THE "MANCHU CANNONS" CAST BY FERDINAND VERBIEST AND THE HITHERTO UNKNOWN TITLE OF HIS INSTRUCTIONS

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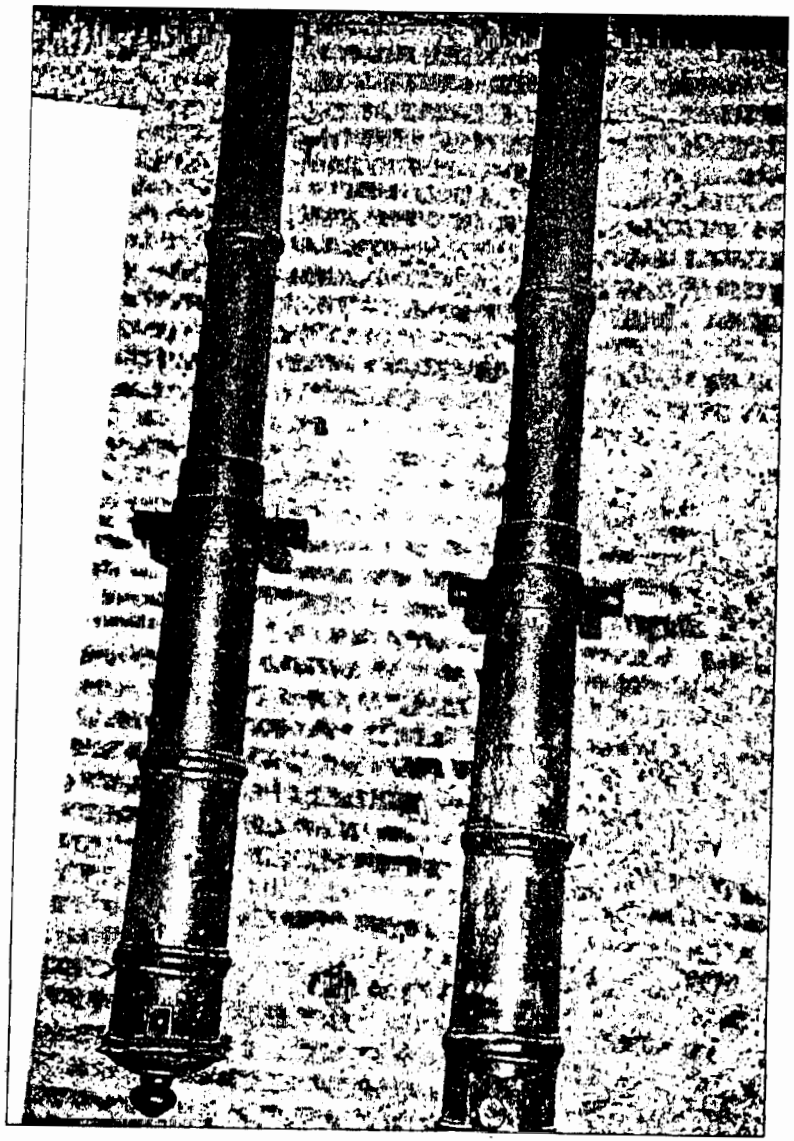
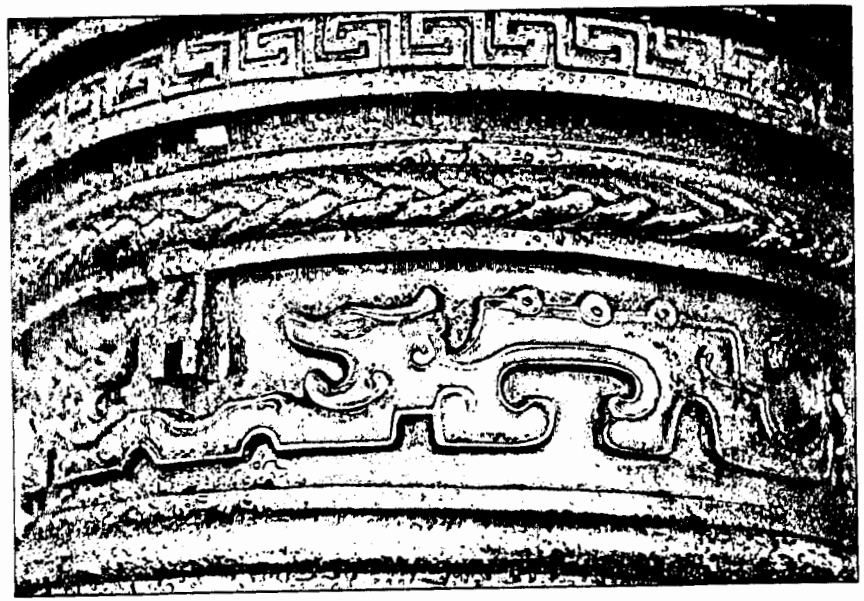
Very few people are aware that seventeenth-century cannons were brought to Italy after the Boxer Rebellion. They are to be found in two Roman museums. Three of these cannons - quite small in size - are in the *Sala della Giustizia* of the *Castel Sant'Angelo* Museum. On the breech of each one there is a bilingual Chinese-Manchu inscription which is hard to read since it is considerably damaged, and thus fragmentary, and also, because of the none too happy installation of the cannons: vertically on a wall, and only a few decimeters off the floor. The inscriptions look very primitive; the ideograms measure six to eight millimeters, and the Manchu writing is equally small, with the word *baitalara*, for example, measuring fifteen millimeters. Despite this, however, I have been able to decipher the date of casting as the twentieth year of Kangxi, 1682, and also the name of the maker, Nan Huairen, in Manchu Nan Hûwai-jin. We are dealing, then, with the work of the Jesuit Ferdinand Verbiest, one of the most famous missionaries in Chinese missionary history.

