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April 9, 2015

The Invention of the First Gun: A Narrative of Challenge and Response in Song China (960AD-1279AD)

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Abstract

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This thesis aims to provide a model with which to determine a likely date for the invention of the first gun. Utilizing maps I generated showing China in 1080 AD and 1200 AD depicting iron, copper, tin, and saltpeter resources and an analysis of conflict during the Song period this study aims to gain a clearer perspective on the development of gunpowder and the invention of the first gun. By making a distinction between scholars who favor a later date of invention around the year 1280 AD and scholars who favor an earlier date prior to the year 1200 AD I suggest the invention of the first gun is likeliest to have occurred between the years 1127 AD and 1234 AD. By considering the Song period as a Warring States period and examining resource distribution in the context of this warfare this project hopes to join in the debate on when the first gun was invented and support an earlier date for the invention of the first gun. I reach this conclusion by engaging with a geographic visualization of resource distribution and departing from a conventional gunpowder narrative that relies heavily on material artifacts.

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The maps you see in the body of this text were made on ArcGIS10.2 courtesy of Emory University and would not have been possible without the patient help of Megan Slemons and Michael Page from the Emory Center for Digital Scholarship.

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Introduction

My thesis aims to provide a model to date the invention of the first true gun. That said this thesis does not provide an exact date for the first gun, but rather a time range that the first gun could have been produced during. I created two maps of the Song period (960-1279) using borders from the years 1080 and 1200 that depict iron deposits from the eleventh century, modern copper and tin deposits, and saltpeter resources from the Song and the Ming (1368-1644) periods in conjunction with an analysis of the frequency of conflict in the Song period between the Song state and its neighbors—the Tangut Xia (1038-1227), Khitan Liao (907-1125), Jurchen Jin (1115-1234) and Mongols (1206-1368)—in order to provide a different perspective on when the first gun was invented by showing which states had access to the resources necessary to produce gunpowder and gunpowder weapons. By reimagining the geography of the Song state in terms of resource distribution of vital gunpowder resources—saltpeter, sulfur, and charcoal—and the watershed year of 1127 when the Northern Song state fell to the Jurchen Jin we can better identify when two or more states were likely to have had access to the gunpowder resources necessary to produce gunpowder weapons. Impending conflict between these states provided the impetus for the development of advanced gunpowder weapons. Suggesting that the first gun was a by-product of development encouraged by the conflict present in the years between 1127 and 1234 when the Jin and the Southern Song shared a border along the Huai river. By engaging with the historical record of gunpowder weapons, geopolitical conflict, and resource distribution we can reconsider the development of gunpowder in the Song dynasty specifically around the watershed year of 1127 and in doing so we can pinpoint the likeliest moments in which the first gun was invented.

A number of scholars have weighed in on the discussion of the gun's invention and there are two major camps in its regard.¹ The more conservative of the two places the date of the invention of the first gun to sometime around the end of the Mongol-Song wars in the 1280s, pointing to a textual record of the use of *huopao* 火炮 in the 1280s and a bronze gun found near the modern Chinese city of Ah Cheng that has been dated tentatively to the same time period.² The second camp places the invention of the gun to sometime in the twelfth century basing their claims on iconographic representations of a 'gun' dated to the year 1127 and the presence of a large metal gunpowder weapon dated to before the fall of the Xia state in 1227.³ Both camps largely dismiss the notion that the gun was invented during the Northern Song period (960-1127) and place the invention of the gun to sometime after the fall of Kaifeng in the year 1127 and the establishment of the Southern Song dynasty. If the use of gunpowder weapons was so widespread in the eleventh and twelfth centuries, as I aim to show, why is it that non-Chinese states present in the tenth through thirteenth centuries—the Tangut Xia, Khitan Liao, and the Jurchen Jin—have received so little attention in the gunpowder narrative?

A common answer has been simply that in the eleventh century non-Chinese peoples were not at the requisite stage of civilization to develop gunpowder weapons, but the Song state had developed gunpowder and various kinds of gunpowder weapons as early as the tenth

¹ Leading this discussion in the conservative camp are Joseph Needham, Tonio Andrade, Wang Zhaochun, Zhang Shaoyi, and Liu Xu. The less conservative group is led by Pan Jixing, Dang Shoushan, and Stephen Haw.

² This gun is discussed in Joseph Needham, *Science and Civilization in China: vol. 5 p. 7 The Gunpowder Epic*, (Cambridge, 1986), 294. The gun was uncovered in Banlachengzi village, near Ah Cheng in Heilongjiang province, the northern most province in China and the first capital of the Jin state. The gun was found among objects attributed to the Jin dynasty, including a bronze hand mirror, a bronze cooking pan, and a bronze vase. This is interesting because the Mongols destroyed the Jin dynasty in 1234. So what were Jin dynasty artifacts doing in a village in the north of China 50 years after the fall of the Jin?

³ Gwei-Djen, Lu, Joseph Needham, and Phan Chi-Hsing, "The Oldest Representation of a Bombard," *Technology and Culture* 29, no. 3 (July 1, 1988): 594–605.; Dang Shoushan 党寿山, *Wu wei wen wu kao shu* 武威文物考述 (Wuwei: Guang ming yin shua wu zi you xian gong si 光明印刷物资有限公司, 2001).

century, so why could other states not follow suit? The Song state has been described as being just on the cusp of modernity and exhibiting many features of a modern state. This is a popular idea highlighted by the massive changes in every sphere of Chinese society between the Tang and Song dynasties.⁴ In conjunction with this early scholarship the states surrounding the Song have often been described as barbarians bereft of civilization let alone modernity. But recent literature is questioning this paradigm of a modern Song state among backward states by showing that the Song's neighbors were in fact very advanced.⁵ In the tenth and the eleventh centuries the Liao and the Xia states both had effective bureaucratic systems that ruled over considerable empires. The Tanguts had a developed script and translation bureaus to translate Song texts from Chinese

⁴ This periodization of Chinese history is credited to the Japanese Sinologist Naito Konan (1866-1934). Joshua Fogel's work on Naito Konan presents Naito's arguments and development as a historian in a succinct and interesting manner. Joshua Fogel, *Politics and Sinology: the Case of Naito Konan*, (Cambridge; London; Council on East Asian Studies, Harvard University, 1984), xv-xxiv and 205-210. Konan's central thesis about the advent of modernity in the Song dynasty has been emphasized by a series of Japanese and Western and Chinese scholars since his death in the 1930s. Many features of the Song have been held up as evidence of modernity: the massive scale of iron production in the northern Song Mitsukuni Yoshida, "(Sodai No Tetsu Ni Tsuite) Iron in Song Times," *Toyoshi Kenkyu* XXIV, no. iv (1966): 152-55.; Robert Hartwell, "A Cycle of Economic Change in Imperial China: Coal and Iron in Northeast China, 750-1350." *Journal of the Economic and Social History of the Orient* 10, no. 1 (July 1, 1967): 102-59.; the large number of employees in iron production operations and the necessary administration that followed Wagner, Donald B. "The Administration of the Iron Industry in Eleventh-Century China." *Journal of the Economic and Social History of the Orient* 44, no. 2 (January 1, 2001): 175-97.; the appearance of modern forms of capitalism and the use of paper money on a large scale discussed by Dieter Kuhn, *The Age of Confucian Rule: The Song Transformation of China* (Cambridge: The Belknap Press of Harvard University Press, 2009), 276.; the high urbanization rates of the Song state noted in Gang Deng, *The Premodern Chinese Economy: Structural Equilibrium and Capitalist Sterility* (London: Routledge, 1999), 183, 322.; the "mechanization of industry" described in Mark Elvin, *The Pattern of the Chinese Past* (Stanford: Stanford University Press, 1973), 179.; and even anthropologically the roots of the modern overbite have been traced to the Song period as people began to eat with chopsticks C. Loring Brace, "Egg on the Face, *f* in the Mouth, and the Overbite," *American Anthropologist*, 88(3) [1986], 695-697, citation p. 696. If the Song state was in fact a modern state what does that say about its neighbors who seemed to be just as advanced as the Song in many aspects?

⁵ Paul Jakov Smith, "Introduction: The Sung Dynasty and Its Precursors, 907-1279," In Denis Twitchett and Paul Jakov Smith, Eds., *The Cambridge History of China, Vol 5 Part One, The Sung Dynasty and its Precursors, 907-1279* (Cambridge: Cambridge University Press, 2009), 1-37.; Morris Rossabi *China Among Equals : The Middle Kingdom and Its Neighbors, 10th-14th Centuries*. Berkeley: University of California Press, 1983.

into Tangut, including military and religious texts.⁶ The Liao used Chinese as their court language and there is ample evidence that military texts and other books frequently crossed borders.⁷ Upon review the Song's neighboring states dispel this notion of civilization vs. barbarian and encourage us to find a different way to approach the question of why gunpowder and guns developed in some states at a particular time and not others.

Important to grappling with the modernity of the Song in opposition to the modernity of its neighbors the definition of what a true gun is will provide a road map for our study. For this we will turn to Joseph Needham's requirements for a true gun: that it have a metal barrel, use a gunpowder mixture high enough in nitrates to be explosive, and have a projectile that totally occludes the muzzle of the barrel.⁸ For the purposes of this study of resources distribution we will focus on the nature of a metal-barreled gunpowder weapon and a high nitrate gunpowder mixture. The occlusive nature of the projectile is an important technologic advancement for the first true gun though it remains outside of my model of analysis. An occlusive bullet was the final step from a gunpowder weapon that simply spewed flame and shrapnel to a true gun that

⁶ As evidenced in Galombres Imre, "Consistency in Tangut Translations of Chinese Military Texts," In *Tanguty v Tsentral'noj Azii: Sbornik stat'ej v chest' 80-letija prof. E. I. Kychanova* [Tanguts in Central Asia: a collection of articles marking the 80th anniversary of Prof. E. I. Kychanov], edited by Irina Popova, 84-96. Moscow: Vostochnaia literature, 2012. Accessed March 10, 2015. Downloaded from <http://shahon.org/wp-content/uploads/2012/12/Galambos-2012-Translation-consistency.pdf>

⁷ Liu Qing 刘庆 and Mao Yuanyou 毛元佑, "Zhongguo Song Liao Jin Xia jun shi shi" 中国宋辽金夏军事史, In Shi Zhongwen 史仲文 and Hu Xiaolin 胡晓林, Eds. *Bai juan ben Zhong guo quan shi* 百卷本中国全史, Vol 11, (Beijing: Ren min chu ban she, 1994).

⁸ Joseph Needham, *Science and Civilization in China*, vol 5 p 7, *The Gunpowder Epic*, (Cambridge, 1986), 10; Liu Xu 刘旭, *Zhongguo gu dai huo yao huo qi shi* 中国古代火药火器史 (Zhengzhou 郑州: Da xiang chu ban she 大象出版社, 2004), 31, provides a three point criteria for a cannon: "1, gunpowder must be present inside of a bronze or iron barrel, the burning of the gunpowder within the barrel must create enough pressure to discharge a bullet; 2, must be a tube shaped; 3, the weight and the bore of the gun must be relatively large." "说明了火炮须具备的三个要素: 1. 火药是装在铜或铁器中的, 这样才可能利用火药在炮膛燃烧产生气体压力发射弹丸; 2." 如筒状", 即是管形射击火器; 3. 其重量和口径都较大。" I prefer Needham's criteria because he discusses all types of guns, whereas Liu Xu is very specific that he is not interested in small, potentially hand-wielded gunpowder weapons, but larger cannons or guns.

produced a loud explosion and shot out a projectile at an incredible rate. It was when all three of these things came together—a high nitrate gunpowder, a strong metal barrel, and an occlusive bullet—that the first true gun was produced.

Thus for a state to have produced a gun it would require saltpeter, sulfur, charcoal, either bronze or iron, and the technological knowledge to produce a gunpowder weapon to the specifications above. Due to the commonness of charcoal and the small proportion of sulfur needed in relation to saltpeter this study will focus on saltpeter and iron production in the Song period. The expensive nature of bronze and the lack of historical resources on bronze production in the Song period has limited this study's focus to iron production in the Song period.

In addition to resource access in the Song period, it is necessary to examine the nature of conflict during this time as well. The Song period should be understood as a type of warring states period. Song rule lasted 319 years and can be divided into three phases each of which is defined by a different set of state actors, geopolitical boundaries, and conflicts: the Liao-Xia-Song phase (960-1127), the Jin-Xia-Song phase (1127-1234), and the Mongol-Song phase (1234-1279). Specific years of note are 1127, when the Jin captured Kaifeng and ended Song rule in the North of China, and the year 1234 when the Mongols defeated the Jin and turned their attention to the Southern Song.

It is appropriate to name this phase a warring states period because in all three phases, conflict was very present, but amongst this conflict there was stability. As Tonio Andrade writes, “within each of these three phases... borders shifted, cities were captured, but geopolitical structures were generally stable.”⁹ The nature of this stability expressed by Andrade, has been addressed by Ruth Dunnell in her history of the Xia state where she notes that the rapid growth of Buddhism as a state faith and a self sustaining agricultural center are evidence of the relative

⁹ Andrade Forthcoming

stability of the Xia in spite of the stresses and demands of war.¹⁰ This notion of stability in spite of war is fascinating because the Song period was a time of intense conflict between standing armies of hundreds of thousands of men and horses, yet geopolitical bodies were only overthrown in a few specific instances.

