tresslerbuch*, p. 495: ... *item 6 m. eyne blydenmacher von Gotland gegeben; ...*

<sup>152</sup> *Ibid.*, p. 590: *item 3 m. 8 scot 10 steyne kabelgarn zu blydenlynen und bochsenstroppen und lyne. item 18 den. wegelon und tragelon. item 1 m. 2 sol. dem seyler vor 4 lyenen und 2 zome zu blyden zu slahen und vor 12 ogen an dylynen, vor yclich oge 1 scot zu machen. item 18 den. — Ibid.*, p. 584: *item 1 m. vor leder zu 2 schuwen zu blyden.*

<sup>153</sup> See note 152.

<sup>147</sup> *Ibid.*, pp. 599–600.

<sup>148</sup> P. Vemming Hansen [with a contribution by J. Svender], *Rekonstruktion og skydeforsøg med Loshultkanonen. With an English summary [The Loshult Gun: Reconstruction and Test-Firing]*, Middelaldercentret, Nykøbing F. 2001, at p. 34.

<sup>149</sup> *Ibid.*, p. 36.



Fig. 5. Mounting the great crossbow in the Castle Museum of Quedlinburg, following a detailed technical examination. Photo: Middelaldercentret, Nykøbing Falster, Denmark.

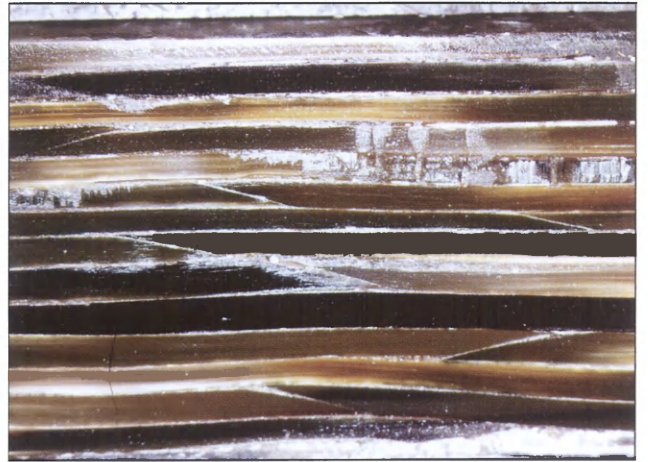


Fig. 6. Horn layers of billy-goat horn in the great Quedlinburg crossbow. Enlargement. Photo: Middelaldercentret, Nykøbing Falster, Denmark.



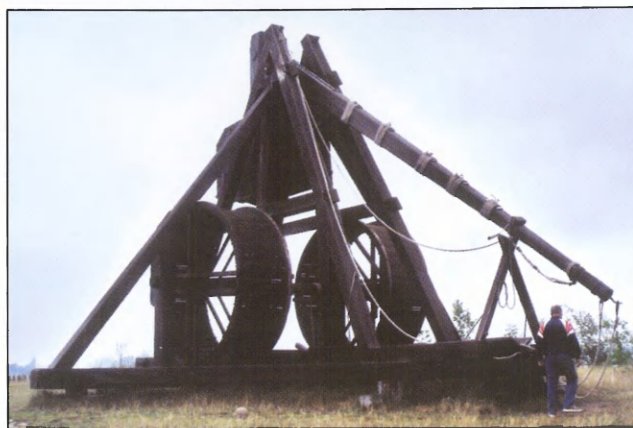
Fig. 14. Traction trebuchet. Replica in Caerphilly castle. Photo: S. Ekdahl.



Fig. 15. Traction trebuchet. Replica in the Medieval Centre, Nykøbing Falster. Photo: Middelaldercentret, Nykøbing Falster, Denmark.



Fig. 19. Counterweight trebuchet, Replica in Caerphilly castle. Photo S. Ekdahl.



↑  
Fig. 21. Large counterweight trebuchet with treadmills. Replica in the Medieval Centre, Nykøbing Falster. Photo S. Ekdahl.

Fig. 20. Counterweight trebuchets. Demonstration of the replicas in the Medieval Centre, Nykøbing Falster. Photo S. Ekdahl.



