

Ordanche PETROV

STONE- AND ROCK-LAUNCHING ENGINES IN THE MIRACLES OF SAINT DEMETRIUS OF THESSALONIKI

Institute for old Slavic culture – Prilep
ordanche.petrov@isk.edu.mk

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Abstract: *The Miracles of St. Demetrius of Thessaloniki is a hagiography abundant in historical data. It contains the first mention of a new type of engine, the description of which indicates a traction trebuchet of the trestle-frame variation. After their first appearance during the siege of Thessaloniki by the Avars and Slavs, these engines see extensive use in Byzantium, Western Europe and the Arab World, their presence gradually declining after the invention of firearms.*

The Miracles of St. Demetrius of Thessaloniki, I & II are hagiographic works which, the religious subject aside, abound in historical data of the late 6th and 7th century.¹ The first collection of *The Miracles of St. Demetrius of Thessaloniki* (Mir. I)² was compiled in the second decade of the 7th century, no later than 620³. Unlike other writings, Mir. I is not an anonymous piece, the author being John, Archbishop of Thessaloniki, who lived at the turn of the 6th and the 7th century. The collection is comprised of thirteen chapters i.e. homilies honoring the Thessalonikian miracle worker.⁴

The book is an exceptionally interesting document for explorers of projectile-launching siege en-

gines⁵. Namely, the description of a type of projectile-launching engine accounted here by John, the Archbishop of Thessaloniki, serves as the basis for a great scientific debate among archeologists, historians and classic philologists.

In this paper I shall try to determine the type of projectile-launching engines described in Mir. I that the author did not denominate with some of the existing terms used by the Rhomais or Roman army for projectile-launching engines. The author refers to this type of projectile-launching engines simply as *stone-throwers* [Πετροβολοι]. They are described as follows⁶:

These (Πετροβολοι) were tetragonal and rested on broader bases, tapering to narrower extremities. Attached to them were thick cylinders well clad in iron at the ends, and there were nailed to them timbers like beams from a large house. These timbers had the slings hung from the back side and from the front strong ropes, by which, pulling down and releasing the sling, they propel the stones up high and with a loud noise. And on being fired they sent up many great stones so that neither earth nor human constructions could bear the impacts.

They also covered those tetragonal ballistae with boards on three sides only, so that those inside fir-

¹ Barisic (Баришић), 1955: 173

² The second collection, Mir. II, was written subsequently by an anonymous author. The writing style employed suggests that the author belonged to the lower Thessalonikian clergy. In Mir. II, the author again notes the use of projectile-launching engines during the Slavic attack of Thessaloniki, but does not provide a detailed description. Therefore, Mir. II shall be absent from this paper.

³ Barisic (Баришић), 1955: 173

⁴ In all thirteen homilies save the first two, the author (John, Archbishop of Thessaloniki) writes as a contemporary and recounts the events from this viewpoint. The contents of the first and second homily make it obvious that he had not witnessed the events described there in.

⁵ In Mir. I, the author gives a detailed description of a type of projectile-launching engines he names stone-throwers, while he only lists the other siege engines, mentioning their use in the Avaro-Slavic attack. The second collection of *Miraculi S. Demetrii II* also mentions the use of stone-throwing engines, once more denominated with the general term Πετροβολοι, but a distinct description of their features is omitted.

⁶ *Miracula S. Demetrii I.14* translated by S. Vryonis, "The evolution of Slavic Society and the Slavic Invasion in Greece", *Hesperia* 50 (1981): 384 and Barisic (Баришић), 1955: 173-184.