The paradoxical ability of states to remain sovereign over long periods of time in which each state was involved in intense conflict makes sense if we begin to unpack the realities of a warring states period. Scholar Zhao Yongchun argues “in the 117 years of relations between the Song and the Jin, there were only 28 years of war and 89 years of peace, this means 24% percent of their interaction was warlike and 76% was peaceful.”¹¹ This interpretation of the Jin-Song period (1127-1234) is biased toward peace, but the fact that the Jin and the Song engaged in heated battles during this period is obvious. One study shows that in a seven-year period of war between the Song and the Jin from 1217 to 1224 there were 114 individual instances of conflict between the two states.¹² It is precisely this relationship between peacetime and wartime that defined this unique type of geopolitical circumstances that allowed for the invention of the first gun.

In the context of these warring states Andrade argues that military innovation in China flourished because constant conflict among stable states spurred creative innovation and resulted

¹⁰ Ruth Dannel, “The Hsi Hsia,” in *The Cambridge History of China*, ed. Denis C. Twitchett and Herbert Franke (Cambridge: Cambridge University Press, 1994), 154–214, 196.

¹¹ The original Chinese is “宋金在117年的交往中，只有28年是战争时期，和平相处则长达89年，战争时期仅占24%，和平相处时期则占76%。” Zhao Yongchun 赵永春, *Jin Song guan xi shi yan jiu* 金宋关系史研究, (Jilin jiao yu chu ban she 吉林教育出版社, 1999): 33. Cited in Lv Hongwei 吕洪伟, *Jin Song guan xi xiang guan wen ti tan tao* 金宋关系相关问题探讨, Doctoral Dissertation, Liao ning shi fan da xue yan jiu sheng bu 辽宁师范大学研究生部, 2006 (Department of Ancient Chinese History), 7.

¹² Lv Hongwei 吕洪伟, “Jin Song guan xi xiang guan wen ti tan tao” 金宋关系相关问题探讨, 7-10.

in the development of gunpowder weapons.¹³ What is important to think about is less the physical moments of conflict, which acted as testing grounds for newly developed weapons, and focus more on the effect war and the psychology of mobilizing for war or the perceived threat of war had on the government and military apparatuses responsible for the development of advanced gunpowder weapons. If the recent memory of conflict or the perceived threat of impending conflict was impetus for innovation then it is necessary to try and gauge a specific states' readiness or preparedness for conflict.

It is notoriously difficult to quantify a state's readiness for war, however, but a basic measure of the number of years since the last conflict or the amount a state spends on defense annually could indicate a sliding scale of readiness. If a scale of this sort could be developed with reasonable accuracy years exhibiting higher levels of military preparedness would have likely seen more innovation than in years where there is a lower level of military preparedness exhibited. The Jin-Song wars between 1127 and 1234 were precisely the type of conflicts that encouraged the military preparedness of actors on all sides that is needed to encourage the invention and innovation of new and more powerful gunpowder weapons.¹⁴

This idea of conflict as an impetus for the development of technology is informed by Geoffrey Parker's theory of challenge and response.¹⁵ Tonio Andrade concurs with Parker's theory stating, "when states grind in competition, fighting wars...so long as the states survive the encounter, each learns a bit, alters its technological and organizational structures, and then tries

¹³ Andrade Forthcoming; Stephen Haw makes a similar argument about the development of gunpowder weapons as a result of conflict in the eleventh and twelfth centuries. Stephen G. Haw, "The Mongol Empire-The First 'Gunpowder Empire?'" *Journal of the Royal Asiatic Society* 3 (August 2013): 1-29, 13.

¹⁴ See Appendix B for graphs that attempt to show the memory of conflict during the Song period.

¹⁵ See Geoffrey Parker, "The Western Way of War," in Geoffrey Parker, ed., *The Cambridge History of Warfare* (Cambridge, UK: Cambridge University Press, 2005), 1-14.

to apply the lessons the next time it fights.”¹⁶ By understanding conflict in this way we can assume that moments in the Song period of protracted warfare between two or more states provided the needed incentive to develop a new technology like gunpowder into a more powerful weapon.

The invention of the first gun occurred when two or more state actors had access to the resources necessary to produce gunpowder weapons and these states were in direct competition and conflict with one another over an extended period of time. With this in mind, the model I developed to determine the date of the invention of the first gun relies on a map of the Southern Song depicting the location of the ingredients necessary for the production of a gunpowder weapon and an analysis of the conflict in the Song period. By examining this map we can determine which states in the period from 1127 to 1234 could be termed ‘gunpowder states’ with access to the requisite materials to produce gunpowder weapons. In conjunction with instances of conflict between these gunpowder states it can reasonably be suggest that the invention of the first gun was sometime during the Jin-Song wars of the twelfth century or the series of conflicts between the Jin, the Xia, the Mongols and the Song at the beginning of the thirteenth century. But before discussing these possibilities it will prove helpful to examine the unique nature of the Song period as a warring states period, discuss gunpowder’s history, and revisit the scholarly debate surrounding the invention of the first gun.

¹⁶ Andrade, forthcoming.

Song Warring States Period (960-1127, 1127-1279)¹⁷

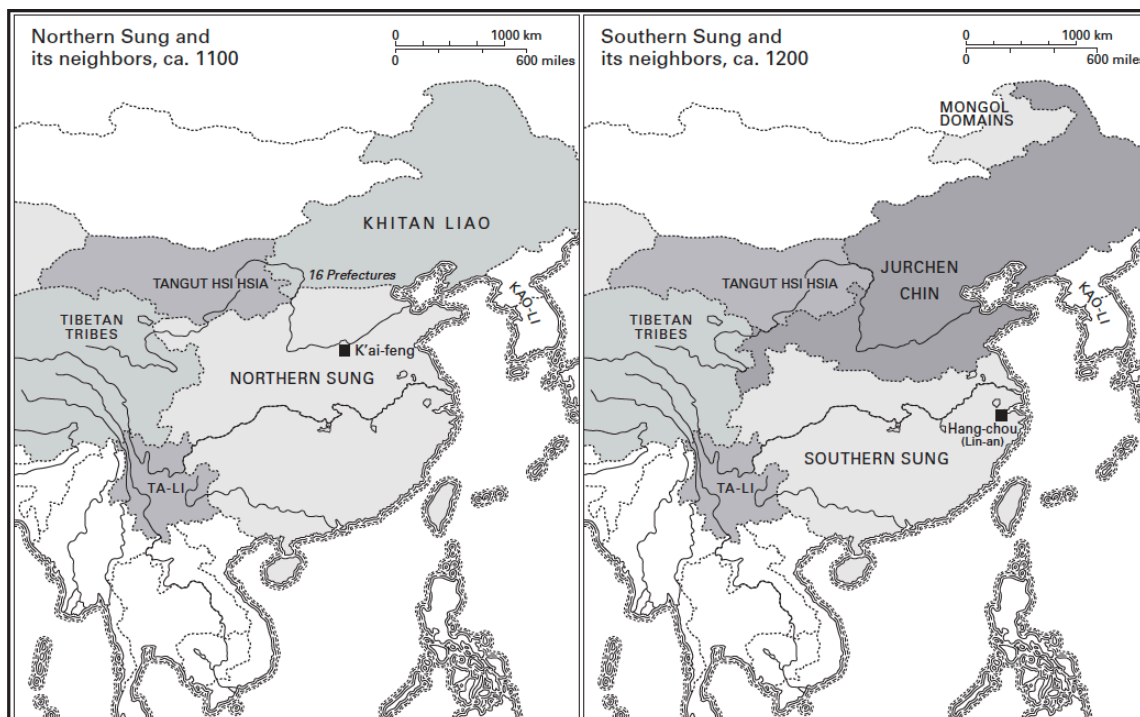


Figure 1 Map of the Northern and Southern Song states

The Song dynasty is notable because of its seemingly paradoxical existence, simultaneously an incredibly wealthy and economically advanced state, it was unable to conquer militarily over its neighbors and was often subjected to humiliating losses. In trying to understand this paradox an earlier era of China scholars led by J.K. Fairbank explained this phenomena of efflorescence and military weakness as a product of a movement away from war and towards civil pursuits.¹⁸ This is referred to in terms of 文 *wen* (culture) over 武 *wu* (warfare), or a preference of cultural growth over warfare. Fairbank and his era of scholars considered that in Song times *wen* was favored over *wu*, and Song statesmen emphasized a type of government

¹⁷ The below map is from Paul Jakov Smith, "Introduction: The Sung Dynasty and Its Precursors, 907–1279," in *The Cambridge History of China*, ed. Denis Twitchett and Paul Jakov Smith (Cambridge: Cambridge University Press, 2009), 1–37, 17.

¹⁸ John King Fairbank and Merle Goldman, *China: A New History* (Cambridge, Massachusetts: The Belknap Press, 1998), 88.

that focused on moralistic ruling at the expense of a strong military. But this argument for the weakness of the military arm of the Song state has been countered by a newer generation of historians that do not ascribe to the simplistic *wen* over *wu* model.¹⁹ In fact recent research suggests that Song dynasty military technology was incredibly advanced for its time. The Song official history says, "their tools of war were exceedingly effective, never before seen in modern times."²⁰ It goes on to note that "their troops weren't always effective," but "their weapons and armor were *very good*."²¹ If the Song did in fact possess such military strength as evidence shows, then why could they not prevail over their neighbors?

Andrade suggests that the answer lies less in the military weakness of the Song and more in the military strength of its neighbors. The Song dynasty ruled for 319 years from 960 AD until 1279 AD, during which time it faced four primary foes and struggled to maintain its territorial claims specifically in the north of China. At the founding of the dynasty in 960 AD the Song Emperor Taizu and his successor Taizong led a unification campaign to conquer the many independent states that had formed after the fall of the Tang dynasty in 907 AD.²² Emperor Taizu

¹⁹ An overview of this historiographical transition is Ari Levine, "Review of Don Wyatt, *Battlefronts*," *American Historical Review* 114(3)[2009]: 733-734. See also Don J. Wyatt, ed., *Battlefronts Real and Imagined: War, Border, and Identity in the Chinese Middle Period* (New York: Palgrave Macmillan, 2008) and Yuan-kang Wang, *Harmony and War: Confucian Culture and Chinese Power Politics* (New York: Columbia University Press, 2011).

²⁰ Translated by Tonio Andrade "戎具精致犀利，近代未有。" *Song shi*, "Bing zhi," cited in Su Pinxiao 粟品孝, *Nan Song jun shi shi* 南宋軍事史 (Shanghai: Shanghai gu ji chu ban she 上海古籍出版社, 2008), 82. Italicization is his. The translation of 近代 as modern is slightly problematic, the term could simply mean recent times, but as has been noted in a previous footnote, the idea that Song state may have been a modern state makes this translation a bit tricky. In this context I interpret the idea of modern as simply meaning different from anything that had come prior to it and not a conscious indication of the 'modernity' of the Song. The language is used in this manner to present a comparison between the Northern Song and the Southern Song to indicate that the weapons of the Southern Song were in fact much more advanced than those of their Northern Song predecessors.

²¹ Translated by Tonio Andrade "兵纪不振，" "器甲视旧制益详。" *Song shi*, juan 197, Bing 11, cited in Su Pinxiao 粟品孝, *Nan Song jun shi shi* 南宋軍事史 (Shanghai: Shanghai gu ji chu ban she 上海古籍出版社, 2008), 82.

²² Paul Jakov Smith, "Introduction: The Sung Dynasty and Its Precursors, 907-1279," 1-37.

was able to claim control over the Central Yangtze area by 965 AD, and by the time of his death in 976 AD he had conquered the Sichuan basin and all but two of the southern polities. Emperor Taizong continued his predecessor's campaigns and brought southern China under the control of the Song by 978 AD. While their southern campaigns were successful both Emperor Taizu and Taizong were stopped short in their expansion in the North by what Paul Jakov Smith calls a "parallel process of state formation on the steppe that was to shape events in China and Inner Asia for the next three centuries".²³²⁴

In 969 AD Emperor Taizu was defeated by the cavalry of the Khitan Liao in what is today the Northern Shaanxi region of China. Ten years later Emperor Taizong led a campaign against the Northern Han. Toppling the Northern Han and defeating Liao troops Taizu pushed onward optimistically toward the Sixteen Prefectures in hopes of recapturing these lands from the Liao. He was once again stopped, however, by a Liao cavalry charge near Yu-chou (modern day Beijing). This defeat marked the end of northern expansion for the Song dynasty. A second invasion of the Sixteen prefectures in 986 AD was again routed by Liao cavalry demarcating a new northern border for the Song dynasty. This border of the Song was solidified in 1004 AD when the Song, unable to conquer the Liao and at risk of invasion, signed the Shanyaun treaty that recognized the Liao dynasty, demarcated a defensible border between the two dynasties, and most importantly established a system of tribute from the Song court to the Liao court recognizing the Liao as an equal state. Naomi Standen and Tao Yukun discuss the nature of the

²³ Smith, 14.

