

MEDIEVAL STONE-THROWING SIEGE ENGINES IN THE AREA OF EUROPE AND THE MIDDLE EAST FROM THE 6TH TO THE 13TH CENTURY

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*The use of stone-throwing machines can be traced back to the military tactics of ancient times. These mechanisms were used for assaulting fortifications, during naval battles and in land engagements. However, the use of stone-throwing machines only became widespread during the Middle Ages. It was at this time that these mechanisms began to be widely used and at a high level in siege technology, becoming indispensable during an assault on a walled fortification or city. This essay will survey the contemporary nomenclature for stone-throwing machines that appeared in various regions and the historical sources related to them. This is supplemented by the presentation of a modern experiment related to these mechanisms. The review of these two issues together will aid in properly interpreting the finds and observations at excavations.*²

RESEARCH HISTORY

The research into and classification of stone-throwing siege engines had already begun in the Middle Ages. Several contemporary historians and experts in the art of war recorded and depicted the mechanisms based on their personal experience. The first precise illustrations and descriptions of stone-throwing machines can be found in the 1187 treatise on military strategy by the Arab writer Marḏī ibn 'Alī al-Tarsūsī.³ The first descriptions and depictions of this type in Europe are found in a

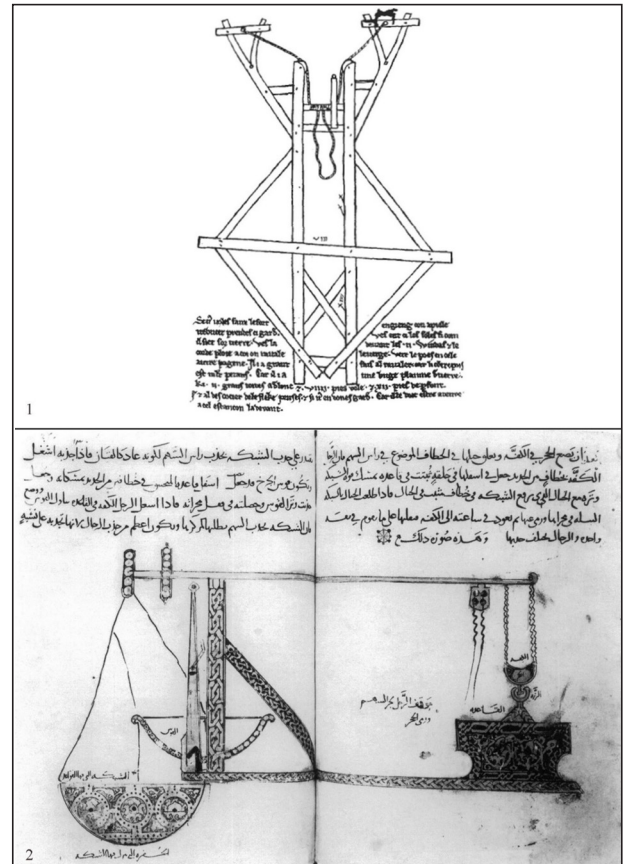


Fig. 1: 1: Villard de Honnecourt's horizontal plan of a counterweight trebuchet. Finó, José Frederico: *Machines de jet Médiévales*. Gladius 10 (1972) 33. 2: Marḏī ibn 'Alī al-Tarsūsī's illustration of a counterweight trebuchet. Chevedden, Paul E.: *The Invention of the Counterweight Trebuchet: A study in Cultural Diffusion*. *Dumbarton Oaks Papers* 54 (Harvard University Press: 2000), plate 1.

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² The topic of the present article deals with medieval siege engines, and within this category, the stone-throwing machines. The basis of the research was my thesis written as a BA/BSc student at the Pázmány Péter Catholic University, Faculty of Humanities and Social Sciences, Department of Archaeology, and the further developed version of this that won third place and a special Military History prize at the 2017 National Scientific Student Conference. Connected to the paper for the National Scientific Student Conference are the archaeological finds and phenomena related to stone-throwing machines I observed during field work in the summer of 2016 with the SHAM (Syrian-Hungarian Archaeological Mission).

