Demystifying a 'Wonder Weapon': A Multidisciplinary Reassessment of a Medieval Ballistic Technology

Michael S. Fulton

The trebuchet often dominates modern images of a medieval siege. Frequently presented as the definitive technological agent of destruction, this common perception has permeated academic discourse, often put forward as, or more implicitly assumed to be, the driving force behind the evolution of medieval fortifications toward complex concentric designs. The scholarly tendency to exaggerate the power of these weapons seems at least partly rooted in a form of technological determinism — a search for revolutionary technologies (in this instance, a 'wonder weapon') to explain historical developments. A more comprehensive examination of the evidence, focusing on the Latin East and surrounding powers, for which we have a rich historical and archaeological tradition, has yielded a different interpretation, one in which these engines were significantly less powerful than previously assumed.[1]

Traditional scholarly and popular perceptions of medieval artillery have relied almost exclusively on a small, select group of historical descriptions, many of which can now be classified as sensational. To counter the inherent bias in such accounts, a multidisciplinary methodology was employed, combining close textual analysis of as many references to this technology as possible (not merely the most detailed), archaeological evidence, topographical data, and ballistics modelling to reverse-engineer the scale, deployment, and use of these engines. The full results of this study were published in 2018, but I return to the topic here to offer a few additional thoughts.[2]

For clarity, the term "medieval mechanical artillery" is employed here to refer exclusively to the 'trebuchet' type of engine. The use of classical torsion weapons (commonly known by names like *ballista* and *onager*) continued well into the Roman imperial period, but such machines apparently disappeared from use fairly early in the Middle Ages, around the time that the western half of the Roman Empire collapsed, or shortly thereafter.[3]

Trebuchet technology took two principal forms: one was powered by the traction force of a team of pullers; the other by gravity acting on a counterweight. Both models operate on the same mechanical principle: a beam was attached to an axle; when a force was applied near the end of the short arm, the end of the long arm rose at a greater rate. A sling was affixed

---

[1] The ideas presented here draw from, and are explored in much more detail in, Michael S. Fulton, *Artillery in the Era of the Crusades: Siege Warfare and the Development of Trebuchet Technology* (Brill, 2018).

[2] See n. 1 above.

[3] Fulton, *Artillery*, 4–9. See also Peter Purton, "The Myth of the Mangonel: Torsion Artillery in the Middle Ages," *Arms & Armour* 3 (2006), 79–90.

to the end of the long arm, further increasing the acceleration of the projectile couched within prior to release. Traction trebuchets came into use in both Europe and the Middle East in the Early Middle Ages and were employed through at least the thirteenth century. When and where the counterweight trebuchet was first invented and deployed remains a matter of debate, though most evidence points to a genesis in the late twelfth century, around which time there are indications that engines of this type were being employed in Italy and the eastern Mediterranean. By the second decade of the thirteenth century, there is strong evidence to support the use of such machines in many regions of Europe, as well as the Middle East.[4]

Focusing on the medieval Near East, closer investigations began with an exhaustive survey of textual references to this technology. Topographical analysis and archaeological evidence — consisting of projectiles[5] — were then incorporated. These helped provide additional variables and certain limitations, which were used to inform the development of ballistic models.[6] By reverse engineering these machines as energy systems, and correlating this information with historical descriptions, topographical conditions, and archaeological finds, a far more grounded impression of this historical technology emerged.

This methodology was first employed to determine certain minimum power requirements at the end of the eleventh century. To do this, a number of textual references to the throwing of heads during sieges of the First Crusade were considered and modelled.[7] With a baseline in place, a variety of situations were then examined where the topography imposed restrictions, again reconciling the landscape with historical descriptions to determine where engines would have been placed and how they were employed. Such assessments provided insights into the fairly limited power of traction trebuchets. While these engines could throw a stone larger and farther than could a person, they would have caused very little damage to standing fortifications. For example, textual evidence indicates that engines threw stones over the walls of Harim in 1177. By reconciling this with the topography — the castle sits atop a conical tell —

---

[4] For the development of this technology and challenges of terminology, see Fulton, *Artillery*, 9–38; idem, "The Diffusion of Artillery Terminology in the Early Thirteenth Century: The Case of Henry of Livonia," *SHARE* 3 (2016), 1–27; idem, "Anglo-Norman Artillery in Narrative Histories, from the Reign of William I to the Minority of Henry III," *Journal of Medieval Military History* 14 (2016), 1–31. See also idem, "Development of Prefabricated Artillery during the Crusades," *Journal of Medieval Military History* 13 (2015), 51–72.