²⁴ For extensive histories of both of these states see Denis Twitchett and Klaus-Peter Tietze, "The Liao," in *The Cambridge History of China*, ed. Denis C. Twitchett and Herbert Franke (Cambridge: Cambridge University Press, 1994), 43–153.; and Ruth Dannel, "The Hsi Hsia," in *The Cambridge History of China*, ed. Denis C. Twitchett and Herbert Franke (Cambridge: Cambridge University Press, 1994), 154–214.

border between the Song and the Liao and its transition over the course of the eleventh century from a frontier zone to a physical line of defenses.²⁵

When this period of Song expansion came to a close in 1004 AD a period of peace settled on the region until Li Yuanhao, the ruler of the Tangut Xia state, located in what today is the Gansu corridor, stretching from the Yellow river in Shanxi west to the desert regions near Yumen, declared himself emperor of a dynastic state in the year 1038 AD. Seeking the same recognition the Khitan Liao had received in the Shanyuan treaty of 1004 AD Li Yuanhao sent diplomatic envoys to the Song court for recognition. These ambassadors were accepted at the court, but their gifts were rejected. Ruth Dunnell describes what followed as “a war of sabotage and attrition, highlighted by three major Tangut victories.”²⁶ Negotiations between the Tangut court and the Song court struggled from the start because the Tangut Emperor refused to sign his letters to the Song Court with the title *chen* (subject).²⁷ In 1042 AD the negotiations ended with Tangut forces routing Song forces in battle, which required the Khitan Liao to enter the conflict as mediators between the two courts. In 1044 AD the Tangut emperor finally accepted Song demands and signed his letters as a subject to the Song court, but a Khitan invasion of the Xia delayed Song recognition of a treaty until the Xia defeated the Khitans later that year. Finally in the winter of 1044 AD a treaty was signed, border markets were reinstated, and the Song agreed to give an annual gift to the Xia totaling “255,000 units: 153,000 *p'i* of silk, 30,000 small *chin* of

²⁵ The relationship between the Song and the Liao is fascinating fraught with spying, migrant populations and illicit trade. To better understand the changing nature of identity along the Liao Song border see Naomi Standen, *Unbounded Loyalty: Frontier Crossing in Liao China*, Honolulu: University of Hawaii Press, 2007. For riveting tales of spies and the formation of a border defense system see Tao Yukun 陶玉坤, *Liao Song guan xi yan jiu 辽宋关系研究*, Doctoral Thesis, Nei meng gu da xue 内蒙古大学, 2005.

²⁶ Ruth Dannel, “The Hsi Hsia,” in *The Cambridge History of China*, ed. Denis C. Twitchett and Herbert Franke (Cambridge: Cambridge University Press, 1994), 154–214, 188.

²⁷ Dunnell, “The Hsi Hsia,” 188.

tea, and 72,000 *liang* of silver”.²⁸ The conclusion of this conflict between the Song and the Xia did not, however, establish clear borders between the two states and this ambiguity resulted in border disputes for as long as the Song and Xia would share a border. This changed when the Jurchen Jin came to power in the twelfth century taking over much of north China and driving a wedge between the Song and the Xia states, thereby preventing further conflict between the two.²⁹

The entrance of the Jin into the region changed drastically the geopolitical situation in China.³⁰ By 1125 AD they had overthrown the Khitan Liao state and in 1127 AD the Jin took Kaifeng, the capital of the Northern Song dynasty, and captured the Song emperor. The Song court fled south and established court in the coastal city of Hangzhou fighting the Jin back to the north of the Huai River. During the rest of the twelfth and into the thirteenth century, relations between the Song and the Jin alternated between peace and war and only when the Mongols conquered the Jin in 1234 AD did conflict between the Jin and the Song truly end. The rise of the Mongols and their campaigns into central Asia and China defined much of the thirteenth century, but I will not go into detail of that history here.³¹ The evidence for guns at the beginning of the Mongolian state suggests that guns had been invented earlier, but did not appear in the record until around the time of the fall of the Song. With this in mind my work attempts to engage with the origins of the gun and while the Mongols definitely played a role in the innovation and proliferation of gunpowder weapons in the early years I examine their role remained less as

²⁸ Dunnell, 189.

²⁹ *Ibid.*

³⁰ For an extensive history of the Jin state see Herbert Franke, “The Chin Dynasty,” in *The Cambridge History of China*, ed. Denis C. Twitchett and Herbert Franke (Cambridge: Cambridge University Press, 1994), 215–320.

³¹ For an extensive history of the Mongols see Thomas Allsen, “The Rise of the Mongolian Empire and Mongolian Rule in North China,” in *The Cambridge History of China*, ed. Denis C. Twitchett and Herbert Franke (Cambridge: Cambridge University Press, 1994), 321–413.

innovators and more as an impetus for innovation. They applied the pressure to the cooker, but largely fall outside if the scope of this thesis.

The Song dynasty was confronted with many fierce competitors through the tenth to the thirteenth century and was forced to recognize and pay tribute to its northern neighbors on more than one occasion. This conflict's major effect was the massive geographic shift in geopolitical borders from the Northern Song period to the Southern Song period. The loss of northern China resulted in the loss of very productive iron and saltpeter regions, thus giving the Jin access to the required resources to produce gunpowder weapons and become serious competitors to the Song state driving development of gunpowder weapons and the invention of the first gun.

The Birth of Gunpowder

In the Tang dynasty alchemists experimenting with elements in the search for an elixir for life accidentally discovered a mixture of saltpeter, sulfur, and charcoal that drastically changed the face of warfare forever. The mixture did not grant immortality to the imbiber, but it did burn with intense heat and a flame that was difficult to extinguish. Experimentation on behalf of an emperor led to the invention of gunpowder quite on accident, but later experimentation for reasons of war led to intentional and substantial developments in the original gunpowder recipes and in its uses in weapons.³²

Gunpowder was not the first fire weapon used in warfare, but it was substantially different in its applications than anything that had come before. The Tang dynasty fell in the year 907 AD, but gunpowder was not lost with the Tang Empire. In the 950s AD a fire-spewing weapon was painted in the hands of a demon with three snakes rising from its head.³³ 100 years later in 1044 AD the first gunpowder recipes were published under the Song dynasty in the military text *Wu Jing Zong Yao* among descriptions of dozens of gunpowder weapons, smoke bombs and flamethrowers, arrows and catapults. This publication was commissioned in 1040 AD in the middle of negotiations between the Song and the Tanguts to the northwest and likely showcases many of the weapons the Song brought to bear against their northwestern enemies in 1042 AD.

Gunpowder, however, did not provide any significant advantage as the Song were humiliated in battle and forced to recognize and pay annual tribute to the Xia dynasty.³⁴ 40 years

³² Jack Kelly, *Gunpowder: Alchemy, Bombards, & Pyrotechnics: The History of the Explosive that Changed the World*, (New York, NY: Basic Books, 2004), 1-19.

³³ Zhong Shaoyi 钟少异, "Zhong guo gu dai huo yao huo qi shi yan jiu" 中国古代火药火器史研究 (Beijing: Zhong guo she hui ke xue chu ban she 中国社会科学出版社, 1995).

³⁴ Kenneth Chase argues that the limited effect of gunpowder weapons in its early stages discouraged

later the Xia and the Song clashed again, and again the Xia fought the Song to a stalemate, further establishing their rule in the Gansu corridor. Despite these setbacks gunpowder weapons production remained a major focus of the Song state as evidenced by a large purchase of sulfur from Japan in 1084 AD.³⁵

The major wars of the eleventh century between the Song and the Xia saw gunpowder weapons become a major feature of the Northern Song military apparatus, such that by the twelfth century gunpowder weapons were mainstays in Song arsenals and used extensively in the Jin-Song wars. As gunpowder weapons were entering Song arsenals so too were they beginning to be used and produced by neighboring states. In the taking of Kaifeng the Jin were initially repulsed in 1126 AD by ‘heaven shaking thunderclap’ bombs, but upon their return in 1127 AD they used these same bombs to capture the city.³⁶ Gunpowder had been co-opted by the Jin and became the deciding factor for the Song’s defense of their southern empire.

In 1132 AD the Jin encircled the city of De’an and the city’s governor, Chen Gui, prepared a new type of gunpowder weapon—the fire-lance—and used it as an anti-personnel weapon to repel attackers from gaining the walls of the city and keeping De’an for the Song.³⁷ A century later the Jurchen’s used the same type of weapon at Kaifeng to defend themselves from the attacking Mongolian armies. The fire-lance is the direct precursor to the gun and it is in this

further experimentation and innovation of gunpowder weapons until they were co-opted by other states and transported to the West. Kenneth Chase, *Firearms : A Global History to 1700*, (Cambridge; New York: Cambridge University Press, 2003).; For a good account of the motivations behind the Xia and Song conflict see Michael C. McGrath, “Frustrated Empires: Song-Tangut Xia war of 1038-44,” in Don J. Wyatt, Ed., *Battlefronts Real and Imagined: War, Border, and Identity in the Chinese Middle Period* (New York: Palgrave Macmillan, 2008), 151-190.

³⁵ Lorge, Forthcoming; Xú Sōng 徐松, *Sònghuìyāo Jìgǎo* 宋會要輯稿, vol 6, (Taipei: Xinwenfeng chubanshe, 1976), 5469.

³⁶ Andrade, forthcoming.

³⁷ Andrade’s interpretation of the use of these fire-lances at De’an differs from Needham’s claims. Needham feels they were used ignite enemy siege works whereas Andrade thinks the evidence is apparent that these fire-lances were anti-personnel weapons.

moment in 1132 AD when Chengui invented a weapon in a desperate attempt to fend off the ferocious Jurchen invaders that the story of the first gun starts.

Conflict between the Song and its neighbors continued through the twelfth and into the thirteenth centuries and gunpowder only got more explosive. After the fall of the Xia and Jin dynasties to the Mongols in 1227 AD and 1234 AD respectively, the Song and the Mongols fought continuously for nearly 50 years until the Song finally capitulated and the Yuan dynasty was founded. It is in these latter years of the Song dynasty that some scholars believe the first gun was invented. But if we include the Xia, the Liao, and the Jin and the invention of the fire-lance in 1132 AD into our analysis the end of the Song seems too late for the invention of the first gun. Thus posing the question could the first gun have been invented prior to the fall of the Jin in 1234?

Fire-lance to True Gun

The development from the fire-lance to the first true gun relied upon three things, the recognition of the fire-lance's propellant capabilities, an increase in the nitrate concentration of gunpowder thus making it truly explosive, and the strengthening of its barrel to contain and direct that explosion. The first came about as small objects, rocks, iron filings, even pottery shards, were incorporated into the gunpowder mix, which when ignited would propel all of this miscellaneous debris out of the barrel with no small force. These projectiles did not necessarily travel far, but these early fire-lances were most likely meant for close combat and these little bits of shrapnel would have been dangerously effective against enemy soldiers at close range.³⁸

³⁸ Peter A. Lorge, *The Asian Military Revolution : From Gunpowder to the Bomb*, (Cambridge, UK ; New York: Cambridge University Press, 2008).; Andrade forthcoming

Needham terms these early fire-lances “co-viatives” meaning they shot out projectiles along with the flame produced from the ignited gunpowder.³⁹

The second factor was the increase over time in nitrate concentration in gunpowder, this increase likely happened organically through trial and error. Haw suggests that explosive gunpowder was invented no later than 1161 and was used that same year in the battle of Caishi on the Huai River.⁴⁰ Andrade favors the later date of 1221 based on the introduction of the iron bomb—a highly explosive gunpowder bomb used in the siege of Qizhou.⁴¹ As gunpowder became more explosive the necessity for stronger barrels that would not shatter under stress grew. Metal began to replace bamboo and paper tubes at some point, and the projectile power of these sturdier and more explosive fire-lances became more prominent. At some point a projectile that occluded the muzzle of these fire-lances was introduced and the true gun was born.

Both of these moments, when the tube of the fire-lance became metal and when a projectile occluded the barrel have been suggested by textual sources. The nature of the metal barrel is thought to have come about after the fall of the Song in 1279, but recent archaeological evidence questions whether this date is in fact too late, could the metal tube have been in evidence much earlier? If there is evidence for early metal tubes, then why were they not more prolific until after the fall of the Song? A common answer is that metal tubes were more expensive and heavier than readily available bamboo. In this sense then early projectile firing weapons could well have been bamboo, but they would not have held up after more than one or two firings, the need for a metal barrel for a true gun was imperative.

³⁹ Joseph Needham, *Military Technology: The Gunpowder Epic*, 9.

⁴⁰ Stephen G. Haw, “The Mongol Empire-The First ‘Gunpowder Empire?’” *Journal of the Royal Asiatic Society* 3 (August 2013): 1–29, 6-9. Pan Jixing 潘吉星, “Shi jie zui zao shi yong de huo jian wu qi—tan yi yi liu yi nian cai shi zhan yi zhong de pi li pao” 世界上最早使用的火箭武器—谈一一六一年采石战役中的霹雳跑, *Wen Shi Zhe* 6, (1984), 29-33.

⁴¹ Andrade, Forthcoming.

*Metal or Bamboo: a discussion of the Tuhuoqiang*⁴²

The *tuhuoqiang* 突火枪 as documented in the *Songshi*, “is made from a large bamboo tube, and inside is stuffed a pellet wad [子窠]. Once the fire goes off it completely spews the rear pellet wad forth, and the sound is like a bomb that can be heard for five hundred or more paces.”⁴³ Stephen Haw interprets this passage as indicative of the presence of cannons in the middle of the thirteenth century. He cites the same passage in the Song imperial histories, but provides his own translation of the term 突火枪 assuming that it means cannon. On one hand he could be translating the term in this manner to confirm his overall thesis that the Mongols were using true projectile firing guns by the turn of the thirteenth century. But later in the same article he presents a list of gunpowder weapons made and repaired in Jiankang (modern day Nanjing). Among these items repaired were 333 突火銅 *tuhuotong*, Haw notes that *huotong* 火銅 of the fourteenth century were clearly cannons firing projectiles and based on the similarities in name Haw makes the assumption that the 突火銅 produced in the Jiankang arsenal in 1259 AD were also cannons. Applying the same logic he proposes that the bamboo *tuhuoqiang* 突火枪 was also a cannon.⁴⁴ The character *tu* 突 however simply means to emit, so in the context of both of these

⁴² The distinction between a metal barrel and a bamboo barrel is an increasingly important one, not only in order to distinguish between a true gun and a proto-gun, but to distinguish a shift in the process of war making from the use of bamboo, a relatively abundant and easily accessed resource, to weapons grade iron or bronze which are both highly technical products whose production was restricted in many ways by the Song state.