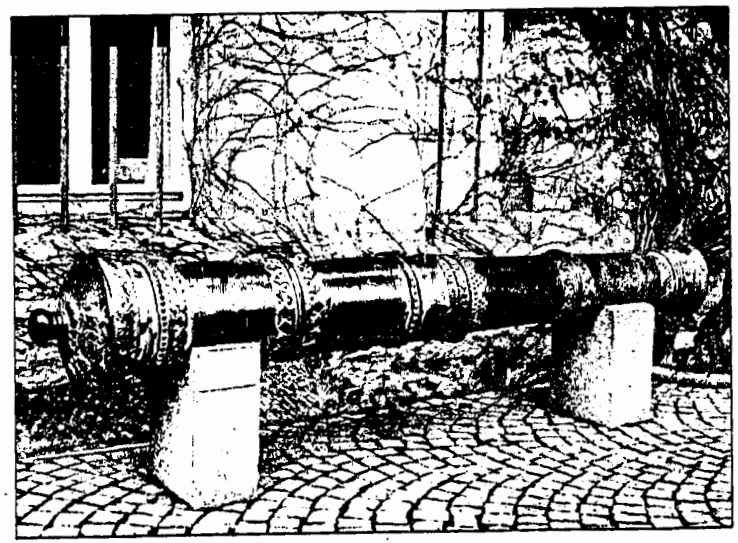
There are another four cannons to be seen in the *Museo dell'Istituto Storico di Cultura dell'Arma del Genio*, at Lungotevere della Vittoria, 31. They differ from those already mentioned both in size and in the rich ornamentation on the barrel. They too have bilingual Manchu-Chinese inscriptions on the breech, more elegant in form and perfectly legible.



Ill. 43: Cannons of the 1st series, 1682, Rome, Castel Sant'Angelo (Photo by G. Stary).



Ill. 44: Cannons of the 2nd series, 1689. Cannon of Ingolstadt. Detail: dragon (Photo by G. Stary).



Ill. 45: Cannons of the 2nd series, 1689. Cannon of Veste Coburg with inscription.

The Manchu text[1] reads as follows:

> *Daicing gurun-i Elhe Taifin-i orin jakûci aniya. hungkerehe horon sanggara enteheme akdun amba jiyanggiyûn. baitalara okto ninggun gin jakûn yan. eshun selei muhaliyan juwan ilan gin. sing ni den jakûn fun uyun li. durun ilibuha hafan Nan Hûwai-jin. tuwame weilehengge hafan Foboo. Sostai. zoguwan Wang J'i-cen: faksi da Li Wen-de: Yan Se.*
>
> In the twenty-eighth year of Kangxi of the Great Qing dynasty (1689) the (cannon named) "Great (and) Eternally Faithful Condottiere (and) Artificer of Imperial Power" was cast[2]. The powder necessary is 6 *gin* 8 *yan* (3879.304 g.)[3]. (With it is shot) a cast-iron ball of 13 *gin* (7758.609 g.). The rear-sight is 8 *fun* 9 *li* (28.48 mm.). The functionary (in charge of) designing the form was Nan Hûwai-jin. The functionaries (in charge of) supervising the work were Foboo and Sostai. The chief of the craftsmen was Wang Zhichen. The craftsmen were Li Wende and Yan Si.

The inscriptions on the other cannons are identical, except for their ballistic data. Two other cannons with different beautiful ornamentations are kept at the *Museum für Deutsche Geschichte*, Berlin (Unter den Linden). One cannon can also be seen at the *Bayerisches Armeemuseum*, Ingolstadt, *Altes Schloss* (cannon n° 18), and, also in Germany, at the

