

weight of the stone they were intended to discharge, in fact so perfect a description of the machine, that any workman in wood and iron could readily make one. The largest spoken of by Vitruvius is calculated to hurl to a distance of some hundred yards a stone of 200 lbs. weight. Hemmingford, an old English chronicler, says that Edward I. had engines of this description at the siege of Stirling Castle which shot stones of 300 lbs. weight.

Nor were stones and darts only thrown. The darts were often covered round with combustible material, for the purpose of setting fire to the enemy's towers—pots of liquid fire, baskets of quick lime, and vessels charged with suffocating compounds of unsavory odor, were hurled by these engines on hostile forts and camps.

Of the time in which these engines were first employed we know little. A thousand years before our Lord's birth, we are told that Uziah, king of the Jews, "made in Jerusalem engines, invented by cunning men, to be upon the towers and upon the bulwarks, to shoot arrows and great stones withal. And his name spread, for he was marvelously helped till he was strong."

The invention has been ascribed to the Syrians by Pliuy, but Diodorus and Plutarch say, that they were first made in Sicily about 300 years before Christ. But this does not accord with the statement made by the inspired writer of the Book of Chronicles, whoever he was, of the act of Uziah, who furnished the walls of the Holy city of Jerusalem with these formidable engines, one thousand years before Christ's birth. The engines are mentioned in common use by many writers, and particularly as employed by Titus at the most memorable siege of antiquity, that of Jerusalem.*

That they must have been made in great numbers is evident from the fact that according to Appian 2000 of them were surrendered to the Roman Consul, Censorinus, by the Carthaginians.

We have no distinct evidence that the Romans or Greeks used these engines in the field, as we do our field artillery; at least I have never met with any. There is no doubt whatever but that the Roman armies when on the march against the enemy carried these engines, in case they had to undertake a siege. But owing to their great size and the nature of their construction, they must have been carried in separate pieces, over the roadless countries into which the Romans pushed their conquests. It is hardly possible to conceive that they could have been put together in sufficient time to be available for use in a general engagement. At a far later period, long after the Turks had taken Constantinople, one of the Sultans carried the metal wherewith to cast cannon, because it could be taken in small portions, rather than drag the heavy guns themselves, when it was proposed to undertake a siege.

There is an ancient story which we find in the traditions of the Romans, that the army of Regulus, on march against the Carthaginians, in Africa, encountered a huge serpent, which prevented the soldiers from approaching the watering place—that it destroyed many of the troops, and was only killed when the military machines

* At the close of the lecture a further explanation was given of the construction of the Catapults and Ballistae, and some passages read from Josephus to illustrate the mode in which an ancient siege was carried on.

were brought up, by which it was battered to death. Its skin was said to have been brought to Rome, and preserved in the Capitol for many centuries.

It is said on the authority of an old English Chronicler, William of Hastings, that the Conqueror, Duke William of Normandy, used machines for discharging darts on the invasion of England, at Hastings, and we know from twenty authorities that they were in common use on board the war ships of the time.

This subject might be infinitely extended, but my object is to show you as fully as possible, what the machines were that the ancients used before I come to the artillery of the present day.

There is however one other missile, up to the present day among the mysteries of the world, and of which we shall, most certainly, never know more than we do, which was used from a very remote period and with a most terrible effect. I allude to the *Greek fire*.

The invention of this extraordinary projectile, which came, as it seemed, between the Old World and the New, between the machines of the ancients and the cannon of the moderns, is attributed to Callinicus, an engineer of the city of Heliopolis in Syria, in the seventh century—and was used to destroy the ships of the Saracens, which was done, and 30,000 men perished.