[5] For a survey of such, see Michael S. Fulton, "Overlooked Ordnance: Artillery Projectiles of the Crusader Period," in *Crusading and Archaeology*, edited by Vardit Shotten-Hallel and Rosie Weetch (Routledge, 2020); Dávid Kotán, "Stone-Throwing Machines and Their Effects on the Medieval Castles of the Syrian Coastal Region," in *Bridge of Civilizations: The Near East and Europe, c. 1100–1300*, edited by Denys Pringle, Peter Edbury, and Balázs Major (Archaeopress, 2019).

[6] For the mechanics, see Fulton, *Artillery*, 39–58; Mark Denny, "Siege Engine Dynamics," *European Journal of Physics* 26 (2005), 561–577.

[7] Fulton, *Artillery*, 62–63.

certain quantitative minimums can be established. A qualitative maximum can then be developed when considering that the projectiles involved were said to have inflicted no damage. This scenario was modelled to further illustrate the historical situation.[8]

The same approach was taken to examine Saladin's siege efforts in western Syria through the summer of 1188, where the local topography often presented critical restrictions and for which we have three eyewitness accounts. Beginning with Bourzey, which Saladin besieged in August 1188, the results were very similar to those at Harim, confirming the technology involved was most likely traction powered. This would also appear to explain conflicting descriptions of the power of Saladin's artillery at the siege of Shughr-Bakas, which took place earlier the same month. Of the three eyewitness sources, one asserts Saladin's engines *could* reach the walls of the castle, another states they *could not*, and the third, the least beholden to Saladin, reports that they could but *not effectively*, apparently revealing the truth of the situation. This evidence was then used to evaluate Saladin's siege of Sahyun (Sâone) in late July 1188. In this case, the traditional interpretation of the siege, which credited Saladin's artillery with smashing down the castle's walls in a matter of days, was completely upended.[9] Although these assessments present a fairly weak picture of contemporary artillery, evidence of change also begins to appear around this time.

A significant challenge to the study of medieval artillery is the vocabulary employed by contemporary authors. Most terms applied to these weapons come from antiquity, where they were used to refer to quite different machines. From the late twelfth century, sources began to use vocabulary more judiciously. An author might use one term to clearly refer to a more powerful type of stone-throwing engine, and another to label a less powerful variety. Unfortunately, there was little consistency in the use of terminology among sources.[10] This is apparent when looking at the siege of Acre (1189–1191), the main episode of the Third Crusade, and the siege of Damietta (1218–1219), the defining struggle of the Fifth Crusade. It was also around this time that new Latin terminology appeared — variants of the term 'trebuchet' are found from about 1190. The word's medieval origin led it to be embraced as a term of convenience to refer to 'trebuchet-type' engines, which have a similar medieval genesis. The specific form of weapon the very first uses of this term were meant to identify is difficult to determine with any certainty. The most conclusive evidence to support the use of counterweight trebuchets from the late twelfth century is the earliest surviving image of such a machine. Although primitive, it dates to the 1180s and is found in a book on weaponry dedicated to Saladin.[11]

---

[8] Fulton, *Artillery*, 131–134.

[9] Fulton, *Artillery*, 161–173; idem, "A Ridge Too Far: The Siege of Saone/Sahyun in 1188 and Contemporary Trebuchet Technology," *Crusades* 16 (2017), 33–53.

[10] For more on terminology, see n. 4 above.

[11] Marḍī ibn ʿAlī al-Ṭarsūsī (al-Tarsusi), *Al-Tabṣīrah fī al-ḥurūb*, MS. Huntington 264, Bodleian Library, University of Oxford, fols. 134b–135a. For an overview of

The use of counterweight trebuchets is evident in the archaeological record of the thirteenth century. Large stones, too large to have been thrown by a traction trebuchet, have been identified at Ascalon, which was besieged in 1247. At Arsuf, which was attacked by the Mamluks in 1265, hundreds of projectiles were discovered through the course of excavations. While a small number of particularly heavy stones, weighing more than 50kg, were identified, indicating at least one counterweight trebuchet was present at the siege, the vast majority are smaller, confirming traction trebuchets remained in use alongside their larger cousins. For a sense of minimum capabilities, the case of Montfort is particularly helpful. Besieged by the Mamluks in 1271, stones in excess of 50kg have been found through the course of excavations, buried in the rubble of the castle, which was destroyed as soon as it was captured. The limitations imposed by the surrounding topography suggest these stones were thrown from at least 100m away, and perhaps twice this distance.[12]