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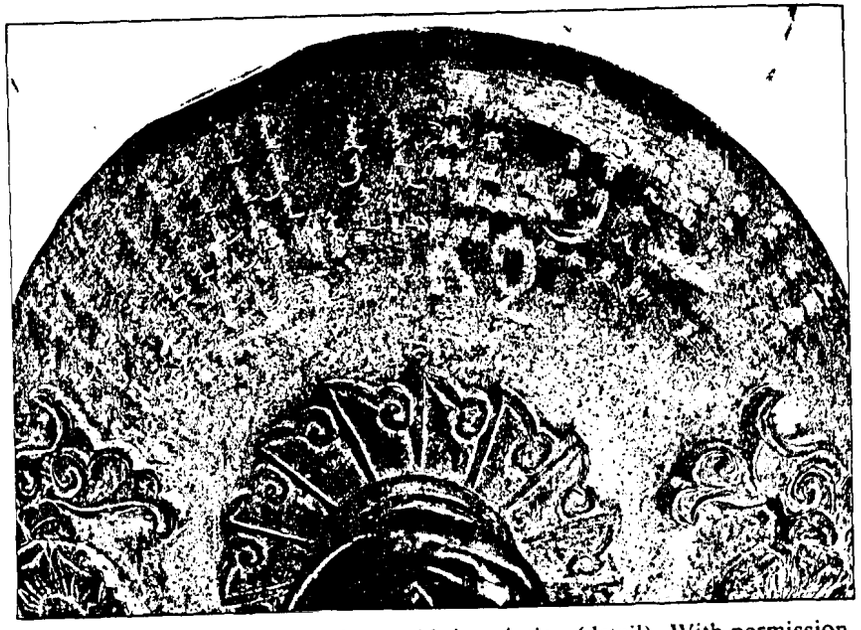
1 Parallel Chinese text, on the right side:

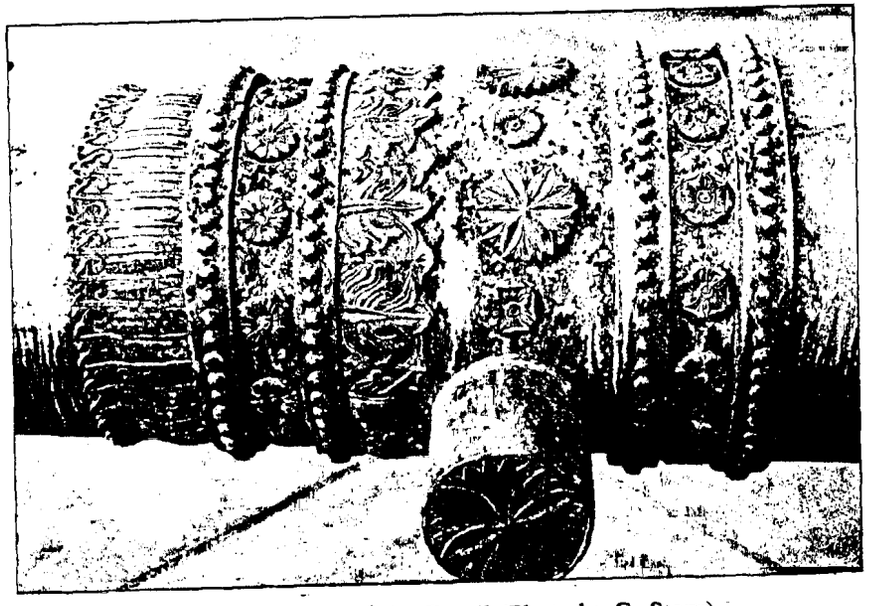
大清康熙二十八年
造永固將軍大砲八十三
成六分八兩九錢
製造法師王之禎
監製官侍郎臣索額圖
匠作官 工部尚書佛倫
役官 管理工部事務內大臣
武英殿大學士伊桑阿
文華殿大學士張玉書
四庫全書總裁官翰林院掌院學士陳元龍

2 The word *horon* is written above the text, as is *Daicing*, and thus justifies the translation "Imperial (power)" instead of the usual "terrible." It should be underlined here that the translation "...the name of the cannon is 'Generalissimo Wu Zhengyong'" (from the Chinese text) is absolutely wrong; "Wu Zhengyong" corresponds to Manchu "horon sanggara enteheme akdun" and is not the name of a "generalissimo."

3 The units of measurements mentioned are: 1 *gin* (*jin*) = 596.815 g.; 1 *yan* (*liang*) = 37.301 g.; 1 *fun* (*fen*) = 3.2 cm.; 1 *li* (*li*) = 0.32 mm.; 1 *cun* (*cun*) = 3.2 cm.



Ill. 46: The cannon of Veste Coburg with inscription (detail). With permission of Kunstsammlungen Veste Coburg, Neg. Nr. 26254 and 26421.



Ill. 47: Cannon of Berlin. Detail (Photo by G. Stary).

Veste Coburg. A photo of the breech of this cannon has been published in 1988, together with a detailed description:

> Material: Bronze; Gewicht des Rohres: 1911 kg.; Gesamtlänge des Rohres: 315 cm.; Laufbohrung: 12.5 cm.; Laufbohrungslänge: 282 cm.; Kugelgewicht: 12-16 Pfund.
> Kunstsammlung der Veste Coburg. Inv. n° G9[4].