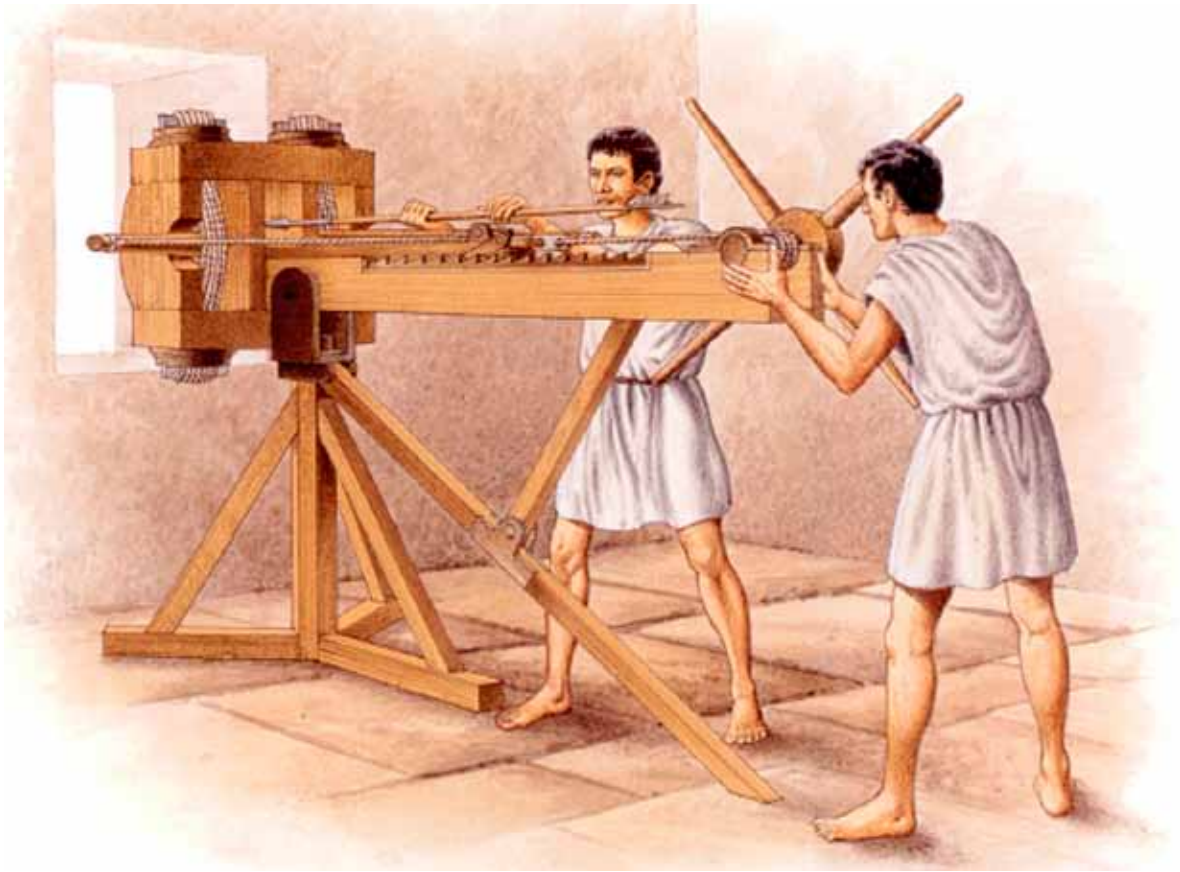


Figure 1a. A torsion engine with two levers (Campbell 2003: 26, illustration B)

ing them might not be wounded with arrows by those on the walls. And since one of these, with its boards, had been burned to a char by a flaming arrow, they returned, carrying away the machines. On the following day they again brought these ballistae covered with freshly skinned hides and with the boards, and placing them closer to the walls, shooting, they hurled mountains and hills against us. For what else might one term these extremely large stones?

The stones made holes in the ground wherever they fell. But the city also defended by stone-throwers. The stones from the city walls “as if obeying God’s command, fell right in the narrow openings of the barbarian engines”, thus killing their crew.

The translations of the word Πετροβολοι [Petroboloi] differ in various translations of Mir. I and it is collated with the terms: catapult, scorpio and ballista⁷. All of these are torsion engines. Catapults, scorpions and ballistae use energy provided by the

elastic deformation of twisted ropes, animal tendons⁸ or even human hair, which was used due to its greater elasticity⁹. Placed in a firm frame, they propelled the engine’s lever using torsion power. (Fig. 1a, 1b)

The fact that the author of Mir. I was a contemporary of the event and describes the engine in detail without using any of the names common at the time, makes one wonder whether the Byzantines were familiar with the engine John describes. The description of the projectile-launching engine present in Mir. I differs in comparison with all the projectile-launching engines known to have been used in Byzantium at the time. This leads to the conclusion that the type of projectile-launching engines termed Petroboloi[Πετροβολοι] in Mir. I was a brand new type of projectile-launching engine, first and foremost unknown to the author, and thus most likely also unknown to the Byzantines before the siege of Thessaloniki by the Avars and Slavs.

