

Professor Willis restored the machine as it is shown in our fig. 19), the artist remarks : "It is a great job to heave down the beam, for the counterpoise is very heavy. For it consists of a chest full of earth which is 2 great toises in length, 8 feet in breadth, and 12 feet in depth" ! (p. 203).

Such calculations enable us to understand the enormous quantities of material said to have been used in some of the larger mediæval machines. Thus Abulfeda speaks of one used at the final capture of Acre, which was entrusted to the troops of Hamath, and which formed a load for 100 carts, of which one was in charge of the historian himself. The romance of Richard Cœur de Lion tells how in the King's Fleet an entire ship was taken up by one such machine with its gear :—

" Another schyp was laden yet
With an engyne hyghte Robinet,
(It was Richardys o mangonel)
And all the takyl that thereto fel."

Twenty-four machines, captured from the Saracens by St. Lewis in his first partial success on the Nile, afforded material for stockading his whole camp. A great machine which cumbered the Tower of St. Paul at Orleans, and was dismantled previous to the celebrated defence against the English, furnished 26 cart-loads of timber. (*Abulf. Ann. Muslem*, V. 95-97; *Weber*, II. 56; *Michel's Joinville*, App. p. 278; *Jollois, H. du Siège d Orleans*, 1833, p. 12.)

The number of such engines employed was sometimes very great. We have seen that St. Lewis captured 24 at once, and these had been employed in the field. Villehardouin says that the fleet which went from Venice to the attack of Constantinople carried more than 300 perriers and mangonels, besides quantities of other engines required for a siege (ch. xxxviii). At the siege of Acre in 1291, just referred to, the Saracens, according to Makrizi, set 92 engines in battery against the city, whilst Abulfaraj says 300, and a Frank account, of great and small, 666. The larger ones are said to have shot stones of "a kantar and even more." (*Makrizi*, III. 125; *Reinaud, Chroniques Arabes, etc.*, p. 570; *De Excidio Urbis Acconis*, in *Martène and Durand*, V. 769.)

How heavy a mangonade was sometimes kept up may be understood from the account of the operations on the Nile, already alluded to. The King was trying to run a dam across a branch of the river, and had protected the head of his work by "cat-castles" or towers of timber, occupied by archers, and these again supported by trebuchets, etc., in battery. "And," says Jean Pierre Sarrasin, the King's Chamberlain, "when the Saracens saw what was going on, they planted a great number of engines against ours, and to destroy our towers and our causeway they shot such vast quantities of stones, great and small, that all men stood amazed. They slung stones, and discharged arrows, and shot quarrels from winch-arblasts, and pelted us with Turkish darts and Greek fire, and kept up such a harassment of every kind against our engines and our men working at the causeway, that it was horrid either to see or to hear. Stones, darts, arrows, quarrels, and Greek fire came down on them like rain."

The Emperor Napoleon observes that the direct or grazing fire of the great arblasts may be compared to that of guns in more modern war, whilst the mangonels represent mortar-fire. And this vertical fire was by no means contemptible, at least against buildings of ordinary construction. At the sieges of Thin l'Evêque in 1340, and Auberoche in 1344, already cited, Froissart says the French cast stones in, night and day, so as in a few days to demolish all the roofs of the towers, and none within durst venture out of the vaulted basement.

The Emperor's experiments showed that these machines were capable of surprisingly accurate direction. And the mediæval histories present some remarkable feats of this kind. Thus, in the attack of Mortagne by the men of Hainault and Valenciennes (1340), the latter had an engine which was a great annoyance to the garrison; there was a clever engineer in the garrison who set up another machine