Two cannons can also be seen in London (The Armouries, Tower of London, Chelsea Royal Hospital)[5]. Two more cannons are kept in Vienna, *Heeresgeschichtliches Museum* (Arsenal, *Geschützhalle* 17, Kammer 2; inv. n° 81446 and 81447), and in Budapest. The two cannons in Budapest are carefully described by G. Kara:

> Les canons échouèrent en Europe au temps du soulèvement de 1900, comme butin des troupes interventionnistes européennes, et furent remis plus tard au Musée de l'Histoire Militaire de Budapest. ... Le canon n° 22 est plus grand; le calibre du tube est de 14 cm., la longueur de 330 cm. Celui qui porte le chiffre 23 a un tube d'un calibre de 12 cm. et d'une longueur de 300 cm. ... Le personnage mentionné sous le nom de Fo Pao par les inscriptions est probablement identique à Fo Lun qui vécut à la même époque et appartenait au drapeau blanc de la droite mandchoue; au temps de Kangxi il remplissait une haute charge militaire, cf. *Zhongguo renmin dazidian*, p. 303. De même on ne sait pareillement rien de certain sur *Cho Sseu-t'ai*, il est peut-être identique à Cho Tai qui s'était également rangé sous le drapeau blanc de la droite mandchoue ... cf. *op.cit.*, p. 1365[6].

These fourteen cannons were cast according to Verbiest's design, even after his death in 1688; the whole casting, of course, began earlier - as we can see from an annotation in the *Qijuzhu* under Kangxi twenty-sixth year, fourth month, *geng shen* (= thirteenth) day (May 23, 1687):

> *Nan Huairen tiqing chongtian pao keming zhi chu*
>
> 南懷仁題請衝天砲刻名之處
>
> "Nan Huairen submitted a memorial asking for a name to be engraved on the blustering cannons ..."[7].

4 E. Schmitt, Th. Schleich, Th. Beck (eds.), *Kaufleute als Kolonialherren: Die Handelswelt der Niederländer vom Kap der Guten Hoffnung bis Nagasaki 1600-1800* (Bamberg, 1988), pp. 213-215.

5 Cf. the catalogue of the exhibition *China, Hemel en Aarde. 5000 Jaar Uitvindingen en Ontdekkingen / Chine, Ciel et Terre. 5000 ans d'inventions et de découvertes* (Brussels, 1988), p. 418, n° 293.

6 G. Kara, "Sur deux canons chinois des Ts'ing", *Acta Orientalia Academiae Scientiarum Hungaricae*, X (1960), 249-253.

7 *Kangxi qiju zhu* (Beijing, 1984), 2:1617.

The circumstances that brought this missionary to the unlikely occupation of manufacturer of cannons are well known, being connected with the Sanfan Rebellion and the Sino-Manchu military expedition against the Russian fortress of Albazin (in Manchu: *Yagsa*), on the Amur, in the years 1685 and 1686. On September 10, 1674, Verbiest was given the pertinent order:

> The emperor sent orders to the Board of War: "When Our Grand Army marches to suppress the rebels, it will need firearms very badly. We order Nan Huairen, the Director of the Imperial Board of Astronomy, to cast light but effective cannons, convenient for transportation[8].

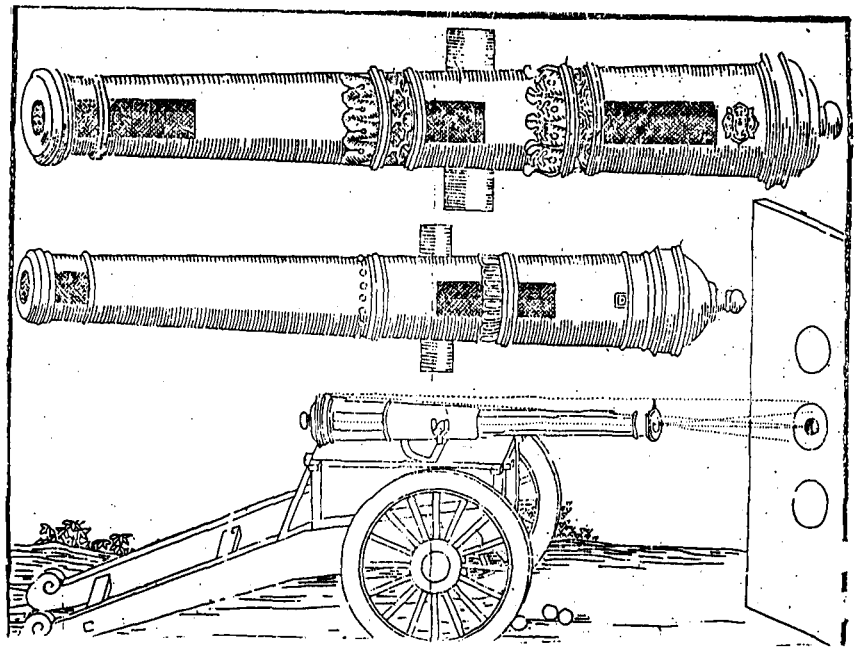
Everything leads us to believe that the cannons now in *Castel Sant'Angelo* are these "light but effective" cannons, thus suitable for transportation from Beijing to the northernmost point of the Amur. The casting of all the cannons in this first series must have been done by 1682. Those at *Castel Sant'Angelo*, in fact, carry this date, when Verbiest received this solemn encomium for his work:

