

= Huolongjing =

The Huolongjing ( traditional Chinese : 火器圖說 ; simplified Chinese : 火器圖說 ; pinyin : Huǒ Qì Tú Shuō ; Wade @-@ Giles : Huo Lung Ching ; rendered by its translator into English as Fire Drake Manual ; in modern English , Fire Dragon Manual ) is a 14th @-@ century military treatise that was compiled and edited by Jiao Yu and Liu Bowen of the early Ming Dynasty ( 1368 ? 1644 ) in China . It outlined the use of various " fire weapons " involving the use of gunpowder .

The Huolongjing provides information about various gunpowder compositions , including " magic gunpowder " , " poison gunpowder " , and " blinding and burning gunpowder " . It has descriptions of the Chinese hollow cast iron grenade bomb , shrapnel bombs , and bombs containing poisonous concoctions . The book describes the 10th @-@ century Chinese fire arrow and its evolution into the metal @-@ tube @-@ launched rocket , various rocket launchers , the advent of the two @-@ stage rocket that has a booster rocket , and fin ? mounted , winged rockets . The book also describes the use of explosive land mines and naval mines , and the latter 's use of a complex trigger mechanism . The book describes the development of other weapons , including various proto ? guns such as the fire lance , handguns with up to ten barrels , handguns with possible serpentine locks used as components in matchlock firearms , early bombard and cannon , cannon barrels filled with metal balls containing poisonous gunpowder solutions , and cannons that were mounted on wheeled carriages .

Although Jiao Yu did not provide the book 's preface until the Nanyang publication of 1412 , the book was published in the 14th century and was a compilation of material written since the late 13th century . From his own personal accounts , Jiao Yu also described gunpowder weapons that were in use since 1355 , with his involvement in the Red Turban Rebellion and revolt against Yuan Dynasty Mongol rule .

= = Gunpowder warfare and weapons = =

= = = Firearms and flamethrowers = = =

The military treatise of Jiao Yu and Liu Bowen went into a great amount of detail about the gunpowder weapons of their time . The fire lance and fire tube ? a combination of a firearm and flamethrower ? came in many different versions and were styled with many different names by the time Jiao Yu edited the Huolongjing . The earliest of these were made of bamboo tubes , although metal versions began to appear in the 12th century . Others , according to description and illustrated pictures of the Huolongjing , emitted arrows called the ' lotus bunch ' accompanied by a fiery blast . Some of these low ? nitrate gunpowder flamethrowers used poisonous mixtures , including arsenious oxide , and would blast a spray of porcelain bits as shrapnel .

The earliest depiction of a fire lance is dated c . 950 , a Chinese painting on a silk banner found at the Buddhist site of Dunhuang . The oldest existent bronze handgun is the Heilongjiang hand cannon from the Heilongjiang archaeological excavation , dated to 1288 . For that year , the Yuan Shi historical text describes the rebellion of the Christian Mongol prince Nayan and the Jurchen @-@ born military commander Li Ting who , along with a Korean brigade conscripted by Kublai Khan , suppressed Nayan 's rebellion using foot soldiers armed with handguns and portable bombards .

The earliest metal barrel guns were not designed for high @-@ nitrate gunpowder and a bore @-@ filling projectile ; rather , they were designed for the low @-@ nitrate flamethrower fire lance that shot small co @-@ viative missiles . This was called the " bandit @-@ striking penetrating gun " ( ji zei bian chong ) , and was illustrated in a drawing in the Huolongjing . In the Islamic world , the fire lance first appears in a book of 1280 written by Hasan al ? Rammah , and again appears in a manuscript of 1320 . In Europe , the first representation of the fire lance is of a horse @-@ mounted knight wielding the weapon in a Latin manuscript illustration dated to 1396 , and also appeared in an illustration of Taccola 's De Mechinis ( 1449 ) .

The Huolongjing also describes and illustrates metal @-@ barrel handguns , including guns with up to ten barrels . It describes the use of a " match @-@ holding lance gun " ( chi huo ? sheng qiang ) , it described its arrangement as a match brought down to the touch hole of three gun barrels , one after the other . During the reign of the Yongle Emperor ( 1402 ? 1424 ) , the Shenji Brigade was formed with cavalry horses that were said to have tubes filled with flammable materials holstered to their sides , along with troops with firearms and light artillery on carriages . In addition to firearms and fire lances , the Huolongjing also illustrates the tall , vertical , mobile shield used to hide and protect infantry gunmen , known as the " mysteriously moving phalanx @-@ breaking fierce @-@ flame sword @-@ shield " . This large , rectangular shield would have been mounted on wheels with five rows of six circular holes each where the gun barrels could be placed . The shield itself would have been accompanied by swordsmen on either side to protect the gunmen .

