

## From Gunpowder to Guns

Long before the invention of guns, gunpowder was used in China and Korea to excavate mines, build canals, and channel irrigation. Alchemists in China used related formulas to make noxious gas pellets to paralyze enemies and expel evil spirits. A more realistic benefit was eliminating disease-carrying insects, a critical aid to the colonization of malarial regions in China and Southeast Asia. The Mongol Empire staged fireworks displays on ceremonial occasions, delighting European visitors to Karakorum who saw them for the first time.

Anecdotal evidence in Chinese records gives credit for the introduction of gunpowder to a Sogdian Buddhist monk of the 500s. The monk described the wondrous alchemical

transformation of elements produced by a combination of charcoal and saltpeter. In this connection he also mentioned sulfur. The distillation of naphtha, a light, flammable derivative of oil or coal, seems also to have been first developed in Central Asia, the earliest evidence coming from the Gandhara region (in modern Pakistan).

By the eleventh century, the Chinese had developed flamethrowers powered by burning naphtha, sulfur, or gunpowder in a long tube. These weapons intimidated and injured foot soldiers and horses and also set fire to thatched roofs in hostile villages and, occasionally, the rigging of enemy ships.

In their long struggle against the Mongols, the Song learned to enrich saltpeter to increase the amount of nitrate in gunpowder. This produced forceful explosions rather than jets of fire. Launched from catapults, gunpowder-filled canisters could rupture fortifications and inflict mass casualties. Explosives hurled from a distance could sink or burn ships.

The Song also experimented with firing projectiles from metal gun barrels. The earliest gun barrels were broad and squat and were transported on special wagons to their emplacements. The mouths of the barrels projected saltpeter mixed with scattershot minerals. The Chinese and then the Koreans adapted gunpowder to shooting masses of arrows—sometimes flaming—at enemy fortifications.

In 1280 weapons makers of the Yuan Empire produced the first device featuring a projectile that completely filled the mouth of the cannon and thus concentrated the explosive force. The Yuan used cast bronze for the barrel and iron for the cannonball. The new weapon shot farther and more accurately, and was much more destructive, than the earlier Song devices.

Knowledge of the cannon and cannonball moved westward across Eurasia. By the end of the thirteenth century cannon were being produced in the Middle East. By 1327 small, squat cannon called “bombards” were being used in Europe.

## Movable Type

Changes in printing, from woodblock to an early form of **movable type**, allowed cheaper printing of many kinds of informative books and of test materials. The Song government realized that the examination system schooled millions of ambitious young men in Confucian ideals of state service—many times the number who eventually passed the tests. To promote its ideological goals, the government authorized the mass production of preparation books in the years before 1000. Though a man had to be literate to read the preparation books and basic education was still not common, some people of limited means were now able to take the examinations; and a moderate number of candidates entered the Song bureaucracy without noble, gentry, or elite backgrounds.

The availability of printed books changed country life as well, since landlords now had access to expert advice on planting and irrigation techniques, harvesting, tree cultivation, threshing, and weaving. Landlords frequently gathered their tenants and workers to show them illustrated texts and explain their meaning. This dissemination of knowledge, along with new technologies, furthered the development of new agricultural land south of the Yangzi River. Iron implements such as plows and rakes, first used in the Tang era, were adapted to wet-rice cultivation as the population moved south. Landowners and village leaders learned from books how

to fight the mosquitoes that carried malaria. Control of the disease became one of the factors encouraging northerners to move south, which led to a sharp increase in population.

## How did post-classical trade affect the diffusion of scientific and technological traditions?