⁴³ From the *Song shi*, Translated by Tonio Andrade from Wang Zhaochun 王兆春, *Zhong guo huo qi shi* 中國火器史 (Beijing: Jun shi ke xue chu ban she 军事科学出版社, 1991), 33.

⁴⁴ Haw, “The Mongol Empire-The First ‘Gunpowder Empire?’”, 12-13.; This same Jiankang arsenal is mentioned in Wang Lingling 王菱菱, “cong tie qian, tie bing qi, dan tong de sheng chan kan song zheng fu dui tie xu qiu de zeng zhang 从铁钱、铁兵器、胆铜的生产看宋政府对铁需求的增长,” 141. Though there is a transcription error in Wang Lingling cites the Jiankang arsenal as producing 3500 bomb shells in the year, but the quotation he provides states that 35,296 shells were in fact produced. “除此之外, 江南东路的建康府也是制造铁火炮的基地之一, 马光祖于开庆元年四月至景定二年七月(1259-1261年)任沿江制置大使、知建康军府事两年多的时间里, 在建康府主持制造了兵器6万多件, 其中

weapons the character *tu* seems to only show that the weapons in question emit fire, the main difference between the two is the final character, *qiang* 枪 and *tong* 銅, both of which in more recent times have been used to denote guns or cannons, but during the thirteenth century seemed to refer to fire-lances. Though there is textual evidence that the character *tong* 銅 does in fact refer specifically to metal barreled weapons, Haw's assumptions are not widely shared among scholars. Liu Xu claims that the *tuhuoqiang* 突火枪 is China's first 'cannon', but he does regard the use of bamboo as primitive and the mechanism of firing as not being quite the same as those of later cannons.

In name maybe the *tuhuoqiang* could be an early 'gun', but the relative weakness of a bamboo tube would not have been able to contain a true gunpowder explosion. Andrade presents another theory that while the weapon might not be a cannon this "pellet wad" could in fact be the first recorded bullet in history, occluding the muzzle of the bamboo barrel, which explains the loud report documented in the *Song Shi*.⁴⁵ Researcher Liu Xu documents the bamboo-barreled firearm as the step directly preceding the metal-barreled firearm and credits the Yuan with making the final transition to the metal-barreled firearm. "It was the Yuan who completed the transition from the bamboo- (or wood- or paper-) barreled firearm to the metal-barreled firearm, and the first firearms in history appeared in China in the very earliest part of the Yuan."⁴⁶ While Liu Xu seems convinced of this logical progression in the development of the gun there is still a large debate over the existence of guns earlier than the Song-Yuan transition period.

仅铁炮壳就达3500多只,“十斤重四只,七斤重八只,六斤重一百只,五斤重一万三千一百四只,三斤重二万二千四十四只”[19] (卷三九《武卫志·军器》),各类铁炮壳合计用铁量达到13万斤以上。”

⁴⁵ This is a position that Ping Jiasheng took in the 1950s and Wang Zhaochun agrees, writing, “冯家升先生在本世纪50年代判断其为最初的子弹,是有一定道理的。” In Wang Zhaochun 王兆春, *Zhong guo huo qi shi* 中國火器史 (Beijing: Jun shi ke xue chu ban she 军事科学出版社, 1991), 33.

⁴⁶ Liu Xu 刘旭, *Zhongguo gu dai huo yao huo qi shi* 中国古代火药火器史 (Zhengzhou 郑州: Da xiang chu ban she 大象出版社, 2004), 53.

The Invention of the First Gun

There is much scholarly debate over the invention of the first true gun. As noted above, the conservative scholarship led by Joseph Needham, Tonio Andrade, and Wang Zhaochun places the emergence of the first true gun at the end of the Song dynasty and the beginning of the Yuan dynasty. Liu Xu takes a middle ground arguing for the year 1259, though much of his argument would place him among this first group of scholars. More radical scholarship published by Pan Jixing in the 1980s and in recent years by Dang Shoushan and Stephen Haw all argue for a date sometime between 1128 and 1234. Both groups of scholars tend to rely on similar evidence to substantiate their claims, but there are identifiable fissure points where they diverge. The most significant points are around the date of the Wuwei ‘cannon’ thought to be from sometime between the years 1214 and 1227,⁴⁷ the interpretation of the Dazu rock carvings in Chongqing municipality in cave 149 of the Beishan group dated to the year 1128,⁴⁸ and a gunpowder weapon called the *tuhuoqiang* 突火枪 described in the *Song Shi* in 1259 and discussed above. In order to better understand the variation between scholars it is important to discuss the current material record at our disposal. The archaeological record is like a puzzle and the most firmly dated artifacts become evidence of many years of experimentation, suggesting the earliest gun has not been found yet.

⁴⁷ Dang Shoushan 党寿山, *Wu wei wen wu kao shu* 武威文物考述 (Wuwei: Guang ming yin shua wu zi you xian gong si 光明印刷物资有限公司, 2001), esp. pp. 103-113.; Niu Dasheng 牛达生 and Niu Zhiwen 牛志文, "Xi Xia tong huo chong: wo guo zui zao de jin shu guan xing huo qi" 西夏铜火铳: 我国最早的金属管形火器, *Xun gen* 寻根, 2004 vol, no 6: 51-57.besp 51-52.

⁴⁸ Lu Gwei -Dien, Joseph Needham, and Phan Chi-Hsing, "The Oldest Representation of a Bombard." *Technology and Culture* 29, no. 3 (July 1, 1988): 594-605.; Pan Jixing 潘吉星, "Shi jie zui zao shi yong de huo jian wu qi—tan yi yi liu yi nian cai shi zhan yi zhong de pi li pao" 世界上最早使用的火箭武器——谈一一六一年采石战役中的霹雳炮, *Wen Shi Zhe* 6, (1984): 29-33.; Stephen G. Haw, "The Mongol Empire-The First ‘Gunpowder Empire?’" *Journal of the Royal Asiatic Society* 3 (August 2013): 1–29, esp. 11.

The Ahcheng gun

A bronze gun found near Ahcheng in Heilongjiang province has been tentatively dated to the 1280s though there is no inscription on the gun itself. Joseph Needham claims that the Ahcheng gun is the same gun that was used in a northern campaign to put down the rebellion of a Mongol prince named Nayan in the year 1288. Needham bases this claim on the report of the suppression of Nayan's rebellion in the *Yuan Shi* and additional contextual dating of the Ahcheng gun. Textual sources from the Yuan imperial history document an uprising in 1288 occurring in the area around a dig site that uncovered a small bronze cannon and Jin dynasty bronze paraphernalia.⁴⁹ According to the *Yuan Shi* towards the end of 1287 the Yuan dispatched a commander, Li Ting, to put down a rebellion started by the Mongol Prince Nayan. This commander, who was of Jurchen descent, equipped his soldiers with *huo pao*, and led them into battle, Needham believes that *huo pao* in this instance refer specifically to a hand held gunpowder weapon.

Li Ting personally led a detachment of ten brave soldiers holding *huo phao*, and in a night attack penetrated the enemy's camp. Then they let off the *phao*, which caused great damage, and such confusion that the enemy soldiers attacked and killed each other, flying in all directions.⁵⁰

A second entry in the *Yuan Shi* describes another encounter sometime in the beginning of 1288,

Li Ting chose gun-soldiers (*chhung tsu*), concealing those who bore the *huo phao* on their backs; then by night he crossed the river, moved upstream, and fired off (the weapons). This threw all the enemy's horses and men into great confusion...and he gained a great victory.⁵¹

⁴⁹ Needham, *Science and Civilisation*, 294. The gun was uncovered in Banlachengzi village, Heilongjiang province. The gun was found among objects attributed to the Jin dynasty, including a bronze hand mirror, a bronze cooking pan, and a bronze vase. This is interesting because the Mongols destroyed the Jin dynasty in 1234. What are Jin dynasty artifacts doing in a village in the north of China 50 years after the fall of the Jin and where does this gun fit in? It is noted that the Mongolian General Li Ting was of Jurchen descent, so maybe the other artifacts belonged to him and were family heirlooms.

⁵⁰ Needham, 294.

⁵¹ *Ibid.*, 294

From these two text entries in the Yuan Shi, Needham claims that the find in Heilongjiang credibly could be the same type of *huopao* that the Yuan commander Li Ting ordered his men to carry and fire off. This would date the gun to before 1290, and therefore in Needham's reckoning it would be the earliest known gun. This interpretation is largely based on Needham's translations of the term *huopao* 火炮 and the character *tong* 銅. He notes that *huopao* was used to refer to catapults or trebuchets in earlier texts, but because Li Thing led a group of foot-soldiers it seems likely that *huopao* meant a different kind of lighter handheld weapon. Needham translates *tong* 銅 as a character used to point out the nature of a weapon as being metal-barreled, Haw on the other hand translates the term *tong* 銅 used in a 1259 text as referring to a cannon. Needham highlights the changing use of the term *tong* 銅 for metal barrel, beginning with its use in the Tang dynasty as a fuse for signal tower fires. Later it was used to describe the metal barrels of fire-lances and eruptors. Needham notes this final transition to describe the metal barrel of a true gun in this Yuan Dynasty source.⁵² The significance of the metal barrel as a development cannot be overlooked, but to distinguish between the metal barrel of a fire lance and a true gun seems almost impossible when relying on text sources alone. While text sources cannot be ignored, archaeological records are more necessary than ever to truly distinguish the first true guns from the fire lance. Since Needham's analysis of the Ah Cheng gun, other archaeological finds have proved that small, probably hand held guns were present in the 1280s and the 1290s.

⁵² Needham, 294.

The Xanadu gun



Figure 2 Xanadu Gun photograph taken by the author

The Xanadu gun is the earliest known extant gun, dated to the year 1298, and corroborates the idea that early guns were in fact small and likely hand-held weapons. The gun was discovered in 1989 during excavations of the site of Xanadu (上都), the Mongol Yuan Dynasty Summer Palace in Inner Mongolia

near the modern day town of Zhenglanqi (正蓝旗) some 350 kilometers away from Beijing.⁵³

The dimensions of the gun are small, weighing in at 6.2 kilograms and measuring 35 centimeters long. It is currently housed at the Inner Mongolia Museum in Hohhot, Inner Mongolia. The barrel of the gun bears an inscription that includes a date equivalent to the year 1298. Alongside the date is a serial number, which suggests that this gun was one of many cast. In addition there are axial holes for mounting the gun, maybe on a wall, which further suggests that the gun itself was the result of much experience and experimentation with other like weapons. The Xanadu gun is evidence not only of the presence of guns in China at the end of the thirteenth century, but that guns were being produced at least a few years prior to 1298, especially if the date of the Ahcheng gun is to be believed. And in some cases evidence suggests that the first gun was invented well before 1298 and the Xanadu gun.

⁵³ Zhong Shaoyi 钟少异 et al, "Nei Meng-gu xin fa xian Yuan-dai tong huo chong ji qi yi yi" 内蒙古新发现元代铜火铳及其意义, *Wen wu* 文物, 2004, issue 11, pp. 65-67.

The Oldest Representation of the Gun

A cave carving discovered in Chongqing municipality in cave 149 of the Beishan group, located above the present-day town of Dazu, was completed in 1128 with what appears to be two spirits, one holding a ‘bombard’ and one holding an onion shaped ‘hand grenade’. An article published in 1988 titled “The Oldest Representation of the Bombard” contains pictures of the cave and the figure holding the ‘bombard’.⁵⁴ In 2002 Pan Jixing discusses these carvings in his book *The Four Great Inventions of Ancient China*⁵⁵ and is adamant that these spirits are in fact the earliest representation of a gun. Stephen Haw is also a big proponent of this argument in his article “The Mongol Empire-The First ‘Gunpowder Empire?’”⁵⁶ Other scholars are more skeptical. Wang Zhaochun points out that the spirit holding the ‘bombard’ is in fact a wind spirit holding a bag of winds.⁵⁷ Cheng Dong similarly claims that the wind spirit holding the ‘bombard’ in fact appears in another cave carving as well.⁵⁸ The presence of a cannonball in the carving at Dazu, however, is hard to ignore. Either way the representation is a fantastic one and whether or not we accept the claims that it is in fact the first representation of the bombard, it is clear that gunpowder weapons were becoming ubiquitous in the twelfth century because four years later in 1132 the first fire-lances were invented by Chen Gui at De’an.

⁵⁴ Gwei-Djen, Lu, Joseph Needham, and Phan Chi-Hsing, “The Oldest Representation of a Bombard,” *Technology and Culture* 29, no. 3 (July 1, 1988): 594–605.; Pan Jixing 潘吉星, “Zhong guo huo yao he huo qi ji shu de zao qi fa zhan 中国火药和火器技术的早期发展,” in *Zhong guo gu dai si ge da fa ming—yuan liu wai zhuan ji shi jie ying xiang 中国古代四个大发明—源流、外传及世界影响* (Zhong guo ke xue ji shu chu ban she 中国科学技术出版社, 2002), 269-308.

⁵⁵ Pan Jixing, 2002.

⁵⁶ Stephen Haw, “The Mongol Empire-The First ‘Gunpowder Empire?’” *Journal of the Royal Asiatic Society* 3 (August 2013): 1–29. 11.

⁵⁷ Liu Xu, *Zhongguo gudai huoyao huoqi shi*, 28–29.