Colonel Chesney, and two scientific French officers, have made great researches into the facts connected with the Greek fire; and their opinion is that nitre was the chief-ingredient employed, and that explosive compounds were used from a very early age. An old author has collected from the works of the Greek and Latin writers many passages favourable to the opinion that gun powder was known to the nations of antiquity. He mentions the attempt of Salmoneus to imitate the thunder of the gods, and attempts of like kind made by the Indian Brahmins, but the most interesting example is that from the life of Apollonius, in which it is shown that Alexander the Great was prevented from extending his Indian conquests, owing to the use of some combustible or explosive missile, by a people or tribe, whom he calls the Oxydracæ; I quote the whole passage from his history because it is curious. "These truly wise men (the Oxydracæ), dwell between the rivers Hyphasis and Ganges; their country Alexander never entered, deterred not by fear of the inhabitants, but as I suppose by religious motives, for had he passed the river Hyphasis, he ought doubtless have made himself master of the country around them; but their cities he never could have taken, for they came not out to the field to fight those who came to attack them, but these holy men, beloved of the gods, overthrew their enemies by tempests of thunderbolts, shot from their walls. It is said that the Egyptian Hercules and Bacchus, when they overran India, invaded this people also, and having prepared warlike engines, attempted to conquer them; they in the meantime made no show of resistance, but upon the enemy's near approach, they were repulsed by storms of lightning and thunderbolts hurled upon them from above."

In the old records of the Hindoos there is mention made of a missile named *Agnicaster*, which is supposed to have been a kind of rocket.

But as to the Greek fire, it does not appear that it was known in Europe till the time of the Crusades. Fire machines for discharging a

burning fluid on the enemy are mentioned by an old Hindu poet, Chased, and he speaks of the missiles as having been propelled to a distance of 1,445 English yards—from whence Colonel Chesney and others have come to the conclusion that an incendiary projectile was in use in the East about the year of our Lord 1200.

We know that the Greeks made great use of this means of destroying an enemy. The Princess Anna Comnene, a daughter of the Greek Emperor Alexius Comnenus, who wrote the history of his reign, about 1100 years A. D., speaks of the Greek fire, and distinctly says that it was shot from copper tubes, which had mouths like those of dragons. She also hints at some of the materials employed in its composition. Nitre is not one of these, but into the composition of the Greek fire I shall not enter, as another of our officers will lecture to you on explosive compounds.

De Joinville who wrote an account of the Crusade under Louis the 9th of France, commonly called St. Louis, describes the Greek fire thus, "it was thrown from a machine called a Peirary, and came forward as a large barrel of verjuice, with a tail of fire issuing from it, as big as a great swan, making a noise in its passage like thunder, and seeming like a dragon flying through the air, and from the great quantity of fire it threw out, giving such a light that one might see in the camp as if it had been day."

Now the Sergeant-Major will tell those of you who never saw the flight of a large military rocket through the air, that no more exact description could have been given. Standing in front of one coming towards you, it appears much larger than it really is—it makes a great noise—not exactly like thunder, but a rushing sound as of a great wind—it leaves a great trail of light, so bright that if fired at night all objects may be clearly seen. It is no objection that the Greek fire was a liquid fire, that is, that it poured out flames, which ignited all objects within its reach. Our own rockets when prepared with carcass composition do precisely the same thing. It is generally understood that the use of the Greek fire arose in the East, and that Callinicus, who first gave it to the Greeks of the Lower Empire, had obtained a knowledge of it from some eastern people. My belief has always been that the Greek fire was simply a rocket. It was with rockets without doubt that the Oxydracæ defended their city against Alexander, for since Europeans have known India and China, they have seen the rocket used. Colonel Symes in his narrative of his embassy to Ava says that the Burmese at a festival at which he was present made a display of rockets which was strikingly grand. The rockets were formed from the trunks of trees, bored out as we bore out trees to make the cylinder of a pump; 9 and 10 inches in diameter, and from 12 to 20 feet long, weighing from 1000 to 2000 lbs. Criminals were often put to death by being attached to one of these huge rockets, and shot into the air. Of course this is a mere question of curiosity, but I have ever had, since I thought of the thing at all, a confident belief that the Greek fire and the rocket are one and the same thing. The account of it may be somewhat tedious, but a correct description of the ancient machines of war could hardly be given without it.