Civilization 222

Chapter 222: The Development of Technology, Part Two

Xiulote reflected for a long while before he finally understood: he had confused the Eastern crossbow with the European crossbow.

However, in the history of both the East and Europe, their designs were completely different, so much so that calling them both "crossbows" might not be accurate. They had also evolved towards different battlefield roles.

The Eastern crossbow was an enhanced upgrade of the long-range war bow, with a large frame, high tension, and long draw distance, using slender bolts nearly resembling arrows, equipped with a specialized sighting structure. Its range and power were both amplified versions of a bow. Many crossbows from the Han and Tang Dynasties could even be used as war bows once the bow arms were detached.

Tactically speaking, from the Qin army's unification of the Six States to the Han Dynasty's crossbow formations marching north to combat the Xiongnu, the Eastern crossbow was an offensive weapon for long distances, widely used in military formations across vast terrains. By the Song Dynasty, heavy crossbows had reached their peak, becoming the singular weapon in field battles that could counter heavily armored cavalry.

"Hmm, like the divine arm crossbow that was known to exist but its craftsmanship was lost," the young man yearned and shook his head slightly.

The European crossbow, on the other hand, emphasized close-range armor-piercing capabilities, a shorter frame, similarly high tension, shorter draw distance, using thick, heavy bolts. Sighting mechanisms had not yet become commonplace in this era, with an effective flat-trajectory range of only about seventy steps. To increase tension, European crossbows first used steel strips for storing energy

and then invented specialized mechanical cocking devices to draw the string. Its trigger mechanism was also different from that of Eastern crossbows.

From a tactical application standpoint, European crossbows were widely used in castle-based defensive battles, mainly positioned as defensive armor-piercing weapons for close-range firing from advantageous terrain. Their design featured a smaller frame and shorter draw distance, trading off some firing power for a higher density of troops within a unit distance, which was highly suited to the limited space in castles.

In this era, European heavy steel crossbows were cocked using mechanical windlasses, with an extremely slow rate of fire, tension reaching over two thousand pounds, and were unstoppable within twenty steps, greatly effective in piercing armor and capable of causing shock injuries to knights inside plate armor, aligning well with the characteristics of castle defense battles.

Xiulote shook his head again; the heavy steel crossbow was still too far-fetched. At that time, the efficiency of transferring energy with steel strips was quite low, resulting in significant energy loss. Relatively speaking, medium-sized wooden crossbows were more practical, with much higher energy transfer efficiency at the same poundage.

Thinking this, Xiulote gave a slight smile to the Master Carpenter, his eyes bright.

Then, he waved to the Head Warrior and made a writing gesture. Bertade nodded in understanding, fetched a wood board and a newly made charcoal pencil, and handed them to His Highness. The young man’s knowledge of physics remained, and he casually sat cross-legged on the ground, quickly engaged in calculations and drawings.

Seeing this scene, Master Carpenter Kushinji was momentarily stunned. Curiously leaning over, he saw His Highness writing unknown strange symbols, "m" "v" "g", the horizontal equations resembling the

priestly script of the heavens. Then, parabolic trajectories were drawn, with "h" "D" marked on them. Finally, various declining curves with "F" "L" at both ends and the shaded areas within the curves were filled in with charcoal, resembling the abstract eyes of deities, gazing darkly at him.

Kushinji's gaze became vacant, utterly bewildered. Astonishment finally replaced his solemn expression, showing on his aged face. Then, turning to Bertade with a grave look, he discreetly pointed at His Highness and then at the heart where the spirit was said to reside in myths.

Bertade nodded seriously, also pointing to his own heart, and then nodded again. He indicated that everything was normal, that this was His Highness's routine operation, a "Divine Revelation" rather than "evil."

Of course, if it were an ordinary citizen without such a lofty status and position, venturing into invention and displaying traits beyond the norm would likely result in being sent to the sacrificial altar.

Xiulote was engrossed in his work, oblivious to the silent conversation happening beside him. He first calculated the potential energy of the bow frame, the kinetic energy and momentum of the arrows. Then he estimated the maximum shooting distances at a forty-five-degree angle for different initial velocities. Finally, he assessed the kinetic energy of the arrows as the tension changed.

After the calculations, the young man had a deeper understanding of both Eastern and Western crossbows.

Long-range shooting was the process of transforming the potential energy of the bow frame into the kinetic energy of the arrow. Energy is the product of force and distance, and the arrow's kinetic energy is determined by both the tension and draw distance, which are integrated over the course of release.

The lethality of an arrow depends on its momentum, which is the deformation from the impact between the arrowhead and the target. When the lethal force of the arrow increases at a constant rate, the demand for kinetic energy rises exponentially, leading to a rapid increase in the size of the crossbow frame and eventually evolving into the giant ballistae. To increase the arrow's weight, thus increasing its momentum for the same kinetic energy, is the most common way to enhance lethality.

Here, tension is what's referred to as poundage. The type of bow or crossbow dictates the effect of changes in tension. The tension of both bow frames and crossbow frames typically decay at different rates, gradually decreasing as the draw distance shortens during the string's release.

The Mexica longbow used by the Alliance now is a straight-pull bow, which has relatively high tension decay and the simplest craftsmanship. More advanced recurve bows can store a significant amount of elastic potential energy in advance, offering a flatter tension curve and transferring more kinetic energy.

The recurve bows in the East also often incorporate compound bows, using stiff tips on both ends to balance the tension curve. The extreme of this can be seen in the Ming and Qing bows, with large recurves, long draw distances, and high tension. They pursue the ultimate in energy transfer, enduring the vibration of the bow frame and sacrificing long-range stability in exchange for a potentially lethal armor-piercing strike at close range.