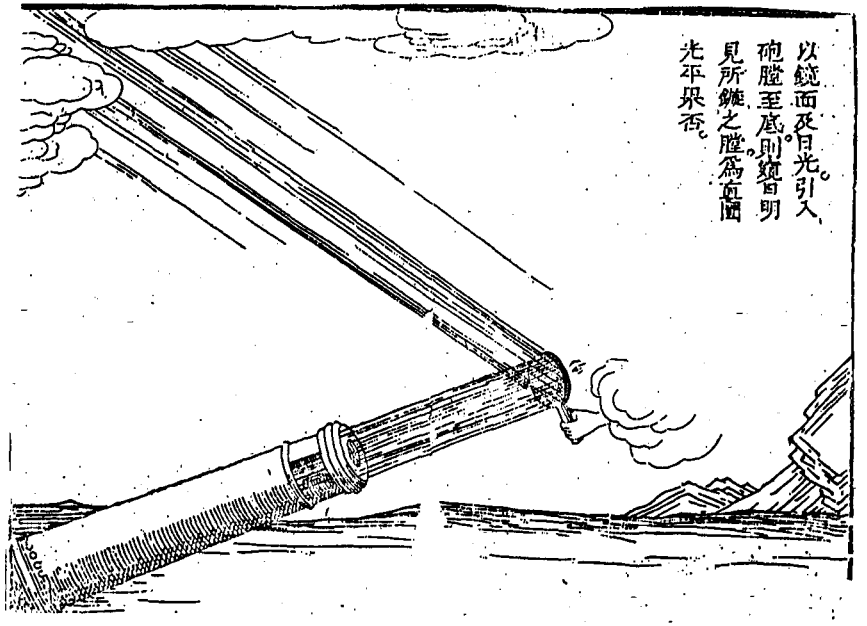
> An additional title of junior vice-president of the Board of Works was conferred upon Nan Huairen, Director of the Imperial Board of Astronomy, Supervisor of the Administration of Calendar-calculation and Commissioner of the Office of Transmission (*tongzheng shisi*). He was thus promoted because the cannons, whose casting he had directed, were good and strong[9].

The *Museo del Genio* cannons and those found in other European museums, however, were cast according to instructions left by Verbiest. Indeed it has come to light that the Jesuit composed a small work in Chinese on the casting and use of western cannons, but no copy of it has been found to date.

8 *Kangxi shilu*, ch. 49, p. 6b, quoted in the translation of Fu Lo-shu, *A Documentary Chronicle of Sino-Western Relations (1644-1820)* (Tucson, 1966), 1:48.

9 *Kangxi shilu*, ch. 102, p. 3b, Fu Lo-shu, *op. cit.*, p. 58.





Ill. 48 and 49: Two pages from Verbiest's *Shenwei tushuo*
ARSI (Rome), Jap. Sin. II, 67 III. Reproduced with the kind permission of the late Father E. Lamalle, to whom this paper is dedicated.

Thus, even its title remained unknown for a long time[10]. All we have by way of evidence, is an observation of Fu Lo-shu, in a note saying that, "Verbiest, who had cast 440 cannons for the Qing government, wrote a book on how to cast cannons, entitled the *Shenwu tushuo*"[11]. This author, however, does not give us, in this case, the characters, which are an essential condition for identifying a Chinese title, so that any affirmation remains unproven.

During my research in this direction, I have analyzed numerous reports from Verbiest to the Manchu emperor, collected in booklets entitled *Xichao ding'an* in the *Biblioteca Nazionale* in Rome[12], the *Biblioteca Apostolica Vaticana*[13] and in the *Archivum Romanum Societatis Jesu* (ARSI)[14]. In the ARSI collection my researches met with success in that a report of Verbiest to the throne reads thus:

> *Nan Huairen jinzou wei jincheng shenwei tushuo qi zhun liu chuan ...*
> 南懷仁謹奏爲進呈神威圖說氣准留傳
> Nan Huairen has drawn up a reverent report to the throne, presenting the *Shenwei tushuo* ...

Thereafter, this phrase is repeated in a document of the Ministry of the Interior[15]:

> *Nan Huairen xian zhupao erbai sanshi er wei you shenweipao erbai sishi wei.*
> 南懷仁先鑄砲二百三十二位又神威砲二百四十位
> Nan Huairen, in the past, cast 232 cannons, and later, 240 *shenwei* cannons.

It is evident, then, from the above-mentioned report, that *shenwei* is the abbreviation of *shenweipao*, i.e. "wonderful, terrible cannon," also known by the Manchu name *Ferguwecuke horonggo boo*[16]. The title of

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10 Cf. Pfister, *Notices*, p. 359: "Je n'ai pas rencontré le titre chinois. Il renferme 44 feuilles de figures nécessaires à l'intelligence de cet art et des instruments propres à pointer les canons;" see also Blondeau, *Mandarijn*, p. 499: "Er is nog geen enkel eksemplaar van dit werk teruggevonden zodat de Chinese titel ontbreekt." This Chinese title, but without sources, was given by Zhang Li and Liu Jiantang in their book *Zhongguo jiao'an shi* (Chengdu, 1987), p. 103.

11 Fu Lo-shu, *op. cit.*, 2:464, N. 83.

12 "Sala manoscritti", n° 72.C.530.

13 *Borgia Cinese*, 350, 27.