³ Marḏī ibn 'Alī al-Tarsūsī: *Tabṣirat arbāb al-albāb fi kayfiyat al-najāh fi al-hurūb min al-aswā' wa-nashr al-ālam al-i'lām fi al-'udād wa-al-ālāt al-mu'īnah 'alā liqā' al-a'dā'* (Instructions of the Masters on the Means of Deliverance in Wars from Disasters, and the Unfurling of the Banners of Information: Equipment and Engines which Aid in Encounters with Enemies). MS 264, Huntington Collection, Bodleian Library, Oxford University, Oxford; MS 2848 mü, Ayasofya Collection, Suleymaniye Library, Istanbul. The chapter in the work dealing with stone-throwing machines was written up by Claude Cahen in the following article: Cahen, Claude: *Un traité d'armurerie composé pour Saladin*. *Bulletin d'études orientales* 12 (1947–1948), 103–163. See: Chevedden, Paul E.: *The Artillery of king James I the conqueror*. In: *Iberia and the Mediterranean world of the Middle Ages: essays in honor of Robert I. Burns S.J. Volume II. Proceedings from "Spain and the Western Mediterranean"*, ed.: Chevedden, Paul E. – Kagay, Donald J. – Padilla, Paul G. (Leiden: Brill Publishers 1996), 57.

French work made by Villard de Honnecourt in the 13th century (Fig. 1).⁴ At the beginning of the 15th century, Konrad Kyeser in his work entitled *Bellifortis* depicted several counterweight trebuchets, which were the most modern siege engines that did not operate with gunpowder (Fig. 2).⁵

In the modern period the first research concerning the mechanisms was performed by the French emperor Napoleon III (1852-1870).⁶ The emperor had a stone-throwing machine constructed, but no written documentation has survived about this mechanism.⁷ The French architect Eugène Emmanuel Viollet-le-Duc studied stone-throwing machines more seriously and made reconstruction drawings of several mechanisms that were accompanied by detailed descriptions. Viollet-le-Duc primarily designed reconstructions of medieval buildings in 19th century France, but in addition to this had a wide understanding of military engineering as well as having written numerous works dealing with architecture.⁸

The study of siege engines developed to a significant extent in the 20th century. At the beginning of the 1900s Ralph Payne-Gallwey performed serious research concerning ancient and medieval stone-throwing machines and crossbows.⁹ Knowledge related to siege engines was further increased by Ada Bruhn Hoffmeyer, who during her research related to Byzantine siege technology began collecting the engines used by the Byzantine Empire.¹⁰ The American historian Paul E. Chevedden examined stone-throwing machines in several of his works, in particular the types employed in the Middle East, the Iberian Peninsula and the former Byzantine Empire.¹¹

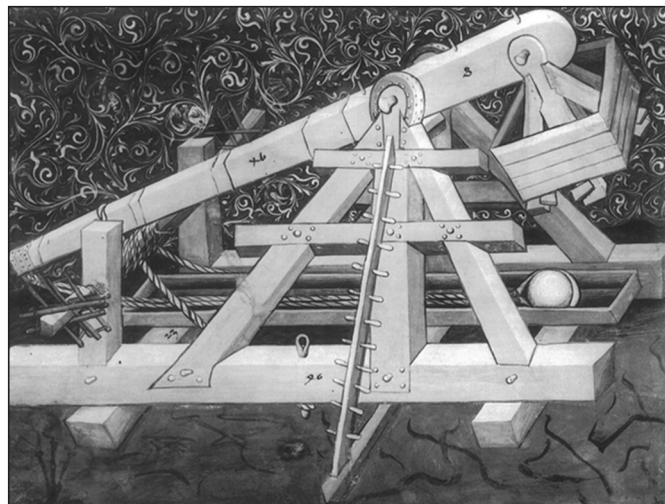


Fig. 2: Stone-throwing machine with a counterweight depicted by Konrad Kyeser at the beginning of the 15th century. Chevedden, Paul E.: *The Invention of the Counterweight Trebuchet: A study in Cultural Diffusion. Dumbarton Oaks Papers 54* (Harvard University Press: 2000), plate 3.