= = = Bombards and cannons = = =

In China , the first cannon @-@ barrel design portrayed in artwork was a stone sculpture dated to 1128 found in Sichuan province , although the oldest archaeological discovery of a cannon is a bronze cannon of China inscribed with the date , " 2nd year of the Dade era , Yuan Dynasty " ( 1298 ) . The prototype to the metal barrel was of course one made of bamboo , which was recorded in use by a Chinese garrison commander at Anlu , Hubei province , in the year 1132 . One of the earliest references to the destructive force of a cannon in China was made by Zhang Xian in 1341 , with his verse known as The Iron Cannon Affair . Zhang wrote that its cannonball could " pierce the heart or belly when it strikes a man or horse , and can even transfix several persons at once " . Jiao Yu wrote that the cannon , called the " eruptor " , was cast in bronze and had an average length of 53 inches ( 130 cm ) . He wrote that some cannons were simply filled with about 100 lead balls , but others , called the " flying @-@ cloud thunderclap eruptor " ( ????? ; feiyun pili pao ) had large rounds that produced a bursting charge upon impact . He wrote that the Chinese in his day had discovered how to pack hollow , cast iron shells of cannonballs with gunpowder to create an explosive effect upon contact with enemy targets . In perspective , exploding cannonball rounds were not discovered in Europe until the 16th century . He also mentioned the use of the " poison @-@ fog magic smoke eruptor " , in which " blinding gunpowder " and " poisonous gunpowder " were packed into the hollow cannonball shells and were effective in burning the faces and eyes of enemies , along with choking them with a formidable spray of poisonous smoke . He wrote that cannons were mounted on frames or on wheeled carriages so that they could be rotated in all directions .

= = = Land mines and naval mines = = =

The first recorded use of a land mine stated that the officer Lou Qianxia of the late Song Dynasty created them to kill invading Mongol troops in 1277 . Jiao Yu wrote that land mines were spherical , made of cast iron , and their fuses were ignited by the enemy movement disturbing a trigger mechanism . Although his book did not elaborate on the trigger mechanism , a late Ming Dynasty book of 1606 said that a complex system of a pin release , dropping weights , cords and axles worked to rotate a spinning " steel wheel " that acted as a flint to provide sparks that ignited the mines ' fuses underground . For the use of naval mines , he wrote of slowly burning joss sticks that were disguised and timed to explode against enemy ships nearby :

The sea ? mine called the ' submarine dragon ? king ' is made of wrought iron , and carried on a ( submerged ) wooden board , [ appropriately weighted with stones ] . The ( mine ) is enclosed in an ox @-@ bladder . It subtly lies in the fact that a thin incense ( ? stick ) is arranged ( to float ) above the mine in a container . The ( burning ) of this joss stick determines the time at which the fuse is ignited , but without air its glowing would of course go out , so the container is connected with the mine by a ( long ) piece of goat 's intestine ( through which passes the fuse ) . At the upper end the ( joss stick in the container ) is kept floating by ( an arrangement of ) goose and wild ? duck feathers , so that it moves up and down with the ripples of the water . On a dark ( night ) the mine is sent

downstream ( towards the enemy 's ships ) , and when the joss stick has burnt down to the fuse , there is a great explosion .

In the later " Tiangong Kaiwu " ( The Exploitation of the Works of Nature ) treatise , written by Song Yingxing in 1637 , the ox bladder described by Jiao Yu is replaced with a lacquer bag and a cord pulled from a hidden ambusher located on the nearby shore , which would release a flint steel ? wheel firing mechanism to ignite the fuse of the naval mine .

= = = Gunpowder and explosives = = =

There were several gunpowder compositions proposed by Jiao Yu , with additions to the standard formula of potassium nitrate ( saltpetre ) , sulphur , and charcoal by adapting gunpowder weapons to early chemical warfare . He described the suitable uses of " magic gunpowder " , " poison gunpowder " , or " blinding and burning gunpowder " in warfare , which displays the various amounts of compositions used in his time . For the making of poisonous gunpowder in hand @-@ thrown or catapult @-@ launched grenade bombs , he advised that a mixture of tung oil , urine , sal ammoniac , feces , and scallion juice is heated and coated upon tiny iron pellets and broken porcelain . For this , Jiao Yu wrote , " even birds flying in the air cannot escape the effects of the explosion " . His book also outlined the use of the " flying @-@ sand magic bomb releasing ten thousand fires " , which included the use of a tube of gunpowder placed in an earthenware pot that was previously filled with quicklime , resin , and alcoholic extracts of poisonous plants , which would be released in the explosion .