The tossing of heavy stones to considerable distances might feed assumptions that these were finally wall-smashing weapons, if it were not for clear material evidence to the contrary. In 1285, the Mamluks employed the greatest engines in their arsenal against the Syrian castle of Margat, leaving evidence of this conflict on the south face of the stronghold's imposing southern tower. Rather than threatening the integrity of this great structure, these machines left only cosmetic damage — pockmarks between the fissures opened by later earthquakes. The limited impact of these weapons becomes more apparent when considering the amount of energy that they were capable of harnessing. Although significant, this was a small fraction of the energy transferred to projectiles by later siege guns. As such, we are left to understand that these engines were not used primarily to breach fortifications, but rather to: damage weaker masonry, such as battlements and unfortified structures within a castle or town; cause indiscriminate damage and contribute to the breakdown of order within an enceinte; and undermine the sense of security held by those within – there was both a real threat to life and limb, and a psychological impact as death might strike from above at any moment.[13]

If the historical and physical evidence demonstrates the limits of medieval artillery, why has the myth of the wall-smashing trebuchet persisted so vigorously in both popular culture and academic circles? The answer lies in a historiographical phenomenon: a Western fascination with the concept of the 'wonder weapon'. Popular media portrayals of medieval (or medieval-inspired) sieges are dominated by action: there is no shortage

---

contemporary texts relating to mechanical artillery, see Michael S. Fulton, "Medieval Mechanical Artillery 'Treatises'," in *Military Literature in the Medieval Roman World and Beyond*, edited by Conor Whately (Brill, 2024).

[12] Fulton, *Artillery*, 275–284; idem, "The Siege of Montfort and Mamluk Artillery Technology in 1271: Integrating the Archaeology and Topography with the Narrative Sources," *Journal of Military History* 83 (2019), 689–717.

[13] For a closer explanation, see Michael S. Fulton, "Trebuchets Were Not Siege Guns, So Why Use Them?" *Atiqot* 111 (2023), 259–273.

of fireballs and dramatic breaches. Most sieges of the Middle Ages, however, were rather protracted, uneventful slogs, more akin to the realities of the trench warfare witnessed during the First World War. Most 'active' troops at a medieval siege would have been deployed to enforce blockading efforts — a rather passive activity that consisted largely of waiting around — while specialist elements may have engaged in sapping actions, attempting to compromise the strength of the enemy's walls from below, or using artillery in a supporting capacity to clear battlements and maintain a constant psychological pressure on besieged defenders.[14] For many historians of the twentieth century, however, such an ancillary role for medieval artillery did not align with contemporary efforts to develop increasingly powerful modern weapons. This trend, which accelerated from the late nineteenth century, saw the construction of increasingly large battleships and artillery pieces, as well as the development of new weapons, such as machine guns, poison gas, combat aircraft, tanks, submarines, ballistic missiles, and finally atomic bombs. Advancements in weaponry were paralleled by broader technological developments, as many in the West embraced technology as a solution to most problems. An extension of this was the belief that ever-greater weapons were the key to ending (or even preventing) wars.

Many historians of the nineteenth century appear to have quite accurately comprehended the limitations of even the largest counterweight trebuchets.[15] Some of these figures were themselves artillerymen, and instinctively grasped the vast differences between mechanical and gunpowder energy systems. But as industrialization continued to accelerate, leading technology to have an increasing impact on society, this shaped how historians viewed the past. Appreciating how influential technology was in their own time, some looked for its revolutionary effects during earlier periods: technological advancements, some scholars posited, could explain sweeping historical phenomena.[16] This line of thinking came to be applied to medieval siege engines, and a theory was developed whereby trebuchets, the perceived siege guns of their day, could only have been used to smash down castle and town walls. This, in turn, informed explanations for the construction of larger and more complex European and Middle Eastern fortifications from about the end of the twelfth century to the neglect of various other factors.[17] With the diffusion and acceptance of this theory by academics, the producers of popular media can certainly be excused for using this as inspiration, adding expected embellishments.