STONE-THROWING MACHINES IN MEDIEVAL HISTORICAL SOURCES

Machines for throwing stones have been known in the area of Europe starting from antiquity. These early mechanisms were based on torsion springs. The first machines capable of throwing stones were made by the Greeks, and then the Romans adopted the technology from them.¹²

The machines utilizing torsion springs were also employed in the Early Middle Ages, but then a

⁴ Finó, José Frederico: *Machines de jet Médiévales. Gladius 10* (1972), 33–34.

⁵ Hansen, Peter Vemming: *Experimental Reconstruction of the Medieval Trebuchet. Acta Archaeologica* (63) (Denmark), 189–208.

⁶ Payne-Gallwey, Ralph: *The Book of the Crossbow* (New York: Dover Publications 1995), 257.

⁷ Hansen, Peter Vemming: *Experimental Reconstruction of the Medieval Trebuchet. Acta Archaeologica* (63) (Denmark), 189–208.

⁸ Viollet-le-Duc, Eugène Emmanuel: *L'Encyclopédie médiévale*. (Paris: L'Harmattan 1996), 448–461.

⁹ Payne-Gallwey, Ralph: *The Book of the Crossbow* (New York: Dover Publications 1995).

¹⁰ Hoffmeyer, Ada Bruhn: *Military Equipment in the Byzantine Manuscript of Scylitzes in Biblioteca Nacional in Madrid. Gladius 5* (1966), 1–194.

¹¹ Chevedden, Paul E.: *The Artillery of king James I the conqueror*. In: *Iberia and the Mediterranean world of the Middle Ages: essays in honor of Robert I. Burns S.J. Volume II. Proceedings from "Spain and the Western Mediterranean"*, ed.: Chevedden, Paul E. – Kagay, Donald J. – Padilla, Paul G. (Leiden: Brill Publishers 1996); Chevedden, Paul E.: *Fortifications and the Development of Defensive Planning during the Crusader Period*. In: *The Circle of War in the Middle Ages*, ed.: Kagay, Donald J. – Villalon, Andrew L. J. (Woodbridge: Boydell Press 1999); Chevedden, Paul E.: *The Invention of the Counterweight Trebuchet: A study in Cultural Diffusion. Dumbarton Oaks Papers 54* (Harvard University Press: 2000), 71–116; Chevedden, Paul E.: *Black Camels and Blazing Bolts: The Bolt-Projecting Trebuchet in the Mamluk Army. Mamlūk Studies Review 8* (2004), 227–278.

¹² Payne-Gallwey, Ralph: *The Book of the Crossbow* (New York: Dover Publications 1995), APPENDIX 4–9.

mechanism with a different construction also appeared on the theaters of battle, the traction stone-throwing machine. The structure and operation of these was first presented in a source describing the *Miracles of Saint Demetrius*, which is from the Byzantine archbishop John of Thessaloniki. The archbishop described in detail the traction stone-throwing machine seen at Thessaloniki when the city was besieged by the Avars in 597.¹³ This type of engine was used by the Byzantines in 626 in their siege of Beneventum, where the emperor beheaded a captured Lombard leader and then shot his head into the city with a traction machine. The siege was recorded by Paulus Diaconus in his *Historia Langobardorum*.¹⁴ The spread of traction stone-throwing machines in western Europe is evidenced by the 885-886 siege of Paris recorded by the monk Abbo Cernuus. During the assault, the Viking forces that had arrived from the north stormed the city with various siege engines, including traction stone-throwing machines,¹⁵ which they had built with the assistance of Byzantine engineers.