⁵⁸ Cheng Dong 成东, “Guan yu zhong guo gu dai huo pao fa ming wen ti de xin tan tao” 关于中国古代火炮发明问题的新探讨, in *Zhong guo ke xue ji shu shi guo ji xue shu tao lun hui lun wen ji 中国科学技术史国际学术讨论会论文集*, edited by Chen Meidong 陈美东, et. al., (1992), 161-165.

The Wuwei 'cannon'



Figure 3 Wuwei 'cannon,' photograph taken by author.

If the gun was evident in the eleventh century at Dazu and almost one hundred and fifty years later in the far Northwest of China what happened in the intervening years. The Wuwei 'cannon' unearthed in Wuwei Gansu, tentatively dated to the latter years of the Xia state in 1227, provides a clue about gunpowder weapons during this time. Found in 1980 in Wuwei in Gansu province, the Wuwei 'cannon' weighs 108.5

kilograms, is a meter long and has an internal bore of 12 centimeters. A small amount of gunpowder and a small iron bullet 9 centimeters in diameter were found with the gun.⁵⁹ The gun itself lacks any date or inscription so it is difficult to date exactly, but the excavator's original estimation between 1214 and 1227 has not been rejected on any credible grounds.⁶⁰ An article written in 2004 by Niu Dasheng and Niu Zhiwen agrees with Dang Shoushan's claim that the porcelain artifacts found with the gun, specifically a piece of porcelain or stoneware with an inscription on it that reads "光定四年", associates the dig site with the latter years of the Xi Xia dynasty.⁶¹

⁵⁹ Dang Shoushan 党寿山, *Wu wei wen wu kao shu 武威文物考述* (Wuwei: Guang ming yin shua wu zi you xian gong si 光明印刷物资有限公司, 2001), 103-113.

⁶⁰ For a discussion of the legitimacy of the dating see Dang Shoushan 党寿山, *Wu wei wen wu kao shu 武威文物考述*, 110.

⁶¹ There is a discrepancy in their account, however, they transcribed the iron bullet found in the 'cannon' as being .9 cm when it is fact 9 cm. Niu Dasheng 牛达生 and Niu Zhiwen 牛志文, "Xi Xia tong huo chong: wo guo zui zao de jin shu guan xing huo qi" 西夏铜火銃: 我国最早的金属管形火器, *Xun gen 寻根*, 2004 vol, no 6: 51-57, 51-52; Dang Shoushan 党寿山, *Wu wei wen wu kao shu 武威文物考述* (Wuwei: Guang ming yin shua wu zi you xian gong si 光明印刷物资有限公司, 2001), 103-113.

Based on the above description of a true gun the Wuwei ‘cannon’ can be determined a co-viative—a firearm in which the bullet does not occlude the muzzle of the barrel and when ignited projectiles along with the flame produced from the ignited gunpowder are expelled from the barrel. Yet the bullet remains very close to occluding the barrel. Though no wadding was found in the archaeological dig it does not seem implausible that wadding could have been used to fill the gaps between the bullet and the barrel of the ‘cannon’ producing a occlusive effect. The bullet found at the site was heavily corroded and in an irregular shape leading me to wonder could the mass of the bullet once have been greater but corroded over time and rusted, losing some of its mass? If so, is the Wuwei gun really the first true gun, or was it just a large co-viative gunpowder weapon that happened to shoot out a large iron ball?

So Which is the First Gun?

For all the evidence we do have the verdict is still out on when the first true gun was invented, but it is clear that by the end of the Song dynasty and the beginning of the Yuan dynasty guns in their true form were in use. Until more concrete archaeological evidence is found the Wuwei ‘gun’ remains the earliest example we have of a metal-tubed gunpowder weapon that used a single projectile that came close to muzzle occlusion. Even the origins of the Wuwei ‘cannon’ are questionable. Whether it truly is a Xixia weapon is a question we can not answer definitively with our present knowledge, but hopefully the next sections of this thesis can outline a road map for future research of the question—when was the first gun invented?

A Geographic Model

Of the many state actors present in the Song period, only those who had access to the essential resources needed to produce gunpowder and the knowledge to extract them in the correct manner were able to produce gunpowder weapons on a large enough scale to unleash upon their enemies. The most common weapons grade metal used was iron because it was relatively cheap and abundant throughout China. Bronze was also used, but was more expensive and required both tin and copper to produce. Early gunpowder was made up of a number of ingredients, the three most vital being charcoal, sulfur, and saltpeter. For the purposes of this study, we will focus on saltpeter because of preliminary research conducted on it and the high concentration of saltpeter required for the gunpowder mixture of a true gun.

The system of resource extraction we know most about is that under the Song state. While the discussion of Song statecraft is beyond the scope of this thesis, it is important to provide a note on the subject.⁶² Both iron and saltpeter were produced locally and then collected by the government as raw or near raw materials through tribute or tax. This meant that resource extraction was conducted privately on a local basis, either on a large or small scale, and the state supervised this activity in order to ensure tribute was paid. Through this predatory act, the government obtained raw materials and was then able to process these for the state's war effort.

Whether these practices extended beyond the Song border is still unsure and until more details on resource extraction in the Jin, Xia, Liao, and Mongol states are collected, we can only assume that these resources were exploited, but can not make any substantial assertions as to how such exploitation occurred. What is more important is to determine which states had access

⁶² The nature of Song Dynasty administrative practices are based on Ruth Mostern's characterization of Song state administration as a balance between costly supervision and maximizing resource extraction for profit in Ruth Mostern, *Dividing the Realm in Order to Govern: The Territorial State in Song China (960-1276 CE)*, (Cambridge, MA: Harvard University Asia Center, 2011).

to iron and saltpeter resources in the Song period. It is helpful to visualize the location of these resources superimposed over the shift in borders from the Northern to the Southern Song that occurred in 1127 AD. To do this I developed two maps of the Song period using ArcGIS software to show iron production sites from the Northern Song state, saltpeter lands from the Northern Song and Ming periods, and modern day copper and tin deposits. In examining these maps it becomes apparent that iron production and saltpeter production were monopolized by the Song state until the fall of the Northern Song in 1127 AD. Shifts in borders gave the Jin and later the Mongols access to vital gunpowder resources. Thus we see the year 1127 AD as a watershed year in which gunpowder resources were redistributed among two or more states and paved the way for the invention of the first gun.



Figure 4 Map of Northern Song period, made by author.

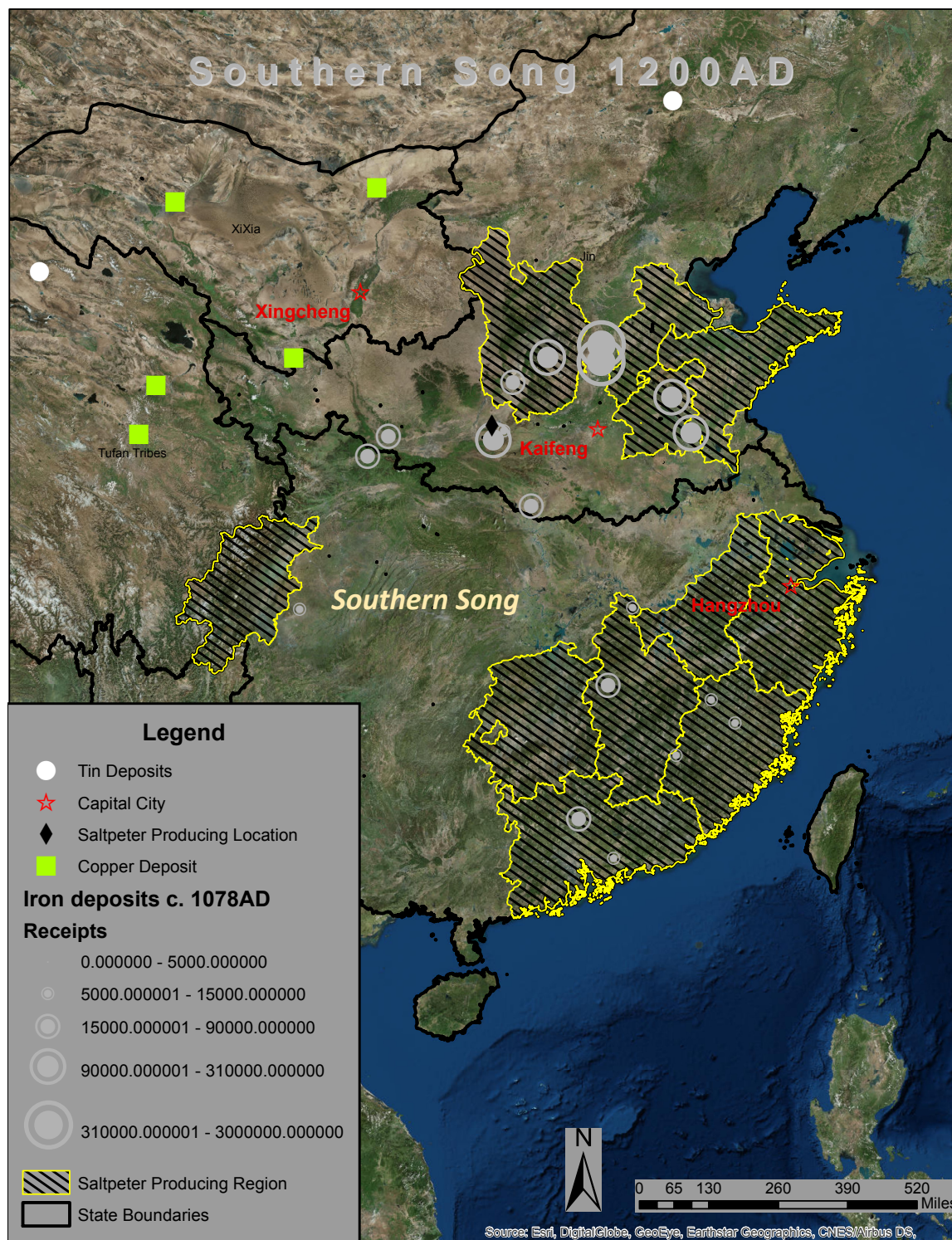


Figure 5 Map of Northern Song period, made by author.

In examining these two maps it becomes abundantly clear that major iron deposits and saltpeter producing lands exploited by the Northern Song state fell into the hands of the Jurchen Jin in 1127 AD. This explains two things: why gunpowder weapons in the eleventh century did not become guns, and why the conflicts between the Jin and the Song in the twelfth and thirteenth centuries are very good candidates for the invention of the first gun.

It was not until 1127 AD that two or more states in the region reasonably had access to large deposits of both iron and saltpeter and thus were able to develop metal-barreled gunpowder weapons on a large scale. By revisiting the notion of a ‘challenge and response dynamic’ in the twelfth century a clearer picture begins to develop of the innovation of metal-barreled gunpowder weapons. These maps do not tell all, however, and it remains important to discuss in more detail the nature of iron and saltpeter exploitation in the Song period as well as the frequency of conflict during this time to better understand where and when the first gun is likely to have emerged. Before doing so I would like to provide a note on the data I used and how we should view the anachronistic nature of the sources used to create the above maps.

My data is anachronistic due to the limited nature of historical resources on gunpowder resources. The borders on these maps were drawn from data compiled by Robert Hartwell accessed through the China Historical GIS database.⁶³ The data for iron production in the Northern Song is limited to what information Robert Hartwell and Donald Wagner have been able to glean from the Song dynasty text the *Song Hui Yao*, which recorded iron quotas and ‘receipts’ from two periods in the eleventh century.⁶⁴ Because research on saltpeter resource

⁶³ The data was downloaded from <http://www.fas.harvard.edu/~chgis/data/hartwell/> as part of the China Historical GIS project.

⁶⁴ Robert Hartwell, “A Revolution in the Chinese Iron and Coal Industries During the Northern Sung, 960-1126 A.D.,” *The Journal of Asian Studies* 21, no. 2 (February 1, 1962): 153-62; Robert Hartwell, “Markets, Technology, and the Structure of Enterprise in the Development of the Eleventh-Century Chinese Iron and Steel Industry.” *The Journal of Economic History* 26, no. 1 (March 1, 1966): 29-58.;

production is scarce, areas shown on the map, other than the site at Jiezhou (marked by a black diamond), refer to regions that produced saltpeter in the Song and the Ming periods and not specific production locations. Hopefully by collating these myriad sources from different years and examining them as two snapshots of resource extraction in the Song period, we can gain a better understanding of the shift in resource access from the Northern to the Southern Song.

Iron Production in the Song and Jin and Xia

Iron deposits in China have been exploited for millennia and there is evidence to suggest that iron production occurred in all states in the Song period, though to what extent remains unclear and worth discussion.

Robert Hartwell wrote a trio of articles in the 1960s that have largely shaped our current perception of iron production in the Song period. He claims that iron production in China reached a peak in the eleventh century under the Northern Song, rivaling the production of early industrial Europe in the eighteenth century, and not reaching similar levels until the Ming or Qing dynasties. Recent literature has questioned this claim, but rather than refuting the magnitude of iron production it instead casts doubts on our ability to estimate, as Hartwell does, the exact amount of iron produced in the Song.⁶⁵ Did iron production really peak in the Northern Song? What about iron production in the Song's neighboring states, the Jin and Xia? What happened to iron production after the fall of the Northern Song in 1127AD?

Hartwell, Robert. "A Cycle of Economic Change in Imperial China: Coal and Iron in Northeast China, 750-1350." *Journal of the Economic and Social History of the Orient* 10, no. 1 (July 1, 1967): 102-59.; Donald B. Wagner, "The Administration of the Iron Industry in Eleventh-Century China," *Journal of the Economic and Social History of the Orient* 44, no. 2 (January 1, 2001): 179-197.