During the 14th century , Chinese gunpowder solutions had reached their maximum explosive potential , with levels of nitrate ranging from 12 % to 91 % . At least six formulae in use by the Chinese that were considered to have maximum explosive force . This came about because of the enrichment of sulphur from pyrite extracts during the earlier Song Dynasty period , while Chinese gunpowder formulae by the late 12th century and at least by 1230 were potential enough for explosive detonations and bursting cast iron shells . The root of all this was the Chinese military handbook written in 1044 , the Wujing Zongyao , which outlined the earliest formulae for gunpowder , which was used in bombs hurled by catapults . Later , Wei Xing ( d . 1164 ) of the Song Dynasty was said to have created a gunpowder formula of saltpetre , sulphur , and willow charcoal for his projectile carriages for launching " fire ? stones " up to 400 yards ( 370 m ) .

Although its destructive force was widely recognized by the 11th century , the Chinese had earlier termed gunpowder as a " fire @-@ drug " ( huo yao ) because of Chinese beliefs in its pharmaceutical properties . Its value in festival entertainment could be seen in firework displays , such as the martial demonstration in 1110 to entertain the court of Emperor Huizong . Leading up to its 10th @-@ century use with Fire Arrows and in fuses for igniting flamethrowers shooting Greek Fire , Daoist alchemists had experimented with various black powder solutions during the Han and Tang Dynasties . After the Wujing Zongyao of 1044 had explicitly stated formulae for gunpowder , the Chinese government became frightened that it could fall into the hands of neighbouring enemies , and in 1076 enacted a strict governmental monopoly over the production and distribution of sulphur . Although saltpetre was a central component of the " fire @-@ drug " and a flavour enhancer for food during the Tang and Song periods , in 1067 the Song government banned the populace of modern Shanxi and Hebei provinces to sell sulphur and saltpetre in any form to foreigners . While engaged in a war with the Mongols in 1259 , the official Li Zengbo wrote in his text " Ko Zhai Za Gao , Xu Gao Hou " that the city of Qingzhou was manufacturing one to two thousand strong iron @-@ cased bomb shells a month , dispatching to Xiangyang and Yingzhou about ten to twenty thousand such bombs at a time .

= = = Fire arrows and rockets = = =

Jiao Yu termed the earliest fire arrows launched from bows ( not rocket launchers ) " fiery pomegranate shot from a bow " because the lump of gunpowder ? filled paper wrapped round the arrow below the metal arrow ? head resembled the shape of a pomegranate . Jiao Yu advised that a

piece of hemp cloth should be used to strengthen the wad of paper and sealed with molten pine resin . Although he described the fire arrow in great detail , it was mentioned by the much earlier Xia Shaozeng , when 20 000 fire arrows were handed over to the Jurchen conquerors of Kaifeng City in 1126 . An even earlier Chinese text of the Wujing Zongyao ( 武经总要 , " Collection of the Most Important Military Techniques " ) , written in 1044 by the Song scholars Zeng Gongliang and Yang Weide , described the use of three spring or triple bow arcuballista that fired arrow bolts holding gunpowder . Although written in 1630 ( second edition in 1664 ) , the Wulixiaoshi of Fang Yizhi said that fire arrows were presented to Emperor Taizu of Song in 960 . Even after the rocket was invented in China the fire arrow continued in use ; this could be seen in the Second Opium War , where Chinese used fire arrows against the French in 1860 .

By the time of Jiao Yu , the term " fire arrow " had taken on a new meaning and incorporated the earliest rockets found in China . The simple transition of this was to use a hollow tube instead of a bow or ballista firing gunpowder impregnated fire arrows . The historian Joseph Needham wrote that this discovery came sometime before Jiao Yu during the late Southern Song Dynasty ( 1127 ? 1279 ) . From the section of the oldest passages in the Huolongjing , the text reads :

One uses a bamboo stick 4 ft 2 in long , with an iron ( or steel ) arrow head 4 5 in long ... behind the feathering there is an iron weight 0 4 in long . At the front end there is a carton tube bound on to the stick , where the ' rising gunpowder ' is lit . When you want to fire it off , you use a frame shaped like a dragon , or else conveniently a tube of wood or bamboo to contain it .