14 Folder *Jap.-Sin. II*, 72, 73, 67/3, 67/5.

15 Cf. p. 179a, and on pp. 183a and 184a-b of the same collection, i.e. copies of original documents not preserved.

16 *Wuti qingwenjian* (Tamura Jitsuzô, Imanishi Shunjû and Satô Hisashi, eds.),

Verbiest's work on the casting of cannons is, therefore, *Shenwei tushuo* (and not *Shenwu tushuo*, as Lo-shu Fu thought): "Explanations and Illustrations (of the cannon named) Wonderful (and) Terrible." Since the above-mentioned report is dated the tenth day of the fourth month of the twenty-first year of Kangxi, i.e. May 16, 1682, we can deduce that the work was finished, and therefore presented to the throne, in the early months of 1682. As has been written above, in the same period (May 23, 1682) Verbiest asked the emperor for a name to be engraved on the breech. The work itself has not yet been found but, in an ARSI folder (*Jap.-Sin. II* 72, 73, 67/3, 67/5), there are, along with Verbiest's reports, two contemporary illustrations (here reproduced) on the use of cannons and, in all probability they are the only evidence to be found to date of that work of Verbiest entitled: *Shenwei tushuo*.

Conclusion

At present, seventeen cannons cast by Verbiest are found in some European museums as can be seen from the following table. All cannons, except those of the first series (1682, *Castel Sant'Angelo*) and those of London (second series, 1689), are characterized by beautiful, different ornamentations, but their inscriptions are identical in Manchu and Chinese. A difference exists only in their ballistic data.

2 vols. (Kyoto, 1966-1968), 1:n° 17418.

Table 3

Verbiest's Cannons in European Museums

Place	Year of casting	Powder	Iron ball	Rear-sight
FIRST SERIES				
Rome, Castel Sant'Angelo Rome, Castel Sant'Angelo Rome, Castel Sant'Angelo	1682 1682 1682			
SECOND SERIES				
Rome, Arma del Genio (*)	1689	6 gin 8 yan	13 gin	8 fun 9 li
Rome, Arma del Genio (*)	1689	6 gin 8 yan	13 gin	8 fun 2 li
Rome, Arma del Genio (*)	1689	6 gin 8 yan	13 gin	8 fun 2 li
Rome, Arma del Genio (*)	1689	6 gin 8 yan	13 gin	8 fun 2 li
Berlin	1689	10 gin	20 gin	9 fun 9 li
Berlin	1689	10 gin	20 gin	9 fun 9 li
Ingolstadt	1689	6 gin 8 yan	13 gin	9 fun 8 li
Coburg	1689	5 gin	10 gin	9 fun 8 li
London	1689			
London	1689			
Vienna	1689	6 gin 8 yan	13 gin	11 fun
Vienna	1689	5 gin	10 gin	8 fun 2 li
Budapest	1689	6 gin 8 yan	13 gin	9 fun 1 li
Budapest	1689	5 gin	10 gin	1 cun

(*) Photos in F. Bortone, S.J., *I gesuiti alla corte di Pechino* (Roma, 1969), between pp. 128-129.

FERDINAND VERBIEST AND THE CASTING OF CANNONS IN THE QING DYNASTY

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Shu Liguang graduated in 1963 from the Department of Mechanics in Wuhan Engineering Institute. At present he is a senior engineer of Beijing Fork Lift Truck Foundry. From 1987 to 1988, he participated in making the replica of the Celestial Globe of Verbiest.

Ferdinand Verbiest was born in Belgium on October 9, 1623[1]. His Chinese name was Nan Huairen, his poetic name Xun Qing[2], and his courtesy name Dun Bo. He was baptized very young and was determined to devote all his life to God. He did a lot of scientific research, especially in the field of astronomy[3]. In 1657, together with the Italian missionary Martino Martini (Wei Kuangguo), he left for China. Having reached China in 1659, he at first did some missionary work in Shaanxi province. Already in 1660 he was ordered to come to Beijing as an assistant to Johann Adam Schall von Bell, the German missionary who was in charge of the Imperial Astronomy Board[4]. Later, in 1668, he was asked to treat personally the affairs of the Board. A year later, because he had made an accurate calculation of the calendar, he was promoted vice-president of the Board[5]. In 1674 he was appointed minister of the *taichang si*, the administration of the affairs of the court, for having made astronomical instruments. Based upon a

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1 Xu Zongze, *Ming Qing jian Yesu huishi yizhu tiyao* (An Annotated Bibliography of Works Written or Translated by Jesuits during the Ming and Qing Dynasties), p. 390.

2 *Cihai*, vol. *zi*, 1980, p. 479.

3 Xu Risheng and An Duo, *Nan xiansheng*, p. 1.

4 Xu Zongze, *op. cit.*, p. 390.

5 Yin Luanzhang, *Qing jian*, p. 192.

calendar list for two hundred years drawn up by Schall, Verbiest compiled in 1678 the calendar of the Kangxi reign, the *Kangxi yongnian lifa* (32 vols.). He was then granted the new title of Head of the Office of Transmission, *tongzheng shisi*. In 1682 he was finally appointed head of the Board of Works, due to his brilliant achievement in casting cannons. When he died in Beijing on January 28, 1688, the emperor himself wrote the funeral oration and the inscription for the tablet[6]. Verbiest was even granted the posthumous title of *qinmin*, meaning "diligent and intelligent." The emperor's uncle and many other ministers were sent as part of a large ceremony in honor of Verbiest at his tomb.