⁶⁵ For two works that reassess and document the legacy of Robert Hartwell's original work on Song iron production in the 1960s see Tim Wright, "An Economic Cycle in Imperial China? Revisiting Robert Hartwell on Iron and Coal," *Journal of the Economic and Social History of the Orient* 50, no. 4 (January 1, 2007): 398-423.; and Donald B. Wagner, "The Administration of the Iron Industry in Eleventh-Century China," 179-197.

Some early scholarship points to 1127 AD as a watershed event, after which iron production experienced a severe decline. This is based less on facts and more on a theory suggested by Robert Hartwell. He explains how iron production grew in the Northern Song specifically in the regions surrounding the Northern Song capital Kai Feng in order to supply massive urban growth.⁶⁶ But when the capital fell to the Jin in 1127 AD and urban growth stopped, iron production stopped as well. Hartwell's theory is not founded in evidence of a decline in iron production in the North but a lack of evidence of production after 1127 AD. Therefore, Hartwell suggests iron production after 1127 AD declined, but is unable to provide concrete data to support this. Suggesting we have little idea of what happened to regimes of iron production after the year 1127 AD. It is clear, however, that the Liao, Jin, and Xia states all had enough iron to support extensive agricultural regions and to support many military campaigns.

The lack of sources regarding Jin and Xia iron production has been lamented but there is evidence from numerous sources that both of these states possessed advanced knowledge of metallurgy. Prior to the establishment of the Jin state the Jurchen people exploited small iron deposits in the far Northeast of China in what is today Heilongjiang province.⁶⁷ Archaeological digs from the 1960s uncovered evidence of iron smelting sites in Heilongjiang dating to pre-Jin

⁶⁶ Urbanization rates in Song dynasty were close to 10%, more than a level not seen in China again or Europe until the eighteenth century. Gang Deng, *The Premodern Chinese Economy: Structural Equilibrium and Capitalist Sterility* (London: Routledge, 1999), 322. He draws on De Vries 1984, tables 2.2, 3.1, 3.2, 3.5, 3.6, and appendix 1. Some estimates of Song urbanization rates reach above 15%. See Deng, p. 183.; The population of Kaifeng during the Song period may have been as high as 1 million inhabitants, John King Fairbank and Merle Goldman, *China: A New History* (Cambridge, Massachusetts: The Belknap Press, 1998), 89.

⁶⁷ Zhang Boquan suggests that the Jurchen's had the handicraft necessary to work iron, but not necessarily the resources to produce iron on a large scale, thus necessitating the import of iron from the Liao and the Korean Peninsula, Zhao Boquan 张博泉, *Jin shi lun gao*, (di 1 juan) [M] 金史论稿, (第1卷)[M] (Changchun 长春: Ji lin wen shi chu ban she 吉林文史出版社, 1986): 86.

Jurchen societies.⁶⁸ There is one interesting piece of evidence from an edict in 1163 AD that allowed for private production of iron in the Jin state. This same edict levied a 5% tax on all iron produced.⁶⁹ The issue with this evidence is that it is entirely without context rendering it all but meaningless, how was iron production regulated in the Jin prior to 1163 AD and what did this edict really change? How much iron was produced? How was this tax paid and collected? All that can be reasonably claimed about Jin iron production is that it occurred and on a scale so as to provide the Jin military with enough iron to fight wars against its formidable foes the Song, the Xia, and the Mongols. It is not until the Ming period that we begin to see a better picture of Chinese iron production with which to compare to the Northern Song period.

Whether the Xia state had domestic iron mines is not clear, but there is evidence that the Xia were not ignorant of iron smelting and iron working practices. There is ample evidence of the Xia using smelting techniques to produce iron weapons and one of the earliest known painted examples of a double piston box bellow has been found and dated to the Xia state.⁷⁰ The Tanguts are also credited with production of the best iron swords in the Song period.⁷¹



Figure 6: Double Piston Bellows, image taken from Wang Xiong, 王雄, *Liao xia jin yaun shi hui: xi xia juan* 辽夏金元史徽·西夏卷, (nei meng gu da xue chu ban she, 2007), 260.

⁶⁸ Though no final iron products were found at the site, evidence of smelting and charcoal residue was present at the dig site. This has led excavators to theorize that iron was smelted close to the source and then iron ignots were sent down the Ashen river (near the site) to where the ignots were worked into a final product by specialists. Hei Long Jiang Shen Bo Wu Guan 黑龙江省博物馆. Hei Long Jiang Ah cheng xian xiao ling di qu jin dai ye tie yi zhi 黑龙江阿城县小岭地区金代冶铁遗址[J]. *Kao gu* 考古 3, (1965): 124—130.

⁶⁹ Zhang Yi 张毅, "Song Yuan shi qi shan dong di qu kuang ye ye yan jiu 宋元时期山东地区矿冶业研究," *Journal of Liaoning Educational Administration Institute* 26, no. 9 (September 2009), 31.

⁷⁰ This is an advanced type of bellows that provided a constant flow of oxygen and was far more advanced than contemporary European models, allowing for extremely high heats to be used in

Saltpeter production

Saltpeter in the Song period remains something of a mystery. It was produced and consumed, but only recently is historical literature beginning to focus on its implications for warfare and trade. Recent literature includes Sun Laichen's work on saltpeter trade in Southeast Asia from the Ming to the fall of the Qing empire, and Peter Lorge's forthcoming article about Northern Song saltpeter and sulfur extraction. There remains little evidence or research on saltpeter extraction in the Jin and Xia states.

Due to a lack of primary source material directly involving saltpeter, Sun and Lorge use evidence for sulfur consumption to make inferences about saltpeter consumption. For instance, Lorge notes that in 1084 AD a shipment of 500,000 *jin* (a *jin* is roughly a pound) of sulfur was purchased from Japan. Based on early gunpowder recipes from the *Wu Jing Zong Yao* Lorge determines three ratios of sulfur to saltpeter, 7/20, 20/37, and 1/2.⁷² From these ratios, if all the sulfur is assumed to have been used for gunpowder the necessary saltpeter required for gunpowder production ranges from 1,428,571.43 *liang* (*liang* is a smaller unit of measure used in Chinese to measure weights) to 925,000 *liang* to 1,000,000 *liang*.⁷³ Sun Laichen does a similar extrapolation of sulfur data in the sixteenth century. In 1509 AD the Dai Viet state purchased 10,000 *jin* of sulfur from the Japanese state of Ryuku, based on a 75% saltpeter to 10% sulfur

metallurgical processes. Mark Elvin, *The Pattern of the Chinese Past* (Stanford: Stanford University Press, 1973), 86.

⁷¹ “西夏铸造的剑在当时号称‘天下第一’” *Swords forged by the Xi Xia were considered the best in the world* in Lu Yidong 鲁亦冬, *Zhongguo Song Liao Jin Xia jing ji shi* 中国宋辽金夏经济史, (Ren min chu ban she 人民出版社: 1994) pg. 214..

⁷² Lorge, forthcoming.

⁷³ These are very rough figures and would translate into about 73,077 pounds, 76,891 pounds, and 83,125 pounds, respectively.

ratio the corresponding amount of saltpeter needed would have been 75,000 *jin*.⁷⁴ Both Lorge and Sun are providing rough estimates, but the estimates do provide a perspective on the scale of saltpeter consumption in these gunpowder states.

By better understanding the consumption of saltpeter and sulfur, we can better strategize where future research is likely to pay off. Peter Lorge relies on local tax and tribute records from the Song, but a more comprehensive search in these records is necessary to inform studies of saltpeter use in the Song after the year of 1127 AD. Looking at Ming sources and determining places and rates of production may shed light on production in the Song period, but one must be wary of assuming too much that Ming consumption is a reflection of earlier Song or Jin consumption.

As has been evidenced in the first section of this work, the Song and its surrounding neighbors were all advanced states possessing the bureaucratic and technologic knowledge to produce the items necessary for gun production. The deciding factor in when and where the first gun was invented thus rests in the access to the necessary resources to produce the first gun. As evidenced in the above maps, this access only occurred after the Jin came to power in the region. The single most important year in the Song period for the history of gunpowder and the first gun is the year 1127 AD, when everything changed.

The Fall of the Northern Song

When Kaifeng fell to the Jin in the year 1127 AD the Song dynasty faced a massive problem of reorganizing and restructuring an empire. The humiliating loss of lands in the north of China as well as the capture of the emperor could have spelled the end for the Song dynasty,

⁷⁴ Sun Laichen, 2013 "Saltpetre Trade and Warfare in Early Modern Asia." *In Offshore Asia: Maritime Interactions in Eastern Asia before Steamships*, edited by Fujita Kayoko, Momoki Shiro, Anthony Reid, 131-184. Singapore: Institute of Southeast Asian Studies. 135-136.

but the court reestablished itself in Hangzhou, troops were rallied and the Song pushed back the invading Jin and establish a new border along the Huai River. The massive changes in jurisdiction had long lasting ramifications for Southern Song statecraft, economy, and culture. For the Jin this must have been a similarly momentous occasion that had significant effects on statecraft, economy, and culture. The transfer of control of vital resources for the production of gunpowder from the Song to the Jurchen Jin state marked a new era in gunpowder development, one that eventually led to the invention of the first true gun. It was precisely sovereignty over certain territories that possessed the resources necessary for gunpowder and gun production that allowed for the proliferation of gunpowder weapons during the Jin-Song wars.

As Ruth Mostern so aptly put it “states...are inherently and fundamentally geographical. Their existence is marked by whether or not they hold sway over some territory on the earth’s surface, and their persistence depends upon how the machinery of dominion is spatially distributed throughout this territory. Sovereignty is based on the control of territory.”⁷⁵ And the Song and the Jin and later the Mongols all controlled territory that had saltpeter and iron. In the context of this sovereignty we can notice patterns of control and conflict that point to the period from 1127 AD to 1234 AD as a likely time in which the first gun was invented.

To reiterate my theory, the invention of the first gun most likely occurred when two or more states with access to the necessary metal and saltpeter resources to experiment with gunpowder weapons were able to use them in conflict with one another. To prove this we should look more closely at the Song period in two phases, before 1127 AD and after 1127 AD. With all of the information we have gathered thus far on the distribution of resources in the Song period, the current material record concerning guns and gunpowder weapons, and the awareness that

⁷⁵ Ruth Mostern, “*Dividing the Realm in Order to Govern*” *The Spatial Organization of the Song State (960-1276)*, (Cambridge, Mass; London, England: Harvard University Asia Center, 2002), 2.

most states in this time were technologically advanced we can analyze these two phases using the frequency of conflict in the Song period as guideposts to point to the most likely moment that the first gun was invented.

Frequency of Conflict in the Song Period (960-1279)

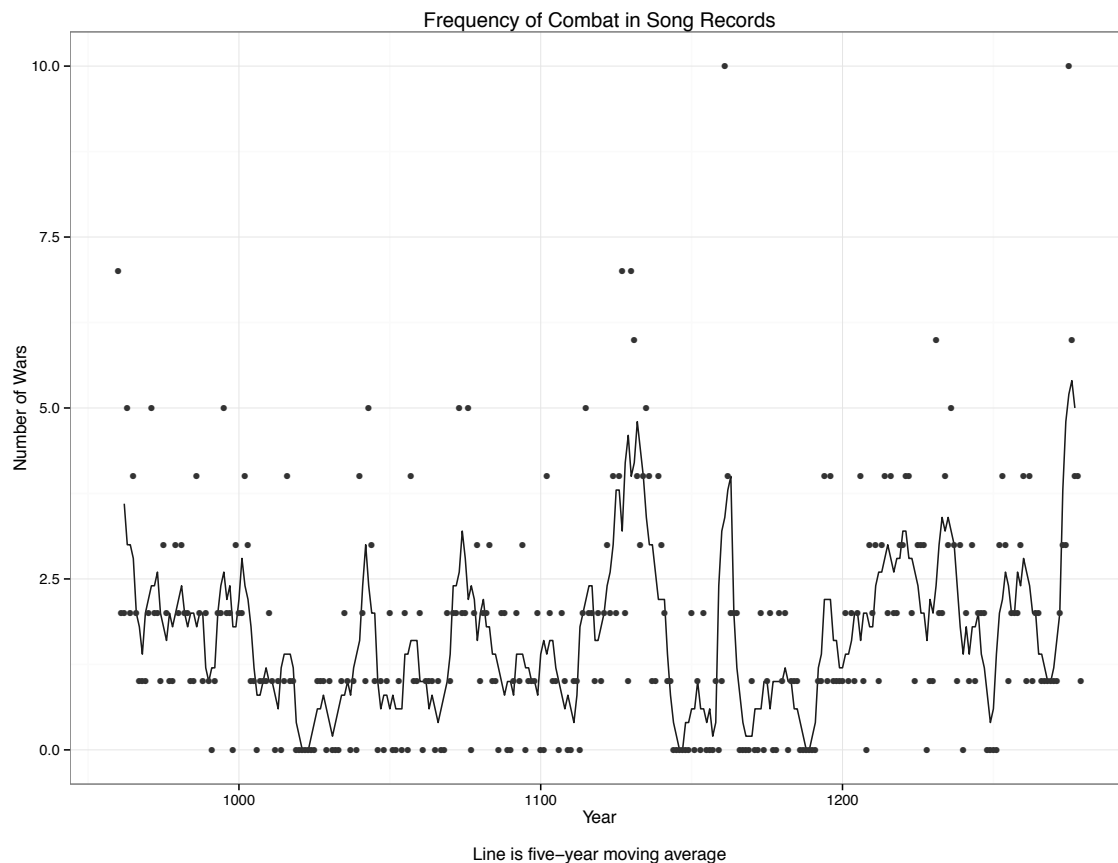


Figure 7: Data points derived from *Zhong guo jun shi shi bian xie zu bian* 中国军事史编写组编, *Zhong guo li dai zhan zheng nian biao* 中国历代战争年表, (Beijing: jie fang jun chu ban she: 2002).

