

LIST OF ILLUSTRATIONS

Figures

Frontispiece: Joseph F. O'Callaghan

Illustrations 1–11 can be found between pages 200 and 201 in the essay “The Hybrid Trebuchet: The Halfway Step to the Counterweight Trebuchet” by Paul E. Chevedden.

1. The city of Naples, defended by Richard, count of Acerra, is besieged by King Henry VI of Germany in 1191. Henry's army bombards the city with stone-shot launched from a pole-framed traction trebuchet. The machine is operated by a pulling-crew of eight knights and a “shooter” holding the sling. The defenders prepare to launch stone-shot from a similar machine mounted on a tower. Peter of Eboli, *Liber ad honorem Augusti*. Bern, Burgerbibliothek, MS 120, fol. 109r.

2. A hinged counterweight trebuchet from *Bellifortis*, a treatise by Conrad Kyeser of Eichstät, which was left incomplete at his death in 1405. The main beam, counterweight box, sling, projectile, windlass and framework are all clearly visible. The machine has some of its dimensions numbered; the long arm of the beam is forty-six feet, and the short arm eight. The prong at the end of the long arm, which is essential for the release of the sling, is not depicted. Instead, both cords of the sling are incorrectly shown as attached to a ring at the extremity of the long arm. This massive machine used a simple peg-and-hole catch-and-trigger device to retain and release the beam. A hole is drilled in the base of one of the machine's triangular trestles, shown in the foreground, for the insertion of the peg. A restraining rope, attached to the base of the other triangular trestle, is drawn over the long arm of the beam at a point just above the windlass and is looped over the bottom end of the peg. When the peg is lifted out of its socket, the looped end is released, and the beam flies free. Trebuchet beams were often banded circumferentially with iron (as shown in the illustration), or lashed with rope, to help withstand splitting. This type of machine was identified in Arabic historical

sources as the Western Islamic trebuchet (*manjanīq maghribī*). Göttingen, Niedersächsische Staats- und Universitätsbibliothek, Cod. MS philos. 63, fol. 30r.

3. A pole-framed hybrid trebuchet with a fixed counterweight bombarding a fortification. It is operated by a single man. From *Avis aus Roys*, an anonymous manual of instruction for kings and princes written and illuminated in France (probably Paris) about the middle of the fourteenth century. New York, The Pierpont Morgan Library, MS M. 456, fol. 127r.

4. Muslim siege of Constantinople as depicted in the *Cantigas de Santa Maria* (c. 1280).

Figures 4 and 5 form a narrative sequence. This illustration shows a trebuchet (foreground L.) in the process of assembly. Its rotating beam with a fixed counterweight is being mounted on the trestle frame of the machine. The chief engineer is guiding the axle bearings of the rotating beam onto the journal blocks surmounting the two trestles. Behind the counterweight trebuchet is a “hand-trebuchet” operated by a single man. This traction machine consists of a forked beam, pivoted on a horizontal axis that is supported by a single-pole frame. The pulling rope, attached to the frame of the machine, passes around a pulley affixed to the forked end of the beam, giving the puller a mechanical advantage. *Cantigas de Santa Maria*, 28c. Escorial, MS T.I.1, fol. 43r.

5. Muslim siege of Constantinople as depicted in the *Cantigas de Santa Maria* (c. 1280). A trestle-framed counterweight trebuchet (foreground L.) is being prepared for discharge while massed crossbowmen are about to unleash a barrage of bolts to clear the battlements of defenders. Under a mantlet, sappers, wearing close-fitting *cervellières* and scale cuirasses, dislodge stones from the city wall. The tent encampment (shown above the trebuchet as a form of perspective) has “behind” it heavy armored cavalry in European-style equipment, led by two Muslim commanders in turbans. Mary intervenes in the siege and uses her mantle, held by two saints and two angels, to protect the city from bombardment. Protective screens, suspended from the battlements of city walls and castles, were widely used in the pre-gunpowder era throughout Eurasia and North Africa to shield fortifications from bombardment. *Cantigas de Santa Maria*, 28d. Escorial, MS T.I.1, fol. 43r.