Among the more than a thousand missionaries of the past four hundred years, Verbiest was the only one to be granted a posthumous title of honor[7]. One of the reasons for conferring this title lies without doubt in Verbiest's role in the casting of cannons during the Kangxi reign. The Kangxi emperor even said after his death: "Since the year of the rebellion of Wu Sangui had started, Verbiest realized a very important military exploit by casting cannons"[8]. Why did Nan Huairen, as a missionary, assist in the casting of cannons? How many and what type of cannons were cast? What were the characteristics of these cannons? How important is Verbiest's contribution to the history of cannon-casting in ancient China? All these questions will be dealt with in the following essay, in order to clarify the facts of Verbiest's cannon-casting.

I.
The Historical Background to Verbiest's Cannon-Casting

In 1673 Wu Sangui, who was in charge of the garrison of Yunnan province, rose in rebellion with the purpose of disrupting the vast Chinese empire. Geng Jingzhong, in charge of the Fujian garrison, and Shang Zhixin, son of Shang Kexi, who was in charge of the Guangdong garrison, as well as some other Han generals who had good relations with Wu Sangui, answered his call to rebellion. Half of China's territory was thus swept with warfare. In Chinese history this period is called "the Rebellion of the Three Feudatories."

Having been informed of the rebellion, the emperor decided to crush

6 Nan Huairen, *Xichao ding'an*.

7 Fang Hao, *Zhongguo tianzhujiaoshi renwu zhuan*, vol. 2, p. 164.

8 Nan Huairen, *op. cit.*, s.n.

it. Elite troops of the Qing army were sent to Jingzhou to cut off the north-south route from the rebellious troops. At the same time Qing troops were sent to Jiangxi province to prevent a possible reunification of Wu's and Geng's rebellious armies. The army stationed in the south of the Yangzi River was reinforced to protect the financial resources located in the southeast. Due to all these measures temporary stability was gained. The emperor, however, was still deeply worried that only a military confrontation between the Qing dynasty and the rebellious army would enable the Qing army to penetrate the battlefields. The reason was that the rebel troops consisted of elite troops of the Qing army. The strongest troops of the rebellions were those of Wu Sangui, who, stationed in Yunnan province, had trained his men and prepared armaments for more than ten years[9]. The regions occupied by the rebellious armies were mountainous, carved by rivers and inconvenient for transportation, and therefore extremely easy to defend and hard to attack.

Facing the facts, the emperor realized that the repression of the rebellion would require considerable effort to improve the artillery. The Qing army was particularly in need of mobile and nimble cannons, easy to be transported along mountains and across rivers without detaining the troops[10]. To meet this urgent need, the emperor ordered the Ministry of Defence to ask Verbiest to take part in the casting of light cannons[11].

II.
Verbiest's Important Achievements in the Casting of Cannons

Of the total 905 cannons cast during the Kangxi reign, more than half were cast under the supervision of Verbiest. On August 14, 1674 the emperor sent his chamberlain to the residence of Verbiest to deliver the following order: "You are asked to work out a good technique to cast cannons that meet the need of military activities in mountainous areas, carved by rivers"[12]. Carrying out the imperial order, Verbiest took up the task and soon presented a model of a wooden cannon to the emperor for examination. On March 14, 1675 the emperor ordered his minister

9 Wei Yuan, *Shengwu ji*, vol. 2, "Kangxi kanding sanfan ji", part 1, pp. 2-3.

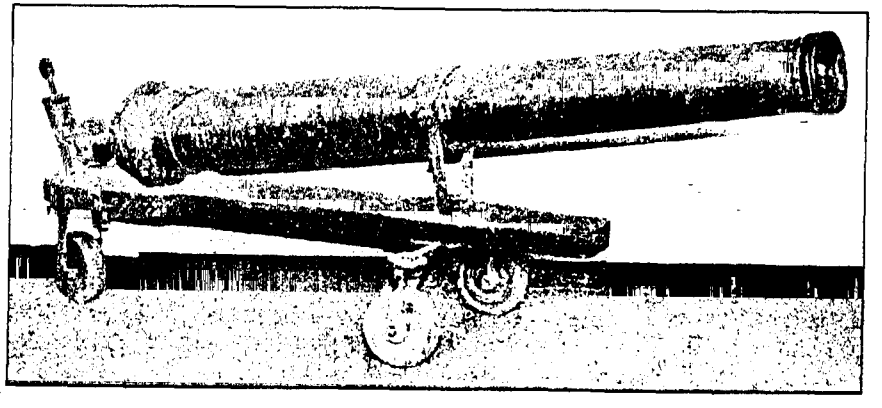
10 *Ibid.*

11 *Qingchao wenxian tongkao*, vol. 194, p. 6587.