As can be seen from the above graphic, the frequency of warfare in the Song period was not static, and in fact was a near constant presence in the Song period. The peaks in this graph correlate with many of the moments of conflict we have previously discussed. Most important to focus on is the period between 1100 AD and 1250 AD. During this time we see a sharp increase in conflict around the year 1127 AD as would be expected considering the conquest of the Song by the Jin in this year. There is a decline shortly following when a ceasefire between the Song and Jin was honored. In 1161 AD there is another peak correlating to the Jin invasion of the

Southern Song in that year.⁷⁶ In the 1190s AD there begins a steady rise in conflict as the Mongols consolidate power on the steppe and put pressure on the Xia and Jin states. In 1206 AD the Song declared war with the Jin and kicked off a period of conflict between the Jin and the Song that Julie Avery characterizes “as a siege—with the Song as the defender, Jin as the aggressor, and the Mongols as the ultimate victor.”⁷⁷ This description is apt and speaks to the near constant rate of conflict we begin to see at the end of the Song period.

By examining these moments of conflict in conjunction with the geographic distribution of resources it becomes clear that a gun could have been produced by the end of the Jin period. Further studies into specific moments of conflict in this period (specifically in the years between 1200 AD and 1234 AD) with a focus on the belligerents and the roles they took in the conflicts and tools they used to make war will hopefully bring to light important moments in the development of the first gun.

It is clear that prior to the year 1127 AD interstate conflict is also present which begs the question could the gun have been invented during this period? The Northern Song control of the most productive regions of saltpeter and iron seem to discourage this view.

Phase 1: The Northern Song, the Xia, and the Liao

In this first phase it is clear that the Song controlled much of Northern China and had a monopoly of the resources necessary to produce gunpowder weapons. Iron production was well within the borders of the Song and while two northern saltpeter zones are shown to border the Liao and the Xia states, the Song maintained strict regulation of the diffusion of saltpeter across borders. In the 1070s a prohibition was placed on the “private markets in sulfur, saltpeter and

⁷⁶ The famous battle of Caishi occurred in this year, and is referenced by Pan Jixing in his 1984 article and Joseph Needham and Stephen Haw and Tonio Andrade.

⁷⁷ Julie J. Avery, “A Record of the Defense of Xiangyang's City Wall, 1206-1207” (master’s diss., University of Massachusetts-Amherst, 2009), 29.

lugan shi” in these two provinces, indicating that the Song government had a vested interest in restricting the export of these war materials.⁷⁸ It seems likely, considering the early development of gunpowder weapons in the Northern Song, that their neighbors were exposed to firearms in the eleventh century, but were unable to develop their own weapons due to Song monopolization of gunpowder resources.

If the Xia were exposed to Song firearms it could have occurred as early as the war in 1038, but certainly exposure occurred by the 1080s when a Song revanchist campaign was launched against the Tangut state.⁷⁹ In both instances despite Song superior firepower, the Tanguts were able to bring the Song military apparatus to a standstill. In these events the Tanguts could reasonably be assumed to have taken the weapons dropped or abandoned by Song troops. Were this the case then the Xia would have not only potentially been under fire from gunpowder weapons, but then could have obtained those gunpowder weapons for themselves. The Xia are particularly interesting because of the northern bordering states at this time they are the only group to have developed their own native script and translated many Chinese texts into Tangut.⁸⁰

This is just speculation, but it seems that the Tangut state could possibly have had access to the resources necessary to produce gunpowder weapons as early as the eleventh century judging from trade networks in the northwest of China. In fact there is mention of sulfur and different types of saltpeter in a Xi Xia records, though they only appear once and in a law text

⁷⁸ Translated by Peter Lorge, original can be found in the Song Shi section 186 page 4563.

⁷⁹ Paul C. Forage, “The Sino-Tangut War of 1081-1085,” *Journal of Asian History* 25, no. 1 (January 1, 1991): 1–28.

⁸⁰ Galombos Imre does an interesting analysis of Tangut translations of Chinese military texts; Liu Qing 刘庆 and Mao Yuanyou 毛元佑. *Zhongguo Song Liao Jin Xia jun shi shi* 中国宋辽金夏军事史. In Shi Zhongwen 史仲文 and Hu Xiaolin 胡晓林, Eds. *Bai juan ben Zhong guo quan shi* 百卷本中国全史. Vol 11. Beijing: Ren min chu ban she, 1994. Discussion of the diffusion of military texts across borders and the mutual influence and communication the Song had on the Liao, the Jin and the Xia. There is evidence that the Tangut Xia even had a translation bureau.

referring to the management of state medical storage facilities.⁸¹ A study of the Song's northwestern border policies during this time suggests that despite the prohibitions of certain trade items the borders were so porous that enforcement was rarely possible and black market trade flourished.⁸² It is clear from the 1070s AD prohibition of the export of war materials that trafficking in war goods was an express concern of the Song state during this first phase of the Song period indicative of the presence of black markets.⁸³ And it was just this prohibition of trade in war goods that suggests a severe lack of domestic access the Liao and Xia states may have had to these gunpowder materials that prevented direct competition in gunpowder production. The first phase of the Song period may have seen the invention and development of gunpowder weapons in the Song state, but there is little evidence to suggest that gunpowder weapons had spread beyond the borders of the Song state.

⁸¹E luo si ke xue yuan dong fang yan jiu suo sheng bi de bao fen suo 俄罗斯科学院东方研究所圣彼得堡分所、zhong guo she hui ke xue yuan min zu yan jiu suo 中国社会科学院民族研究所、shang hai gu ji chu ban she 上海古籍出版社 “E Cang Hei Shui Cheng Wen Xian” 俄藏黑水城文献, 8 Shang hai: shang hai gu cang chu ban she 上海: 上海古籍出版社, (1996): 338. top and bottom. See Appendix C for images of these records.

⁸² Li Wenjun 李文军, "Lun bei song dui xi bei bian qu jing ji huo dong de fa lv gui zhi" 论北宋对西北边区经济活动的法律规制, *Inner Mongolia Social Sciences* 内蒙古社会科学 (汉文版) 29, No. 2 (March 2008): 37-40.

⁸³ Julie J. Avery, "A Record of the Defense of Xiangyang's City Wall, 1206-1207" (master's diss., University of Massachusetts-Amherst, 2009), 12-13. She presents black market trade across the Southern Song borders to the Jin as an inevitable outcome of restrictive trade policies by the Song state and provides a long quotation from Chan, Hok-lam, "Tea Production and Tea Trade under the Jurchen-Chin Dynasty," in *Studia Sino-Mongolica*. Ed. Wolfgang Bauer. Wiesbaden: Franz Steiner Verlag GMBH, 1979. Pp. 115.

Phase 2: the Jin, the Southern Song, and the Xia

The second phase of the Song period is defined by the fall of the Northern Song and the rise of the Jin as hierarchs in the region.⁸⁴ The map in figure 5 shows the borders in China from the year 1200 AD and it is clear that the Jin controlled important iron deposits and saltpeter producing earths. What is also clear is that the Southern Song still possessed major production sites of iron and saltpeter. This shows clearly the existence of two states with the resources necessary to conduct gunpowder warfare and produce gunpowder weapons. According to my theory this phase is the likeliest time period for the invention of the first gun.

What requires our attention though, is the Xia state to the northwest and the evidence of the Wuwei ‘cannon’ discussed above. Without substantial deposits of iron or saltpeter how did the Xia state obtain a ‘cannon’ complete with gunpowder and bullet at the beginning of the 1200s AD? It is important to note that trade between the Xia and its neighboring states occurred, but aside from attaining iron or gunpowder weapons through the spoils of war as has been suggested, but more important than that is to note that the Wuwei ‘cannon’ was not iron at all, but bronze.⁸⁵ This is important because all of a sudden iron becomes a lot less important for the casting of a gun, and bronze production becomes a necessary factor to consider in the production of the earliest gunpowder weapons. A study of bronze production in the Liao, Jin, Xia and Song states requires much additional research, but by looking at modern day deposits of copper and tin in the Northwest of the People’s Republic of China we can see that there are very few exploitable tin deposits, but a number of large copper deposits. If the Xia state had known about

⁸⁴ For evidence that the Jin may have superseded the Northern Song as hierarchs in the region see the table of Xia tributary missions from 947AD-1227AD in Appendix A, Hans Bielenstein, *Diplomacy and Trade in the Chinese World, 589-1276*, (Leiden ; Boston: Brill, 2005): 524.

⁸⁵ See Dang Shoushan 党寿山, *Wu wei wen wu kao shu 武威文物考述* (Wuwei: Guang ming yin shua wu zi you xian gong si 光明印刷物资有限公司, 2001), 103-113.

these deposits and were able to exploit them they would have had access to a very important resource at that time. Questions do remain though.

Did the Xia have the technological savvy to exploit their copper resources? If so did they have the trade networks to obtain the tin necessary for bronze production? Were the Xia advanced enough technologically to craft and cast their own gunpowder weapons and gunpowder mixtures? A lot of evidence points towards yes, and if in fact the Xia were producing gunpowder weapons at the beginning of the thirteenth century or even earlier we must rethink the gunpowder narrative and its role in Song period China.⁸⁶

⁸⁶ Cui Fengxiang 崔凤祥, Cui Xing 崔星, "Xixia yan hua Dang Xiang zu jun shi ti yu huo dong kao xi 西夏岩画党项族军事体育活动考析," *Journal of PLA Institute of Physical Education*, 29 no 1 (2010), 22-25. This source talks about the advanced nature of Xia iron production, citing their effective techniques as reason for their superior military strength. The article also makes the claim that the Xia in fact had plenty of domestic iron mines though does not provide sources for this. Qin Wenzhong 秦文忠, Zhou Haitao 周海涛, Qin Ling 秦岭, "Xixia jun shi tiyu yu ke xue ji shu 西夏军事体育与科学技术," *Ningxia University Journal Philosophy Social Science Press*, 20, no (Yinchuan, 1998), 48-50. This article makes the claim that the Xia learned of gunpowder and gunpowder weapons from the Song, and despite the fact that war was a rampant part of society at this time there was communication and transfer of ideas among the states. Whereas I am arguing that it was because of war that this information transferred from one state to the other.

Conclusion

The conclusions we can draw from this study are simple: the Northern Song had access to all the ingredients for gunpowder weapons and there is clear evidence that they had developed and used gunpowder weapons in battle by the eleventh century. The Liao and the Xia had limited if any access to substantial iron or saltpeter deposits, though the Xia may have exploited copper resources that are exploited in the region today. It is clear that when the Jin conquered large portions of northern China from the Song they took over very productive centers of iron production and saltpeter production. The Jin also separated the Song from the Xia and prevented direct trade or conflict between the two states and the Xia began paying tribute solely to the Jin after the year 1127 AD. Though the Jin took over iron and saltpeter producing sites in the north the Song still had access to sites in the south, thus a challenge response dynamic of innovation was possible between the two states. After the Xia and the Jin fell to the Mongols, the borders in the region changed once more and a new era of conflict arose ushering in the time period that many scholars have pointed to as the likeliest period for the invention of the first gun. The advances the Jin, the Xia, and the Song had made in gunpowder weapons up to the year 1234 AD were co-opted by the Mongols and gunpowder weapons continued to develop during the extensive warfare between the Mongols and the Song in the latter half of the thirteenth century.

Specific challenges to this study and future studies lie in a lack of non-Song sources, which makes it difficult to accurately assess resource extraction, bureaucratic structure, and military production in Non-Song States. What this study shows is that despite this challenge, warfare between a gunpowder state and a non-gunpowder state could encourage a diffusion of technology. It is clear that the gunpowder technology the Song developed quickly diffused to its neighbors such that by the time the Jin established their dynasty they were able to adopt

gunpowder weapons and quickly begin producing them. In turn, the Jin likely influenced their adversaries as well, continuing this theme of challenge and response in the development of gunpowder weapons.

Whether the gun was invented as this study suggests during the Southern Song and Jin period (1127 AD-1234 AD), or at another point earlier during the Xia-Song, Liao-Song period (960 AD-1127 AD) or later during the Mongol-Song wars (1234 AD-1279 AD), is impossible to say for certain without new archaeological artifacts being found. But by assessing resource distribution and conflict frequency from the tenth to the thirteenth century however, we can better understand the Song period and likely moments for the invention of the first gun.

What I hope to accomplish with this study is to bring a critical lens to the period between 1127 AD and 1234 AD in the search for the invention of the first gun. By reviewing the role the Liao, the Xia, and the Jin played in the early narrative of gunpowder and gunpowder weapons, we begin to see this period as a type of testing ground in which gunpowder weapons were used again and again and through experimentation developed into more and more diverse and powerful weapons. This conclusion is largely based on the assumption that the frequency of conflict in the Song period was the driving factor behind innovation. And access to specific resources allowed for experimentation with and the production of gunpowder weapons.

That said there is still a lot to be learned about the Song state and its neighbors. Studies of Song weapons production and resource extraction is only the start. Sources on production in neighboring states are scarce, but the recent field of Xi Xia studies and an increased focus on archaeological studies of the Song period over-all prove promising avenues for future research and understanding of this fascinating period in the history of the gun.

