

whilst the shot is projected in its parabolic flight.* To secure the most favourable result the shot should have acquired its maximum velocity, and should escape at an angle of about 45° . The attainment of this required certain proportions between the different dimensions of the machine and the weight of the shot, for which, doubtless, traditional rules of thumb existed among the mediæval engineers.

The ordinary shot consisted of stones carefully rounded. But for these were substituted on occasion rough stones with fuses attached,† pieces of red-hot iron, pots of fused metal, or casks full of Greek fire or of fowl matter to corrupt the air of the besieged place. Thus carrion was shot into Negropont from such engines by Mahomed II. The Cardinal Octavian, besieging Modena in 1249, slings a dead ass into the town. Froissart several times mentions such measures, as at the siege of Thin l'Evêque on the Scheldt in 1340, when "the besiegers by their engines flung dead horses and other carrion into the castle to poison the garrison by their smell." In at least one instance the same author tells how a living man, an unlucky messenger from the Castle of Auberoche, was caught by the besiegers, thrust into the sling with the letters that he bore hung round his neck, and shot into Auberoche, where he fell dead among his horrified comrades. And Lipsius quotes from a Spanish Chronicle the story of a virtuous youth, Pelagius, who, by order of the Tyrant Abderramin, was shot across the Guadalquivir, but lighted unharmed upon the rocks beyond. Ramon de Muntaner relates how King James of Aragon, besieging Majorca in 1228, vowed vengeance against the Saracen King because he shot Christian prisoners into the besiegers' camp with his trebuchets (pp. 223-224). We have mentioned one kind of corruption propagated by these engines; the historian Wassáf tells of another. When the garrison of Dehli refused to open the gates to Aláuddin Khilji after the murder of his uncle, Firúz (1296), he loaded his mangonels with bags of gold and shot them into the fort, a measure which put an end to the opposition.

Ibn Batuta, forty years later, describes Mahomed Tughlak as entering Dehli accompanied by elephants carrying small *balistae* (*ra'ádat*), from which gold and silver pieces were shot among the crowd. And the same king, when he had given the crazy and cruel order that the population of Dehli should evacuate the city and depart to Deogir, 900 miles distant, having found two men skulking behind, one of whom was paralytic and the other blind, caused the former to be shot from a mangonel. (*I. B. III. 395, 315.*)

Some old drawings represent the shaft as discharging the shot from a kind of spoon at its extremity, without the aid of a sling (*e.g.* fig. 13); but it may be doubted if this was actually used, for the sling was essential to the efficiency of the engine. The experiments and calculations of Dufour show that without the sling, other things remaining the same, the range of the shot would be reduced by more than a half.

In some of these engines the counterpoise, consisting of a timber case filled with stones, sand, or the like, was permanently fixed to the butt-end of the shaft. This seems to have been the *Trebuchet* proper. In others the counterpoise hung free on a pivot from the yard; whilst a third kind (as in fig. 17) combined both arrangements. The first kind shot most steadily and truly; the second with more force.

Those machines, in which the force of men pulling cords took the place of the counterpoise, could not discharge such weighty shot, but they could be worked more rapidly, and no doubt could be made of lighter scantling. Mr. Hewitt points out a curious resemblance between this kind of Trebuchet and the apparatus used on the Thames to raise the cargo from the hold of a collier.

The Emperor Napoleon deduces from certain passages in mediæval writers that the *Mangonel* was similar to the Trebuchet, but of lighter structure and power. But

* The construction is best seen in Figs. 17 and 19. Figs. 1, 2, 3, 4, 5 in the cut are from Chinese sources; Figs. 6, 7, 8 from Arabic works; the rest from European sources.

† Christine de Pisan says that when keeping up a discharge by night lighted brands should be attached to the stones in order to observe and correct the practice. (*Livre des faits, etc., du sage Roy Charles*, Pt. II. ch. xxiv.)