In addition to traction and torsion mechanisms, a new type of stone-throwing machine appeared middle third of the 12th century, the counterweight trebuchet. It is conceivable that the first counterweight trebuchets had already been used in 1097 during the Siege of Nicea (Fig. 3). This notion may be based on information that can be found in the *Alexiad* written by Anna Komnene.¹⁶ Anna Komnene's work is from the time of the First Crusade, and the author writes about the Siege of Nicea in addition to several other events from the crusade. In the work she reports that the Byzantine emperor knew that without the use of siege engines the crusader armies would not be able to capture the city, which was easily defended and had strong walls, so he had numerous engines built.¹⁷ Stone-throwing machines of various types were built, many of which had structures that differed from the usual. After this, the emperor handed over the engines to the leaders of the crusader armies, who continued the siege of the city, so stones were shot over the walls of Nicea as well.¹⁸

At the end of the 12th century, counterweight trebuchets were already employed during most large-scale sieges alongside the smaller engines. The counterweight trebuchets inflicted serious damage on the defensive works, since they were capable of hurling projectiles larger than 100 kilograms to distances over 200 meters. The improvement of siege technology in this direction led to the development of concentric castles and the



Fig. 3: The Siege of Nicea in 1097. In the illustration the crusader armies launch decapitated heads into the city with a stone-throwing machine. Nicolle, David.: *Medieval Siege Weapons (1) Western Europe AD 585–1385*. New Vanguard 58. (Oxford: Osprey Publishing 2002), 21.

¹³ John I, archbishop of Thessalonike: *Miracula S. Demetrii*. In: *Les plus anciens recueils des miracles de saint Demetrius et la pénétration des slaves dans les Balkans*. 2 vols. (ed.: Lemerle, Paul). Paris: Centre National de la Recherche Scientifique 1979.

¹⁴ Paulus Diaconus: *A Longobardok története. Historia longobardorum (History of the Lombards)* (ed.: Gombos F. Abin.). Középkori Krónikások I. (Brassó. Brassói Lapok 1901), 203.

¹⁵ Abbo of Saint-Germain: *Le siège de Paris par les Normands*. (ed. and trans.: Waquet, Henri) Paris 1942.

¹⁶ Chevedden, Paul E.: *The Invention of the Counterweight Trebuchet: A study in Cultural Diffusion. Dumbarton Oaks Papers* 54 (Harvard University Press: 2000), 76–77.

¹⁷ Dawes, Elizabeth A. S. (Ed.): *Anna Comnena. The Alexiad*. (Cambridge: In Parentheses Publications 2000), 192–193; Krey, August C.: *The First Crusade. The Accounts of Eye-Witnesses and Participants*. (Princeton: Princeton University Press 1921), 101–110.

¹⁸ Dennis, George T.: *Byzantine Heavy Artillery: The Helepolis*. In: *Greek, Roman and Byzantine Studies*: v.39 (1998), 99–115.

Nomenclature for stone-throwing machines according to their historical-geographical regions		
European type stone-throwing machines	Middle Eastern type stone-throwing machines	Byzantine type stone-throwing machines
biffa	al-manjanīq al-ʿarabī	alakatia
bricola	al-manjanīq al-fārisī wa-huwa al-turkī	helepolis
blide	al-manjanīq al-rūmī	lambdarea
couillard	arrāda	lithobolos
mangonel	luʿab	petrobolos
perrier	manjanīq firanjī	tatreboloi
petriera	manjanīq ifranjī	tetrarea
trabucium	manjanīq maghribī	triboloi
trebuchet	manjanīq qarābughrā	
tribok	manjanīq shaytānī	
	manjanīq sultānī	

Fig. 4: The classification of stone-throwing machines according to their names.

transformation of military architecture in the Holy Land as well as in the area of Europe.

THE NOMENCLATURE OF STONE-THROWING SIEGE ENGINES

Differing nomenclature was used in Europe and the Middle East for medieval stone-throwing machines, so it is worthwhile to examine these separated according to historical-geographical regions. The stone-throwing siege engines used in the Middle Ages can be divided into three groups on the basis of their nomenclature: machines used in Europe, and the Middle Eastern and Byzantine types. I have compiled the most widespread terminology for the machines in a table (Fig. 4). The nomenclature used by different historical-geographical regions can also refer to machines with similar structures. A good example for this is the highly developed 12th-13th century version of the counterweight stone-throwing machine, which in Arab terminology was called a *manjanīq maghribī*, the Byzantines used the term *helepolis* for a machine of this construction, and *trebuchet* means a counterweight stone-throwing machine in European regions.

