

## Civilization 223

### Chapter 223: The Development of Technology Middle\_2

And even more implausibly, the pulling curve of the modern pulley bow remained nearly a flat line, meaning that under the same pulling force and pulling distance, the energy stored was twice that of a straight-pull bow.

At this thought, Xiulote nodded slightly and then shook his head. It was only with a large supply of buffalo horn and sinew that he could consider producing a composite crossbow. The pulley crossbow, meanwhile, was distant and impractical. By the time technology had evolved to efficient steel-making and precision machinery, the era of gunpowder weapons would have already arrived.

The pulling distance, the distance over which force is applied, is another crucial factor determining the kinetic energy of arrows, yet it is often overlooked. Due to the rapid decay of force when a bow is released, increasing the pulling distance effectively increases the integral area of force and distance, and the increase in kinetic energy exceeds linearity. In other words, a longer pull distance significantly enhances the functionality of arrows.

The youth recalled the images in his memory, lost in thought.

Take for example the Qing bow, preserved in photos, where the archer can stretch the bowstring to the other shoulder, and the pulling distance is the entire arm plus body width. Based on the theory that arm span equals height, the pulling distance of the Qing bow could even reach over one meter. This pulling distance brought about terrifying kinetic energy, and coupled with heavy arrows, it could penetrate heavy armor within fifty steps.

The pulling distance of a Japanese bow was between 90 cm and one meter, compensating for the lower stored energy of its bamboo body, yet still achieving notable results. European longbowmen in oil paintings could only pull back to the cheek, similar to Longbow Warriors in Tang Dynasty murals, with a

pulling distance of about 80 cm. This was what they called hearing the twang by the ear. The Turkish bow also had this level of pulling distance, but utilized a high-strength composite material to maintain force while minimizing the bow's length.

Below that, at a pulling distance of 70 cm, there were only small-pull American hunting bows, along with slightly smaller cavalry bows. These bows were usually used primarily for hunting, having very limited effectiveness against armored warriors.

Xiulote recalled the Tlaxcalan bows they had seized; their pulling distance also fell into this range, hence their relatively low power. As for the shorter and weaker primitive bows, they were the weapons of tribal hunters, posing a negligible threat to Mexica leather-armored warriors, unless it was a divine archer capable of hitting the eye within thirty steps.

Corresponding to bows were the pulling distances of crossbows, which could be judged by the distance between the stringing position of the crossbow mechanism and the body of the crossbow.

In Han Dynasty murals, arm-stirrup crossbows were strung with one hand, reaching nearly half an arm's length, with a pulling distance of about 40-50 cm. Stirrup crossbows were strung by stepping on them with both feet and pulling with both arms to the end of the thighs. The youth estimated the pulling distance to be at least 70-80 cm. As for the waist-stirrup crossbow, with the strongest pulling force and an unusually wide body, it required robust crossbowmen to sit on the ground and use all their strength to string it like a rowing machine, pulling it past their knees, and the pulling distance was also likely to be between 40-60 cm.

Xiulote then recalled the wartime scenes in European oil paintings. He was particularly impressed with their crossbowmen.

These European crossbowmen, slender in build, often held a crossbow that only pulled to mid-arm, with a pulling distance probably within 30 cm. European steel crossbows had great pulling force but a very short pulling distance, hence the kinetic energy they could transmit was actually limited. A 160-pound long-pull longbow and an 800-pound short-pull steel crossbow had very similar kinetic energy in tests. However, the heavy arrow momentum of the steel crossbow was outstanding, making it excellent at penetrating armor at close range.

Overall, the development of Eastern bows and crossbows spanned a full three thousand years, with more mature technology and more efficient structures, making them the absolute mainstay in the war history of Huaxia. Whereas the development of Western bows and crossbows was shorter, additionally suppressed continuously by the Church, serving only as a defensive auxiliary in warfare for piercing armor.

In fact, large-scale deployment of crossbow warriors was the key weapon of successive Celestial Empires against heavy armored cavalry, from the Qin and Han Dynasties to the Tang and Song Dynasties, far more advanced and mature than Europe at the time in terms of range and power.

After a moment of contemplation, Xiulote decided to follow the development path of Eastern crossbows. Based on the images in his memory and the current level of technology, he decided to copy the specifications of the Han crossbows and establish a three-level crossbow warrior system of arm-stirrup crossbows, stirrup crossbows, and waist-stirrup crossbows.

The youth flipped over the wooden board full of formulas and curves, then with a black charcoal pen, he carefully drew the rough shapes of the three types of crossbows and the actions of the warriors stringing them on the back.

Xiulote made some corrections and took a while to finish drawing, finally exhaling in satisfaction.

Then, the youth glanced up slightly, gazing at the distant Western sky. He had crossed oceans and millennia, recalling the vast and extensive intercontinental wars between Han and Hun, as well as the subsequent decisive battles, smiling complexly and sentimentally. All these detailed memories came from that time, albeit he had not expected to use them here.

Everyone stood by, waiting for a long time, until His Highness finally stood up. He put down the wooden board filled with strange drawings and symbols, picked up a simple wooden crossbow, and smiled confidently again.

"Kushinji, come here."

Xiulote waved to the master carpenter not far away, then pointed to the drawings on the board. The master carpenter looked around cautiously to ensure His Highness was back to normal. He then approached and looked at the mysterious board.

"The issue of shooting stability is something I initially forgot. It shouldn't use thick, short arrows, but ones similar to feathered arrows, only slightly shorter for better flight. Then, the position of the crossbow arm groove should be slightly tightened, holding the feathers just a bit. This way, although the sliding of the arrow slightly hinders the process, the trajectory after shooting becomes much more stable."