In the late 14th century , the Chinese had discovered how to combine the rocket launching tube with the fire lance . This involved three tubes attached to the same staff . As the first rocket tube was fired , a charge was ignited in the leading tube which expelled a blinding lachrymatory powder at the enemy , and finally the second rocket was fired . An illustration of this appears in the Huolongjing , which describes the effectiveness of this weapon to obfuscate the location of the rockets from the enemy . The Huolongjing also describes and illustrates two kinds of mounted rocket launchers that fired multiple rockets . There was a cylindrical , basket work rocket launcher called the " Mr. Facing both ways rocket arrow firing basket " , as well as an oblong section , rectangular , box rocket launcher known as the " magical rocket arrow block " . Rockets described in the Huolongjing were not all in the shape of standard fire arrows because there some had artificial wings attached . An illustration shows that fins were used to increase aerodynamic stability for the flight path of the rocket , which according to Jiao Yu could rise hundreds of feet before landing at the designated enemy target .

The Huolongjing also describes and illustrates the oldest known multistage rocket ; this was the " fire dragon issuing from the water " ( huo long chu shui ) , which was used mostly by the Chinese navy . It was a two stage rocket that had carrier or booster rockets that would automatically ignite a number of smaller rocket arrows that were shot out of the front end of the missile , which was shaped like a dragon 's head with an open mouth , before eventually burning out . This multistage rocket may be considered the ancestor of modern cluster munitions . Needham says that the written material and illustration of this rocket come from the oldest stratum of the Huolongjing , which can be dated to about 1300 - 1350 from the book 's part 1 , chapter 3 , page 23 .

= = Historical perspective = =

Gunpowder warfare originated in medieval China and underwent technological advancement during the preceding dynasties ; however , its technological and methodical perfection occurred elsewhere . Although the inventions and writings of Jiao Yu and the Chinese " fire weapons " of his time revolutionised warfare in China , there was little Chinese innovation in gunpowder weapons during and after the 15th century . With no significant enemies , there was no need to advance gunpowder weaponry . In stark contrast , in the competitive European environment , failing to adopt and improve gunpowder technology meant conquest by your neighbours . When the Portuguese arrived in China in the early 16th century , they were mostly unimpressed with Chinese firearms in comparison to their own . With the progression of the earliest European arquebus to the matchlock

and the wheellock , and the advent of the flintlock musket of the 17th century , they surpassed the level of earlier Chinese innovation . The Chinese of the late Ming Dynasty adopted the Ottoman Turkish matchlockman 's kneeling position and bought European firearms for their infantry musketeers . Illustrations of Ottoman and European riflemen with detailed illustrations of their weapons appeared in Zhao Shizhen 's book Shenqipu of 1598 .

The 16th @-@ century breech @-@ loading model entered China around the time that the Portuguese embassy of Fernão Pires de Andrade came to China in 1517 and was eventually rejected . Portuguese and Chinese ships battled near Tuen Mun in 1521 and the Portuguese were repelled by the Ming Dynasty navy . These hostilities began when the Malacca Sultanate ( a tributary vassal loyal to the Ming ) was defeated and conquered by the Portuguese under Afonso de Albuquerque in 1511 , and in the process slaughtered a large community of Chinese merchants living there .

In 1523 , the Chinese navy captured two Western ships with Portuguese breech @-@ loading culverins aboard , which the Chinese called a folangji ( ??? ; meaning either a Frank or Frankish culverin ) . According to the Ming Shi , these cannons were presented to the Jiajing Emperor by Wang Hong and their design was copied in 1529 . The Frankish culverin was first illustrated in China in a drawing in a Chinese book published in 1562 . However , according to earlier Ming records , it was the War Ministry official He Ru who first acquired these guns in 1522 , while copies of them were made by Yang San ( Pedro Yang ) and Dai Ming ? Westernised Chinese in Beijing , . In an even earlier account of Wang Yangming ( 1472 ? 1529 ) , the philosopher and governor of Jiangxi , he intended to use folangji cannons to suppress the rebellion of Prince Zhu Chenhao in 1519 . In any case , the arrival of the breech @-@ loading rifle and cannon into China signified the beginning of continual European influence upon Chinese firearms and artillery . Song Yingxing wrote in his encyclopedia of 1637 that both foreign and unique , native , gunpowder weapons were used :

Refined copper is used in the casting of Western @-@ ocean cannon , the Red @-@ hair barbarian cannon , and the French cannon . Equal amounts of refined and raw [ or blister ] copper are used in making such arms as signal guns and muskets . For making guns like Xiangyang , Zhankou , First General and Second General , iron is used .