ARCHAEOLOGY AND EXPERIMENTAL ARCHAEOLOGY

The archaeological find materials that can be linked to stone-throwing machines are unfortunately quite scanty, since not a single piece that could be examined has survived from examples built in the Middle Ages. Although in 1890, Bernhard Rathgen reported that a medieval stone-throwing machine that had survived intact was found during the demolition of an old chapel in Liebenmühl in eastern Prussia (Miłomłyn,

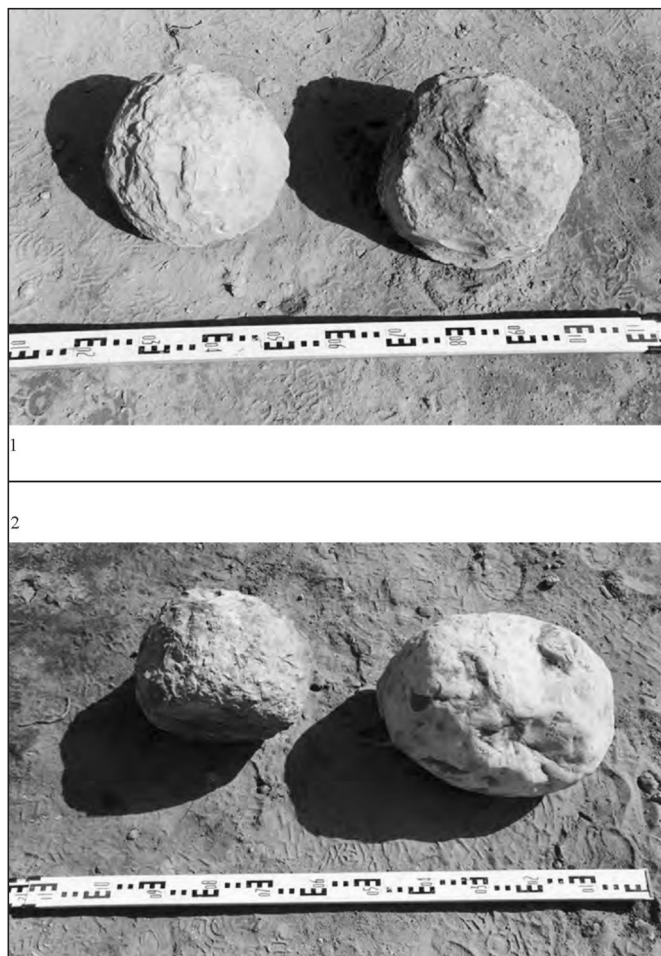


Fig. 5: Seen in the pictures are roughly carved stone balls discovered during the excavation of the Crusader castle of Arsuf in Israel. These were undoubtedly projectiles shot from stone-throwing siege engines. Raphael, Kate-Tepper, Yotam: *The Archaeological Evidence from the Mamluk Siege of Arsuf*. ©Mamlūk Studies Review. Creative Commons license, Vol. 9. No. 1. 2005. http://mamluk.uchicago.edu/MSR_IX-1_2005-Raphael-Tepper.pdf (Most recent download: 26 October 2017)



Fig. 6: The 12th-13th century sling pouch that may have been made for a stone-throwing machine of smaller size.

The projectiles shot from this siege engine may have been the size of a man's fist. Nicolle, David: *The early trebuchet documentary and archaeological evidence*. In: *La fortification au temps des croisades*. Eds.: Faucherre, Nicolas–Mesqui, Jean–Proudeau, Nicolas (Rennes: Presses Universitaires Rennes, 2004), 273.