This had led a large number of researchers to enter into polemics concerning the features of the engine described in Mir. I. Consequently, a view growing in acceptance in recent years has been that the author of Mir. I, used Petroboloi to denote the projectile-launching engine now known as the Trebuchet¹⁰.

⁷ In the Barisic (Баришић) 1955: 180 translation the word Πετροβολοι [Petroboloi] is interpreted as stone-throwers, but in footnote 16, Ibid., he notes he is unclear on what the author had meant under the general term Πετροβολος, and assumes that the author had intended to denote some of the already familiar projectile-launching engines, such as catapults, ballistae, or scorpions; Vryonis 1981: 384 translates this word as ‘ballistae’, which does not match the description given in Mir. I;

⁸ Chevedden 1995: 1, Newark 1988: 102

⁹ Newark 1988: 102

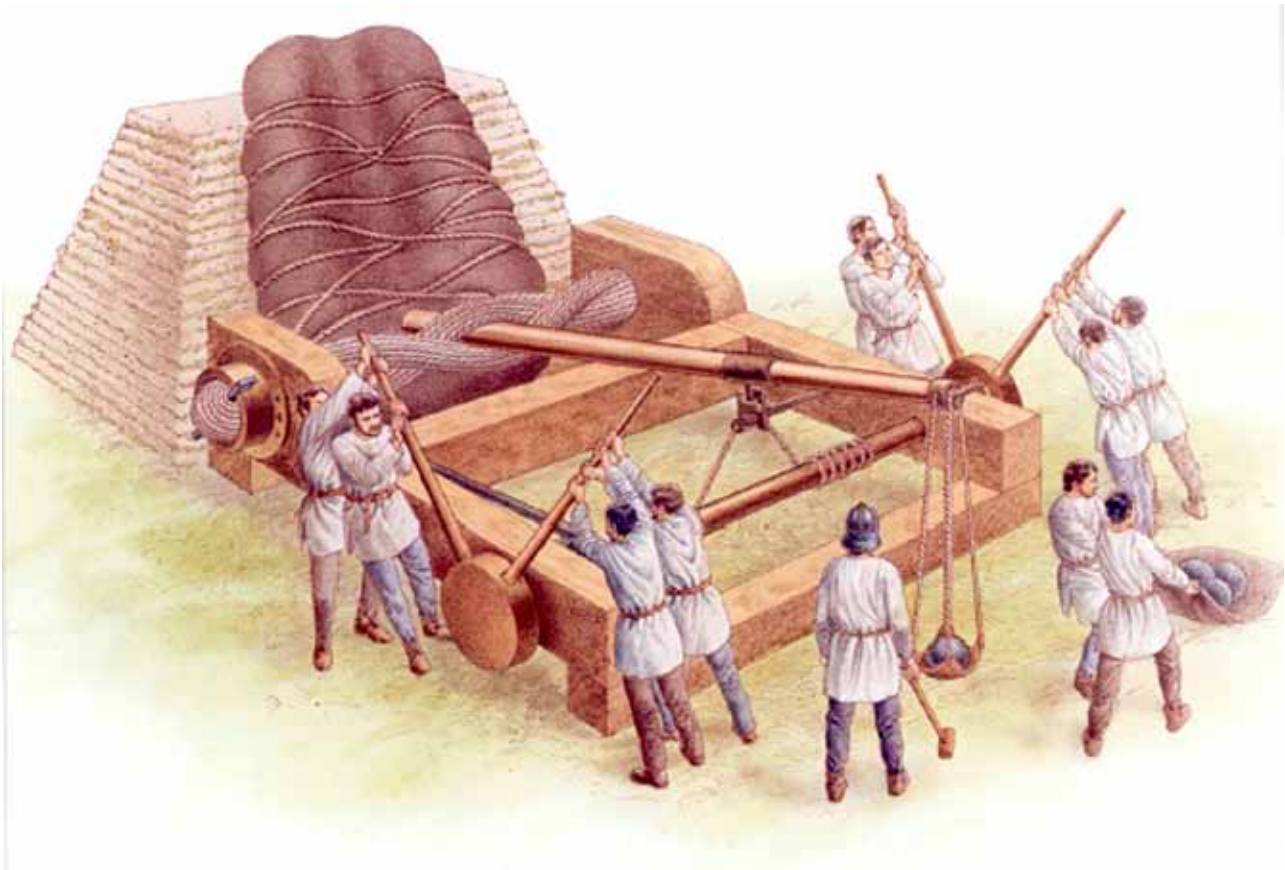


Figure 1b. A torsion engine with a single lever (Campbell 2003: 32, illustrationG)