---

[14] For siege dynamic, see Michael S. Fulton, *Siege Warfare during the Crusades* (Pen & Sword, 2019).

[15] See, for example, Eugène-Emmanuel Viollet-le-Duc, *Dictionnaire raisonné de l'architecture française du XIe au XVIe siècle*, 10 vols. (Paris: A. Morel, 1854–1868), 1:344.

[16] For a seminal work in this area, see Lynn White Jr., *Medieval Technology and Social Change* (Oxford University Press, 1962).

[17] For interpretations of the role of offensive artillery in the development of fortifications, see Fulton, *Artillery*, 322–355.

The careful reassessment of artillery used in and around the Latin East has shown the benefits of embracing a multidisciplinary approach. By incorporating examinations of texts authored from various cultural backgrounds, archaeological remains, geographical constraints, and the laws of physics, it has been demonstrated that medieval mechanical artillery was not the revolutionary weapon of destruction it is often portrayed to be. The traction trebuchet was a fairly simple mechanical device. It was employed to throw stones of a larger size to distances greater than could be achieved by hand or with a sling. The counterweight variety threw even larger stones to similar and even greater distances, but it seems to have fallen short of threatening the integrity of most fortified walls. As with any new theory, it will take time for this one to replace that which Hollywood has embraced. It will also, inevitably, need future revision, as new information comes to light, methodologies develop, and contemporary biases are revealed. It is a reality that historians are influenced by the environments in which they live; while technology was abuzz in the mid-twentieth century, interest in data and connectivity surged with the development of the Internet, and climate is among the various avenues of historical research that receives disproportionate attention today.

Bibliography

Denny, Mark. “Siege Engine Dynamics.” *European Journal of Physics* 26 (2005): 561–577.

Fulton, Michael S. “Anglo-Norman Artillery in Narrative Histories, from the Reign of William I to the Minority of Henry III.” *Journal of Medieval Military History* 14 (2016): 1–31.

——— *Artillery in the Era of the Crusades: Siege Warfare and the Development of Trebuchet Technology*. Brill, 2018.

——— “Development of Prefabricated Artillery during the Crusades.” *Journal of Medieval Military History* 13 (2015): 51–72.

——— “The Diffusion of Artillery Terminology in the Early Thirteenth Century: The Case of Henry of Livonia.” *SHARE 3* (2016): 1–27.

——— “Medieval Mechanical Artillery ‘Treatises’.” In *Military Literature in the Medieval Roman World and Beyond,* edited by Conor Whately. Brill, 2024.

——— “Overlooked Ordnance: Artillery Projectiles of the Crusader Period.” In *Crusading and Archaeology,* edited by Vardit Shotten-Hallel and Rosie Weetch, 300–327. Routledge, 2020.

——— “A Ridge Too Far: The Siege of Saone/Sahyun in 1188 and Contemporary Trebuchet Technology.” *Crusades* 16 (2017): 33–53.

——— “The Siege of Montfort and Mamluk Artillery Technology in 1271: Integrating the Archaeology and Topography with the Narrative Sources.” *Journal of Military History* 83 (2019): 689–717.

——— *Siege Warfare during the Crusades*. Barnsley: Pen & Sword, 2019.

——— “Trebuchets Were Not Siege Guns, So Why Use Them?” *Atiqot* 111 (2023): 259–273.

Kotán, Dávid. “Stone-Throwing Machines and Their Effects on the Medieval Castles of the Syrian Coastal Region.” In *Bridge of Civilizations: The Near East and Europe, c. 1100–1300,* edited by Denys Pringle, Peter Edbury, and Balázs Major. Archaeopress, 2019.

Purton, Peter. “The Myth of the Mangonel: Torsion Artillery in the Middle Ages.” *Arms & Armour* 3 (2006): 79–90.

al-Ṭarsūsī, Marḍī ibn ʿAlī (al-Tarsusi). *Al-Tabṣīrah fī al-ḥurūb*. MS Huntington 264. Bodleian Library, University of Oxford.

Viollet-le-Duc, Eugène-Emmanuel. *Dictionnaire raisonné de l’architecture française du XIe au XVIe siècle*. 10 vols. Paris: A. Morel, 1854–1868.

White, Lynn, Jr. *Medieval Technology and Social Change.* Oxford University Press, 1962.