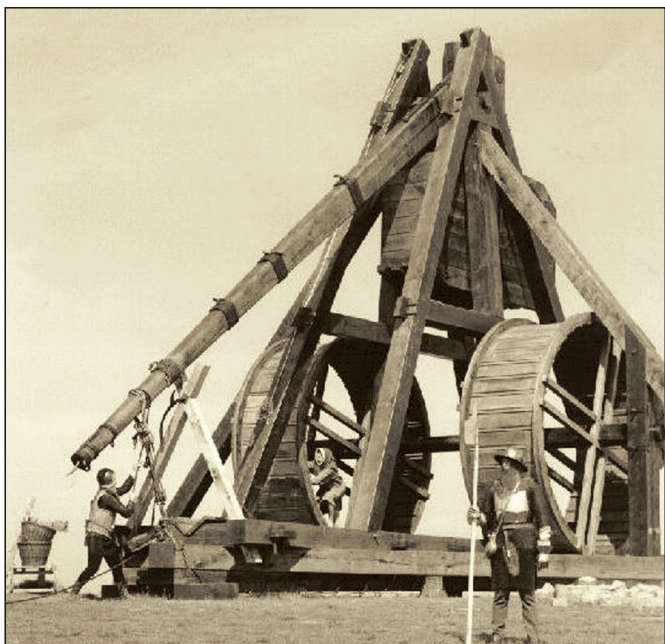


Fig. 8: The counterweight trebuchet reconstruction built at the Middelaldercentret of Nykøbing Falster. <http://members.iinet.net.au/~rmine/middel3.html> (Most recent download: 26 October 2017)

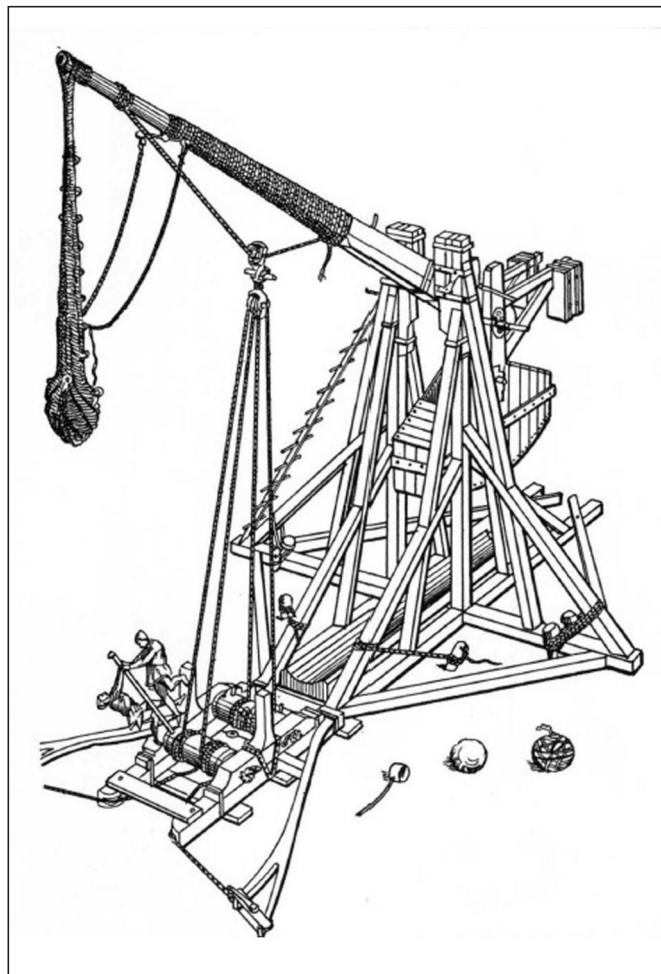


Fig. 7: A reconstruction drawing of a trebuchet. The illustration was made by Viollet-le-Duc. Viollet-le-Duc, Eugène Emmanuel: *L'Encyclopédie médiévale*. (Paris: L'Harmattan 1996), 455.

Poland),¹⁹ this is no longer available today, because after it was found it was broken up for firewood. Most of our knowledge about stone-throwing machines comes from the study of medieval accounts and historical depictions.²⁰ The projectiles fired by the machines have survived in the greatest numbers as material remains. In general these were rocks that were carved into shape (Fig. 5). It is quite easy to mistake them for projectiles shot from cannon, since stones that had been carved into spheres could also be loaded into cannon in the Middle Ages.²¹ Besides the projectiles, there is only a single medieval find known, a sling pouch made of leather for a siege engine from the 12th-13th century (Fig. 6).²²

¹⁹ Saimre, Tanel: *Trebuchet – A Gravity-Operated Siege Engine. A study in Experimental Archaeology*. *Estonian Journal of Archaeology* 10/1 (Estonian Academy Publishers 2006), 64.