The description emphasizes that the engine itself was tetragonal and had a broader base, with narrowing upper ends where large cylinders were placed. The cylinders had been clad in iron at the ends, and timbers ‘like beams from a large house’ were nailed to them, timbers with slings¹¹ hung on the back side

¹⁰ The trebuchet is a launching engine with one rotating lever. Depending on the way it gets its energy, there are three types of trebuchet: traction (propelled by human force), gravitational (Counterweight: propelled by a counterweight hung at the short side of the lever which is divided into a short and a long lever by the axis), and Hybrid trebuchet, which uses both human force and counterweight. These engines are presumed to be the product of three continents and four civilizations. In Chevedden 2000: 74, it is thought they appeared in China shortly before the beginning of 4th century B.C. and later developed in Byzantium, the Arab World and Western Europe. The main assumption is that this engine’s diffusion from China to Europe was made possible by the Turk tribes who penetrated the Arab World and Byzantium from Central Asia. Hill 1973:99, is of the opinion that the Turks first handed their knowledge of building these throwing engines to the Arabs. Written Arabic sources note the usage of projectile-launching engines resembling the traction trebuchet. The Arabs are assumed to have started using these engines towards the end of the 7th century.

¹¹ Something resembling a bucket is placed at the center of a rope, where projectiles about to be discharged by the engines are put. It works in the same way as a sling, the

and ropes¹² for pulling down on the front side. This perfectly fits the appearance of the Trebuchet, the base of which can be tetragonal while its frame narrows towards the upper ends, where a cylinder representing the axis of the rotating lever of the engine is placed. The structure of torsion engines includes one or two levers, but the levers do not have two loose endings. One ending holds a beam used for the discharging of projectiles, whilst the other ending is placed between twisted ropes, tendons or hair firmly tightened in the engine’s frame. Moreover, the engine’s frame does not have narrowing ends holding a large cylinder. (Fig. 2)

The author’s description mentions that the engine was enclosed on three sides by wooden boards¹³ cov-

difference being that the projectiles launched by the sling are much smaller.

¹² The number of ropes serving to set the engine in motion varied depending on the size of the projectiles as well as range requirements. At times there were so many ropes they resembled hair, causing this type of engine to be also known as “The Rope-Haired Witch” in Arabic sources.

¹³ Tarver 1995: 158, after his reconstruction and experimentation concludes that a protection for the crew could be installed during the building of this engine, because the engine itself allowed it. The crew was stationed directly under the short lever, and part of the crew could be stationed under the axis itself.

ered in dry or freshly skinned, bloodied hides. These served to protect the crew stationed inside the engine from arrows, stones and fire. This leads us to the conclusion that the object at hand is in fact a traction trebuchet propelled by human force, where the engine's crew pulls the ropes attached to the short end of the lever¹⁴. The presence of a crew protected from three sides, yet stationed inside the engine, eliminates the possibility of the engine in question being a torsion or a tension engine. These types of engines were not manned by a large crew or, even when they were, the crew was not stationed inside the engine. Torsion engines could operate without a large crew, while the engine itself would be far too dangerous for anyone to be stationed inside its frame. Such engines would be manned only by the men needed to prepare the engine to discharge the projectiles. This is not the case with the traction trebuchet, which requires a larger crew responsible for setting the engine in motion, plus a single operator who operated it directly.

Further proof that what Mir. I describes is indeed a traction trebuchet and not a torsion engine is set forth in the following abstract:

...famine entered among them as early as the second day. The night of the second day, when it got dark, they lit a fire round the entire city. It was a horrible sight to behold: a fire burning round the city, while the barbarians yelled and shouted so that both the sky and the earth trembled. There was uproar throughout the night. The next day at dawn, i.e. on the morning of the third day:

'And on the following day, they prepared siege machines, iron battering rams, catapults for throwing stones of enormous size, and the so-called tortoises, onto which, along with the catapults, they placed dry skins, again having devised so that they might not be harmed by fire or boiling pitch. They nailed bloodied hides of newly slain oxen and camels onto these machines and they thus brought them up near to the wall. From the third day, and thereafter, they hurled stones, or rather mountains as they were

¹⁴ According to Chevedden 2000: 74, the most powerful Chinese traction trebuchets included a crew of over 250 men in charge of pulling down the front side of the lever, thus discharging the stone projectiles. The engines were able to discharge projectiles weighing between 57 and 63kg to a distance of over 75 meters. According to Hill 1973: 100, Arabic sources note how some of these engines had a crew of over 500 men under the guidance of an experienced operator who was in charge of the discharging of projectiles. During experiments with the traction trebuchet, Tarver 1995: 162, with a crew of 15 men, managed to discharge 6 projectiles, each weighing 4.7 kg, to a distance between 93 and 105 meters, in a time interval of just over a minute.