What has largely been ignored in this study, yet remains fascinating, are the societal implications of the introduction of gunpowder weapons in the Song dynasty. The Song was a large empire with many private citizens of massive wealth and power. Could these individuals have produced gunpowder weapons? Were these weapons used anywhere outside of warfare in a social context in state affairs for instance?⁸⁷ Further study of representations of early guns in rock carvings at other sites in central China⁸⁸ and other artistic representations of early gunpowder weapons would prove invaluable to better understanding the world perspective of people and the state in the Song period.

⁸⁷ The simple answer would be no, weapons production in this period was under the purview of the state and required massive infrastructure and capital investment. Additionally the details of the production of gunpowder was kept very secret and within military circles. It is an interesting avenue to explore in order to see the level of autonomy individuals and non-government groups were able to exercise under the Song state.

⁸⁸ A future site of study may be in Lushan county in Sichuan Province. Huo Wei 霍巍, *Si Chuan lu xian song mu yan jiu liang ti* 四川泸县宋墓研究两题, *Jiang Han Kao Gu* no 134, (Sichuan, Chengdu 2014): 85-92.

Appendix A

The number of Tribute missions sent from the Xia state 947-1226⁸⁹

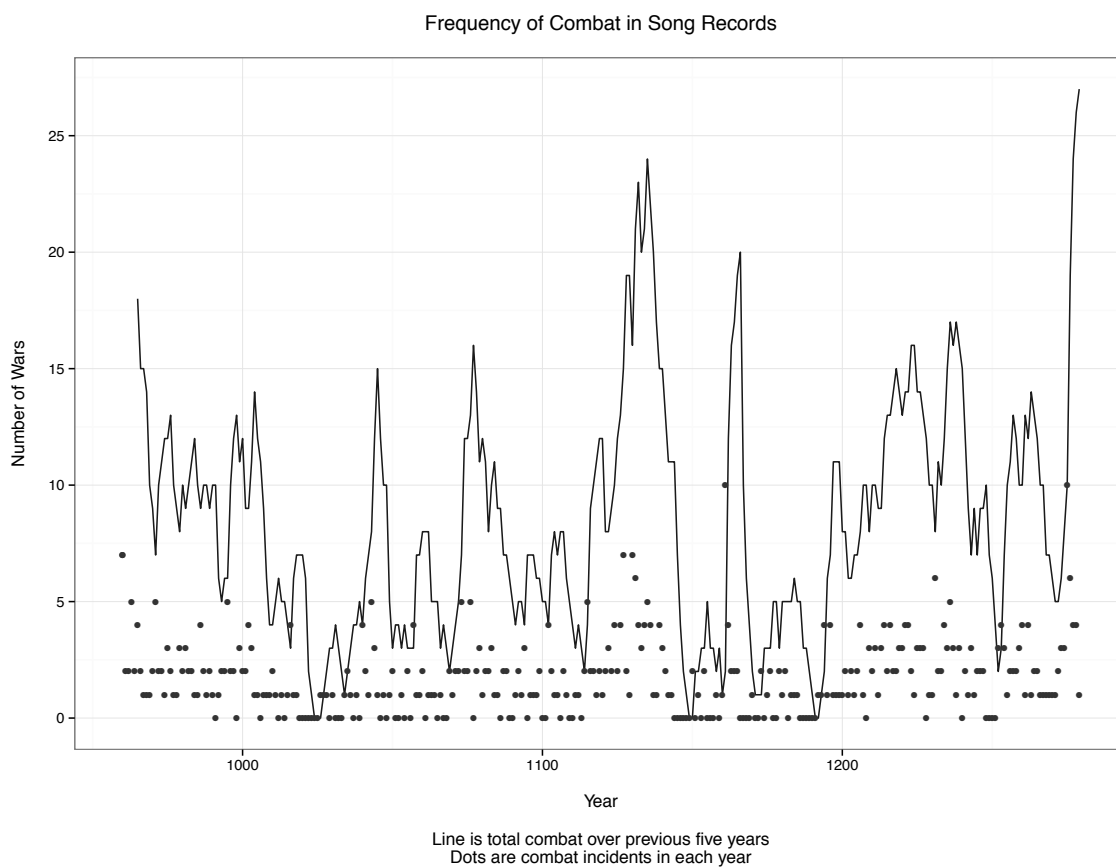
Year	To Song	To Liao	To Jin
947-966	1	-	-
967-986	1	2	-
987-1006	8	31	-
1007-1026	5	2	-
1027-1046	6	18	-
1047-1066	16	18	-
1067-1086	18	11	-
1087-1106	23	21	-
1107-1126	7	6	7
1127-1146	0	-	40
1147-1166	0	-	40
1167-1186	1	-	41
1187-1206	0	-	47
1207-1226	2	-	12

⁸⁹ Taken from Hans Bielenstein, *Diplomacy and Trade in the Chinese World, 589-1276*, (Leiden ; Boston: Brill, 2005): 524.

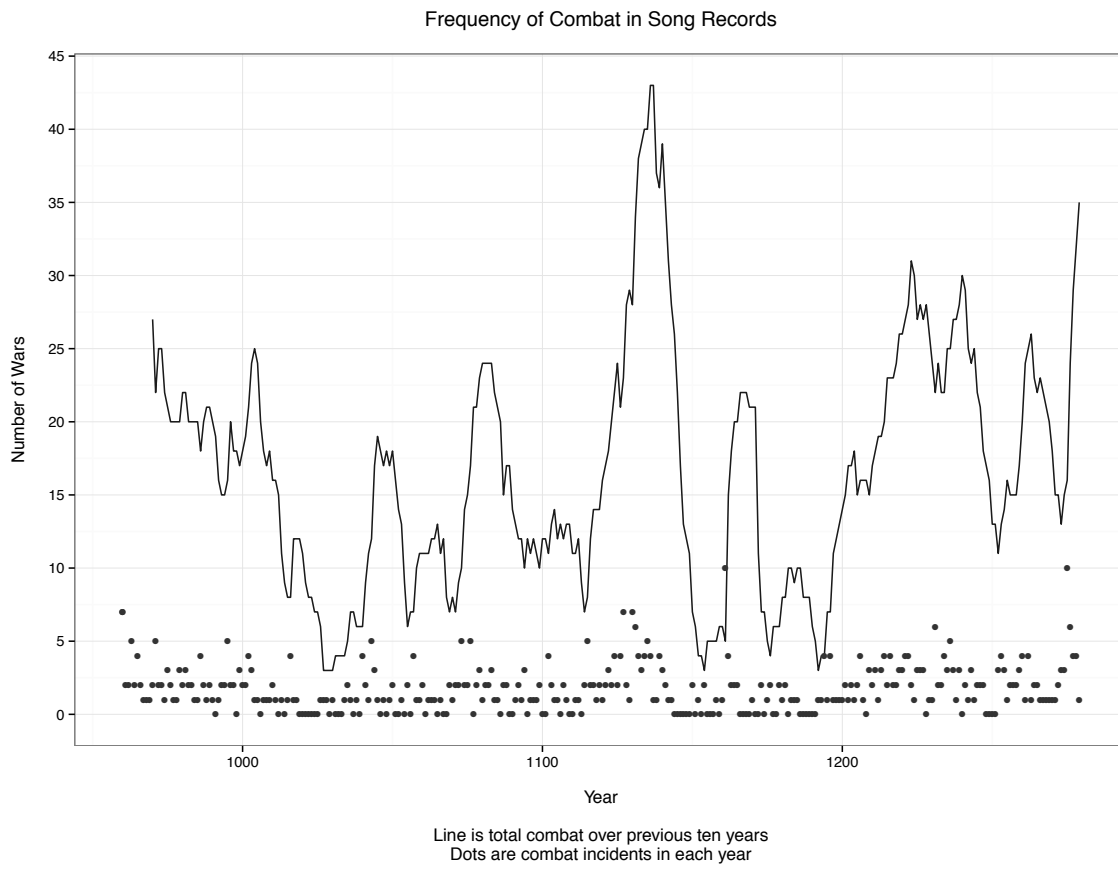
Appendix B

The below graphs are an attempt to depict a memory of war. The line represents the number of wars that have occurred in the past 5 and 10 years respectively. In the 5-year view there are only a few moments when the line reaches zero. In the 10-year view the lowest number of wars experienced was three. This suggests a high level of consciousness of war the Song and surroundings states must have possess throughout this period regardless of whether a state was at war or not.

5-year view

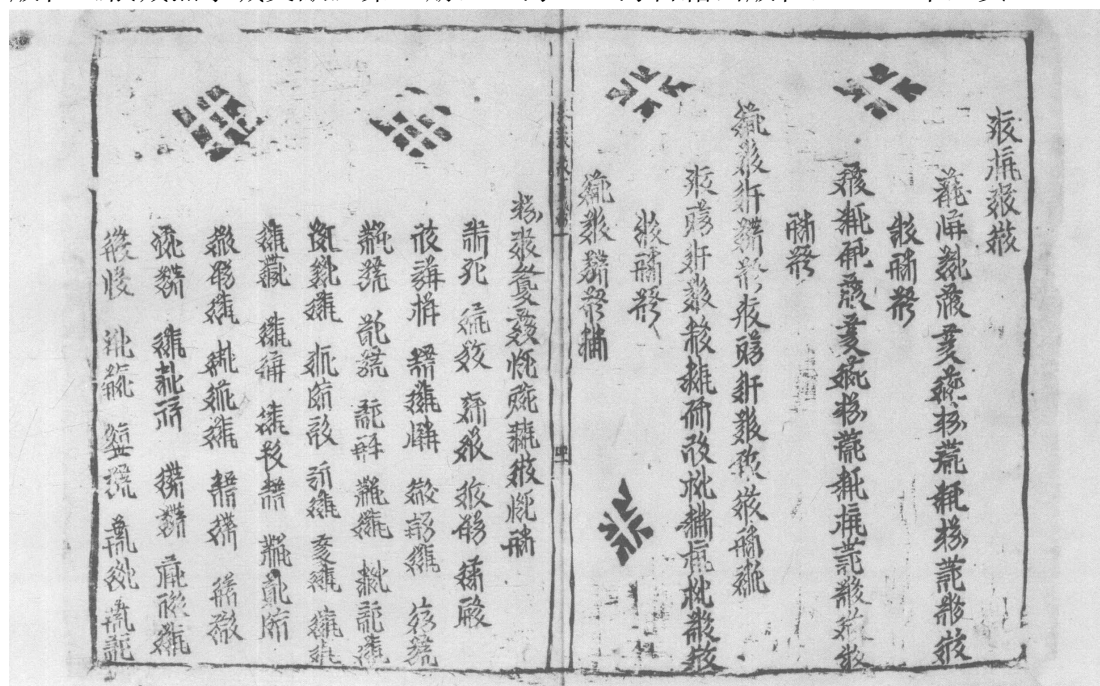


10- year view



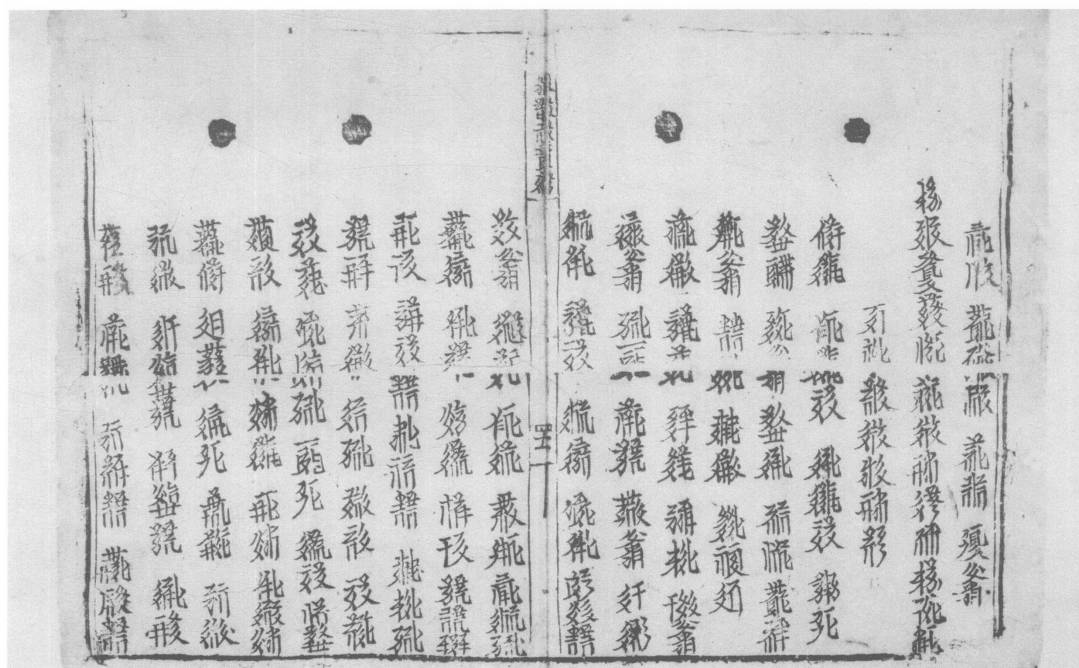
Appendix C

俄罗斯科学院东方研究所圣彼得堡分所、中国社会科学院民族研究所、上海古籍出版社《俄藏黑水城文献》第8册，上海：上海古籍出版社，1996年，页338上图：



左半叶右起第4行的第2个词是“硫磺”。

页338下图：



左半叶右起第6行的第3-5个词是“消石”“乾消”“馬牙消”。（消 = 硝）

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