²⁰ Hansen, Peter Vemming: *Experimental Reconstruction of the Medieval Trebuchet*. *Acta Archaeologica* (63) (Denmark), 189–208.

²¹ Otero, José Suárez – Vila, Xurxo Ayán – Suárez, e. Carlos Marín.: *Rochaforte* (Santiago de Compostela: Plana Artes Graficas, S. L. 2013), 92.

²² Nicolle, David: *The early trebuchet documentary and archaeological evidence*. In: *La fortification au temps des croisades*, ed.: Faucherre, Nicolas – Mesqui, Jean – Proudeau, Nicolas (Rennes: Presses universitaires Rennes, 2004), 273.

Medieval stone-throwing machines can be best understood and examined through experimental archaeological projects. For an authentic reconstruction it is necessary to be familiar with the given historical sources, miniatures from contemporary illuminated chronicles, precise design drawings and their detailed descriptions. One of the best documented and completed projects was the experiment led by Dr. Peter Vemming Hansen, which was performed in 1989 at the Middelaldercentret of Nykøbing Falster in Denmark.²³ The main goal of the project was to build an experimental archaeological reconstruction of a 13th century trebuchet (Fig. 7) with the aid of tools and production techniques of the period and utilizing the medieval historical sources and illustrations, research performed up to that point and the results of experimental archaeology. The completed machine was able to successfully throw projectiles, and numerous examinations were performed in relation to the firing power of the mechanism. The machine is still in operation and can be seen at the Middelaldercentret (Fig. 8).

ASSESSMENT

In the wake of the survey of the professional literature presented here, an in-depth study on the basis of international professional literature and in particular the sources has been begun and been partially processed. The objective of this is to collect and review this object type that played a very important role in medieval military engineering. This is a scientific question that Hungarian research has not yet investigated. In addition to the written materials, it is possible to become familiar with the medieval use of stone-throwing machines as well as the physical properties of the machinery through the aid of experimental archaeology. My research performed on this topic has been significantly facilitated by the opportunity that I received to examine the archaeological finds and phenomena related to stone-throwing machines within the grounds of the castles of Margat and Crac des Chevaliers through the Syrian-Hungarian Archaeological Mission.²⁴ I would like to summarize the results of the structural investigations and the examination of the archaeological finds in the future in another essay.

The available information served as a launching point for the commencement of research in Hungary, and this can also aid in interpreting the domestic archaeological finds related to these machines. The collection of the nomenclature for foreign-language stone-throwing siege engines will facilitate in tracing the machines employed during Hungarian sieges in the historical sources.

ACKNOWLEDGEMENTS

I would hereby like to express my thanks to my thesis consultant, Dr. Balázs Major, who provided assistance to me in both the selection of the topic and its elaboration in the greatest detail.

RECOMMENDED LITERATURE:

For a historical summary of siege engines:

CHEVEDDEN, PAUL E.:

The Invention of the Counterweight Trebuchet: A study in Cultural Diffusion. *Dumbarton Oaks Papers* 54 (Harvard University Press: 2000) 71–116.

PURTON, PETER:

History of the early Medieval Siege c. 450–1200. (Woodbridge: Boydell Press 2009)

²³ Hansen, Peter Vemming: Experimental Reconstruction of the Medieval Trebuchet. *Acta Archaeologica* (63) (Denmark), 189–208.

²⁴ The archaeological research related to crane structures that can also be linked to stone-throwing machines has been summarized by Dr. Balázs Major in a separate article, in which the common utilization of hoisting apparatuses and stone-throwing machines is also discussed. Major, Balázs: Középkori daruszerkezetek a szíriai -ban (Medieval Crane Structures at the Qal'at al-Marqab in Syria). *Hungarian Archaeology Online Magazine*. Winter 2012.

For ranged medieval weaponry:

PAYNE-GALLWEY, RALPH:

The Book of the Crossbow. (New York: Dover Publications 1995).For experimental reconstructions of stone-throwing machines:

HANSEN, PETER VEMMING:

Experimental Reconstruction of the Medieval Trebuchet. *Acta Archaeologica* (63) (Denmark), 189–208.