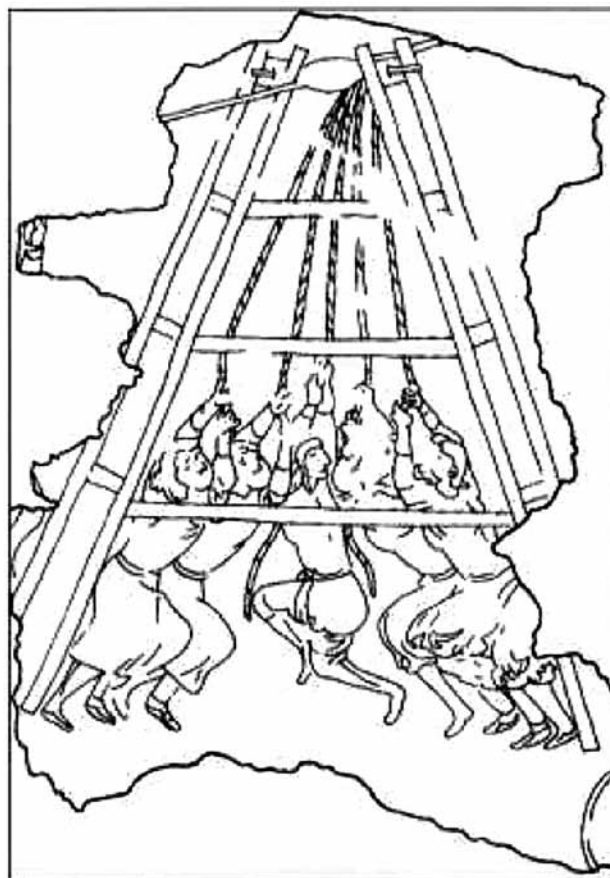


Figure 2. The wall paintings in Penjikent, dated to the late 7th and beginning of the 8th century, is where one finds a painted presentation most resembling the description given in Mir. I. The painting depicts a trebuchet of the footed traction trebuchet variation, along with the crew. (Nicolle 2003: 14)

*in size, and the archers shot further, imitating the winter snowflakes, with the result that no one on the wall was able to emerge without danger and thus to see something outside.*¹⁵

This description mentions that the barbarians were able to manufacture all those siege engines including the giant stone-throwers over a single night, which in reality would have been impossible for torsion or tension engines. Only the Roman Empire or Byzantium, which had a large army, might afford to own workshops, experienced craftsmen and experts who could manufacture this type of projectile-launching engines or other weaponry¹⁶. The production of such weapons largely depended on certain resources and raw

¹⁵ Miracula S. Demetrii I.14 translated by Barisic (Баришић) 1955: 173-184

¹⁶ Tarver 1995: 140, points out that specialized workshops or *fabricae ballistariae* existed in the 4th century, where such engines were produced. In these workshops owned by the empire one could find all the necessary resources as well as a large number of experts and experi-

materials which were not readily available and required a prolonged preparation. Henceforth, it would have been impossible to build them overnight, unless the engine in question was a traction trebuchet. The manufacturing of a traction trebuchet is quite simple and requires less craftsmen and resources. To build a traction trebuchet, one would need timber of the appropriate size, an experienced woodcarver, and a few assistants.

‘And the archers shot further, imitating the winter snowflakes’ probably refers to the large number of projectiles launched by the engines of the Avars and Slavs towards the city. This tells us about the duration of the interval between the launch of the stone projectiles, which is much shorter in traction trebuchets compared to torsion engines. The preparations needed to launch a traction trebuchet projectile are very short¹⁷.