6. A trestle-framed counterweight trebuchet having a fixed and a hinged counterweight. In front of the trebuchet is a cat-castle (*chat-chastel*), a combination of “cat” or mantlet (here equipped with a ram) and a “castle” or mobile siege-tower. From Paolo Santini’s *Tractatus*, 1470–1475. Paris, Bibliothèque Nationale, Codex Latinus 7239, fol. 109r.

7. *Center*: The Chinese pole-framed trebuchet called a “Whirlwind” (*hsüan-kêng*) machine because it could be turned to face any direction. According to the Chinese military treatise *Wu Ching Tsung Yao* (“Collection of the Most Important Military Techniques”), completed in 1044, this trebuchet had a beam of 5.5 m in length mounted on top of a pole-frame that stood 5.2 m in height. Attached to the butt-end of the beam were forty pulling ropes hauled down by a crew of fifty men. The machine could throw a stone-shot weighing 1.8 kg a distance of more than 77 m. *Left*: The Chinese “hand-trebuchet,” operated by a single man. A pole, fixed in the ground, carried a pin at its topmost extremity that acted as a fulcrum for the arm of the machine. Tsêng Kung-Liang, ed., *Wu Ching Tsung Yao* (*Chhien Chi*), ch. 12, p. 50a.

8. The Chinese “four-footed,” or trestle-framed, trebuchet with a composite beam of 8.6 m made up of seven wooden (or perhaps bamboo) spars lashed together with rope or bound with metal bands. The beam was mounted on a trestle frame that rose to a height of 6.5 m. The butt-end of the beam had 125 pulling ropes attached to it that a crew of 250 men hauled down. This machine could throw a stone-shot weighing between 53.7 and 59.7 kg a distance of more than 77 m. Tsêng Kung-Liang, ed., *Wu Ching Tsung Yao* (*Chhien Chi*), ch. 12, p. 48a.

9. The single pole-framed traction trebuchet (*manjanîq ‘arrâdah*), illustrated in Ibn Urunbughâ al-Zaradkâsh’s *Kitâb anîq fî al-manâjanîq* (867/1462–1463). A small counterweight is fixed to the butt-end of the rotating beam of this machine to enhance its power. Istanbul, Topkapı Sarayı Müzesi Kütüphanesi, Ahmet III Collection, MS 3469/1, *Kitâb anîq fî al-manâjanîq*, fol. 44r.

10. Detail of a stone fragment with a relief carving on its outer face depicting a siege. This fragment, mounted on a wall in the Church of Saint-Nazaire in Carcassonne, France, dates from the early thirteenth

century. Some scholars believe it depicts the siege of Toulouse in 1218 during which a stone-shot hurled from a trestle-framed trebuchet killed Simon de Montfort. The relief carving shows a trestle-framed traction machine being prepared for discharge. Pulling ropes are attached to six rings affixed to the butt-end of the beam, and a six-member pulling-crew is set to launch a rounded stone-shot that the operator of the machine is placing in the pouch of the sling. This trebuchet has a curved axle, a feature that it shares with the pole-framed traction trebuchet illustrated in Ibn Urunbughā al-Zaradkāsh's *Kitāb anīq fī al-manājanīq* shown in Figure 8.

11. A trestle-framed traction trebuchet as it is about to discharge a stone-shot from its sling. The pulling crew—obscured by knights charging in the foreground—is hauling down the ropes attached to the butt-end of the beam. The traction power of the pulling-crew swings the throwing arm of the beam upward, sending the operator of the machine aloft. By holding on to the sling for a moment and then releasing it, the operator increases the efficiency of the machine by utilizing the force generated by the flexion of the beam. From the “Maciejowski Bible” produced in Paris around 1250. New York, The Pierpont Morgan Library, MS M.638, fol. 23v.

Map (p. xxiv)

1. Medieval Spain