TARVER, W. T. S.:

The Traction Trebuchet: A Reconstruction of an Early Medieval Siege Engine. *Technology and Culture*. Vol. 36, No. 1. (Baltimore, Maryland: The Johns Hopkins University Press), 136–167.

GLOSSARY

arrāda (Arabic): This is a type of stone-throwing siege engine and can refer to a machine that uses torsion power or is operated through manpower. Due to the differing descriptions in the sources it is probable that the term *arrāda* may have been used for engines with various forms of construction. The Spanish equivalent is *algarrada*.

Bellifortis: This is the handbook written by Konrad Kyeser that is the first fully illustrated book on military technology starting from the beginning of the 15th century. The work summarizes the works of military technology by classical authors such as *De Re Militari* by Vegetius, amongst others.

biffa (French): This is a counterweight trebuchet that had either one or two moving counterweights. The term is also used for hybrid engines with a fixed counterweight; a smaller counterweight was affixed to the shorter end of the stone-throwing machine's throwing arm and the ropes used for pulling were attached here.

blide (German): This is the term for trebuchet in German and Scandinavian areas. It is possible that the word is derived from the French term *biffa*.

bricola (Italian): This is a counterweight trebuchet that had two symmetrical counterweights. The engine is also known by several other terms: *bricole*, *briccola*, *brichola*, *brigolo*, *bidda*, *bliden*.

couillard (French): This is a trebuchet that had two counterweights that could be moved symmetrically.

counterweight trebuchet/stone-throwing machine (English): In terms of its construction, this stands on a framed substructure onto which a beam was attached that was affixed to a rotating axle at a 1:6 ratio. On the shorter end of the beam either a fixed counterweight or a hinged box filled with the counterweight was attached. The latter would swing with the rotating motion of the beam and the pull of gravity.

helepolis (Greek): Literally, “taker of cities”, a term of Byzantine origin for a siege tower. Later, starting from the 9th century several historians used this to define large stone-throwing siege engines.

lu'ab (Arabic): This is a small traction engine that was also called a spinning stone-throwing machine.

mangonel: This is one version of a traction stone-throwing machine. A small counterweight may also have been placed on the shorter section of the throwing arm on this type of engine, so it was a step on the path from traction to counterweight stone-throwing machines.

manjanīq (Arabic): This is the term for a stone-throwing siege engine in Arabic, being used for both traction and counterweight machines. There were different types of *manjanīq*, which were differentiated from one another on the basis of the mechanism's method of construction or its size. According to this classification, there were Arab, Byzantine, Frankish, Persian and Turkish forms.

perrier (English): In modern terminology this is used to indicate small traction stone-throwing machines, while in the Middle Ages the term appeared in relation to siege engines of varying forms. The French equivalent is *pierrière*.

petraria (Greek): This term was used for a new form, the traction stone-throwing machine, which appeared in the Byzantine Empire in the 6th-7th century.

Tabsīrat fī al-ḥurūb: This is a treatise written by Marḍī ibn 'Alī al-Tarsūsī that contains illustrations of stone-throwing siege engines in addition to their detailed descriptions. Al-Tarsūsī's essays were written for Saladin around the year 1187. This is the most important military study that was made in the Islamic area in the Middle Ages.

torsion powered siege engines (English): These stone-throwing machines utilized the stored energy of coiled ropes. The ropes were made from animal sinew or fur, but threads spun from silk may also have been woven into the ropes to strengthen them.

trabucium (Latin): This is a counterweight trebuchet that had a fixed counterweight.

traction stone-throwing machine (English): This is similar to counterweight trebuchets in structure. It is comprised of a beam affixed to a rotating axle atop the substructure, but ropes were attached to the shorter end of the beam. A large number of personnel pulled on the ropes, which would raise the longer end of the arm, thus firing the projectile in the desired direction. Synchronized pulling was essential for the operation of the engine.

trebuchet (English): This term refers to counterweight stone-throwing siege engines. The term was used in many forms, the best known of which are: *trabuchellus*, *trabucchi*, *trabuchus*, *trabuco*, *tripantium*, *trabuctium*, *trebusket*, *trabuchis* and *trabuquet*.