Fig. 24. Bombard (Steinbüchse) of the 14<sup>th</sup> century, calibre 12 cm. Replica in the Medieval Centre, Nykøbing Falster. Photo: S. Ekdahl.

for shortening or lengthening the sling<sup>154</sup>. It sounds plausible, but the *Tresslerbuch* in this case uses the word *lyne* and not *zome*.

The *Tresslerbuch* also offers other details. It tells us that six carpenters were in the army of the Knights that marched against the Poles at the end of September and beginning of October 1409, when a truce was concluded at the border between Prussia and Poland (8.X.1409)<sup>155</sup>. Their main task was probably to care for and erect the trebuchet or trebuchets. It may also be mentioned that from 1416 until (at least) 1446 a trebuchet “with all equipment” was stored in the castle of the command centre of the Order in Danzig (Gdańsk): *Snytczhuws: [...] item 1 bleyde mit allem gerethe, die leyt in dem speicher, [...]*<sup>156</sup>.

Not only the Teutonic Knights and the Lithuanians, but also the Poles still used such mechanical siege machines for a long time, for instance during the siege of the Marienburg castle after the victory at Tannenberg (Grunwald/Żalgiris) 1410<sup>157</sup>, and during the war with the Order in 1433<sup>158</sup>. In August of that year the commander (*Komtur*) of Osterode informed Grand Master Paul of Rusdorf that the boats intended for the Polish pontoon bridge at the river Vistula (Weichsel/Wisła) as well

<sup>154</sup> B. Rathgen, *Das Geschützwesen ...*, p. 613, note 6; V. Schmidtchen, *Büchsen, ...* (see note 17), p. XLII, note 76.

<sup>155</sup> *Tresslerbuch*, p. 590: *item 5 m. 6 zimmerluten, dy mete in dy reyse zogen, als mit den Polan frede wart. item 1 m. den ochsentrybern in dy reyse.* — As for the war expedition 1409, see S. Ekdahl, *Soldtruppen des Deutschen Ordens im Krieg gegen Polen 1409*, [in:] *Le convoi militaire*, ed. T. Poklewski-Koziół, “Fasciculi Archaeologiae Historicae”, XV, Łódź 2002 (2003), pp. 47–64, at p. 61.

<sup>156</sup> *Das große Ämterbuch*, pp. 694, 697, 699, 701, 703, 705, 706, 708, 709. Quotation from 1418 (p. 697).

<sup>157</sup> Especially the barbican, the stables and the towers were damaged by the *buchsin und blydin* (bombards and trebuchets). Posilge, p. 320.

<sup>158</sup> OBA 6535, 6611.

as the trebuchets there had been destroyed in a night-action by friends of the Order: “Namely are the trebuchets, which they had ordered to be built, totally ruined and perforated by drills, so that they are absolutely useless”<sup>159</sup>. The action had been performed secretly in the night to avoid attention caused by the noise.

It is clear that by the 15<sup>th</sup> century and even beyond trebuchets continued under certain circumstances to be preferred to *pixides* and bombards. This had surely some practical reasons even while taking the inherent inaccuracy of such engines and their missiles into account. The trebuchets were not dependent on round stones of a certain diameter for hurling, and they could be loaded much faster than a bombard. Besides they had a manifold usage for throwing incendiaries, waste, dead animals etc. in a high trajectory over defences into the castle or city, thus causing fire, diseases and demoralizing terror.

However, by this time the high point in the use of the trebuchets had passed, and more modern technologies began to prevail in the various theatres of war. Even so, during more than 200 years these fascinating mechanical siege engines, constructed on tried and true principles of leverage, torsion, and tension, had dominated siege warfare in Europe, including the Baltic region. Historical chronicles from the Baltic crusades continue to leave behind tantalizing evidence of those weapon’s enduring effectiveness.

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<sup>159</sup> *Nemlich dy bleyden, dy sy hatten lassen machen, gancz synt vorterbet und durchboret mit nebegeren, das sy mit nichte mehe nutze werden, ....* Letter of 6 August 1433. OBA 6611.