It is stated that although the Avaro-Slavs made use of more than fifty Petrobols during this attack they failed to hit the bulwark even once, their gigantic rocks landing either inside or just short of the city fortifications. Some researchers¹⁸ point out that this lack of success was due to the Avars and Slavs being inexperienced in the handling of these engines, but a reconstruction which experiments with the traction trebuchet provides valuable insight. Through reconstruction of and experimenting with the traction trebuchet, Tarver reaches the conclusion that projectiles are fated to almost certainly miss the target unless they are of unified weight and form, having a proper spherical shape¹⁹. The prospect of the Avars and Slavs building more than fifty projectile-launch-

enced craftsmen required to produce effective torsion- or tension-powered engines.

¹⁷ Tarver 1995: 158, determined during his experiments that it can launch as many as 4 projectiles per minute.

¹⁸ Chevedden 2000: 75, points out that the Avars got their knowledge of how to produce the traction trebuchet from Bousas, a captured Byzantine who in exchange for his life revealed the secret of manufacturing siege engines to the Avars during the siege of Appiaria. Chevedden got this data from Teophilakt Simokatta, who describes this event in details - the author writes his History in the period from 628 to 638, describing the events during the reign of emperor Maurice (582-602)

¹⁹ Tarver 1995: 161-162 points out that during the Middle Ages the operators of such engines took great concern to have projectiles shaped as close as possible to a perfect sphere, and similar in weight. Experienced operators could offset a difference of approximately 10% of the projectiles’ weight. According to Contamine 1984: 104, in England in the year 1244, the mass production of round stone projectiles for trebuchets was conducted by the English government.

ing engines of this kind in a single night, yet not being able to aim them, is most likely due not to their lack of experience²⁰, but rather to the deficiency in processed stone projectiles and the usage of amorphous stones differing in weight as projectiles instead.

From the above, we may conclude that during the siege of Thessaloniki by the Avars and Slavs, the author of Mir. I witnessed a type of projectile-launching engine unknown to the Byzantines until then. These engines, which he described in detail and denominated with the general term Πετροβολοι [Petroboli], have at times been thought of as torsion engines, but are in all likelihood traction engines, specifically traction trebuchets of the trestle-frame variation. The presence of a double-sided lever, cylinder, and protected crew leads us to the conclusion that this is the most acceptable option. (Fig. 2)

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²⁰ Tarver 1995: 158-159, notes during his experiment that any group of people could learn to manage this engine relatively quickly.

Орданче ПЕТРОВ

ПОСТРОЈКИТЕ КОИ ФРЛАА КАМЕЊА И КАРПИ ВО МИРАКУЛИТЕ НА СВЕТИ ДИМИТРИЈА СОЛУНСКИ

Резиме

Чудата на св. Димитрија Солунски I и II претставуваат хагиографски дела кои изобилуваат со историски податоци за крајот на 6ти и 7ми век. Тие ни даваат мноштво на податоци за раното населување на словените и нивните напади на Солун. Особено е интересен описот на митрополитот Јован во Миракула I за аваро-словенскиот напад на Солун и нивната употреба на артилериски оружја кои досега не им биле познати на жителите на Солун. Имено во описот кој го дава солунскиот митрополит Јован, тој вели дека во овој аваро-словенски напад тие за една вечер изградиле педесетина фрлачки постројки кои имале четвртеста основа, која во горните делови се стеснува. На нив биле закачени големи цилиндри а на истите стебла како греди од големи куќи. На овие стебла имало закачено праќа од задната страна додека многубројни силни јажиња од предната кои влечејќи ги надолу ја издигнувале праќата нагоре и исфрлале големи камења. Самите постројки

биле опкружени со парапети од три страни и обложени со крвави кожи за заштитата на посадата.

Овој опис како и навестувањето на митрополитот Јован дека на овие постројки ниту името не им го знаеле не упатува да размислуваме дека овде не станува збор за некоја од добро познатите антички фрлачки постројки. Описот ни укажува на фрлачки од типот на тракциски требушет од варијантата на ногарест требушет. Оваа фрлачка постројка за прв пат се појавува во Кина кон крајот на 5ти век ст.е. и со помош на номадските народи кон крајот на 6ти век успева да стигне и на територија на Византија. Во ова време оваа постројка се прифаќа и во арапските земји а наскоро ќе се рашири и на запад. Заедно со подоцните модификации оваа постројка ќе претставува најмоќно и најмасовно употребувано артилериско оружје се до појавата на огненото оружје па и паралелно со него се до неговото усовршување.