12 Nan Huairen, *op. cit.*, p. 166.

of the Imperial Guard, Da Deng, to accompany Verbiest to test the cannons. The testing met with success, in that over a hundred shots were fired without damaging the cannon itself. He was then ordered, on April 19, to cast the cannons following the model. On May 24, the Kangxi emperor was personally present at the final testing. He highly praised the success of Verbiest[13].

According to similar cannons collected in the Palace Museum in Beijing, the wooden cannon was in fact a type of cannon with an iron barrel, the mouth being equipped with a bronze ring, and to the rear part a bronze ball is added. The whole is covered by painted wood (Ill. 50). At the rear of the cannon a fire gate with cover is placed, and the cannon is loaded on a chariot. Behind the bronze ball there is an iron bar with a whorl, which serves to adjust the slant of the barrel. The degree of resistance of a wooden cannon against the pressure of the shot is said to be not as strong as that of bronze and iron cannons.



Ill. 50: Verbiest's wooden cannon
(Palace Museum, Beijing. Photo: courtesy of Shu Liguang).

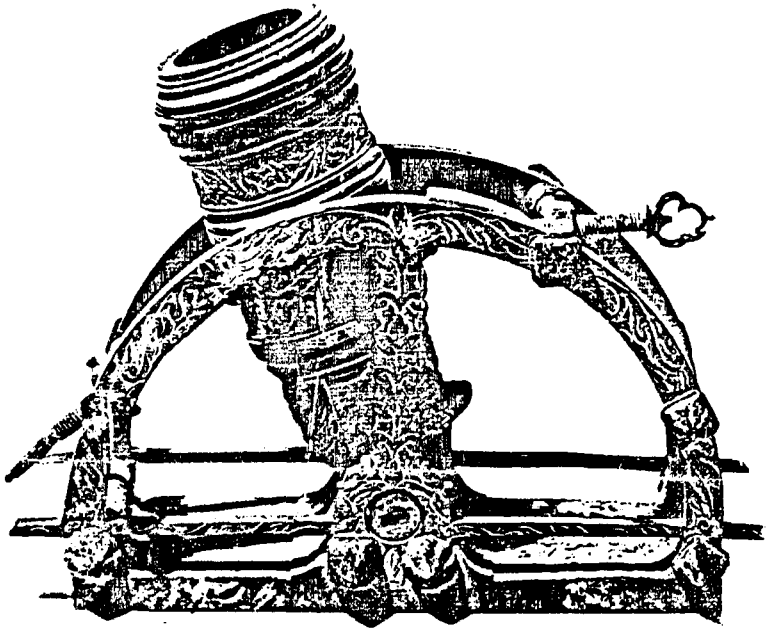
13 *Ibid.*, p. 166.

In November 1675 the commander of the local army of Shaanxi, Wang Fuchen, rose in rebellion, thus menacing Shanxi and Gansu. The Dutch cannons, imported in 1604 from Holland, were much needed to put down Wang's rebellion. Verbiest and his workers had cast twenty of these Dutch cannons within only twenty-eight days[14]. They were the most powerful cannons of that time. Also in November Prince An Yuele, who was preparing a counterattack from Jiangxi against the rebellions in Hunan, sent a letter to the emperor, stating: "No military base can be broken down without the Dutch cannons." Later he set forth another demand: "The Dutch cannons are too heavy to be transported from Guangdong to here. We therefore would like to have twenty light cannons, which are easier to move in our conquest of the rebellions." The emperor replied: "The cannons cast by Verbiest will be sent to the camp of Prince An in Jiangxi in the amount asked for"[15].

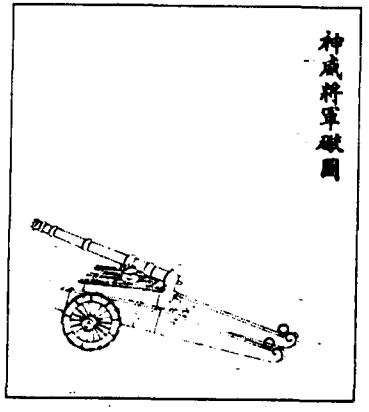
In the first month of 1676 Verbiest was ordered to cast some more Dutch cannons. In March he was asked to test two cannons at Haizi (Nanyuan, Beijing). The emperor himself attended the testing of the cannons. At a banquet, he praised Verbiest's work by awarding him with money[16]. From 1674 to 1676, Verbiest made 132 wooden cannons and Dutch cannons to put down the rebellions. In 1677 the emperor sent the Dutch cannons cast by Verbiest to the troops of Prince An[17]. At the beginning of 1679 government troops reconquered Yuezhou and, consequently, Hunan was generally under control. In August, the emperor prepared his army for the conquest of Taiwan province. All twenty cannons therefore were ordered to be transported from Guangdong to Fujian, because "They are powerful, light, and easy to move"[18].

In 1680 the rebellion of the three princes was crushed with success, and the Kangxi emperor, who was determined to unify the whole of China, began to pay close attention to the improvement of artillery. He ordered the old and damaged bronze cannons in Zhili to be collected, melted down, and cast into new cannons by Verbiest. All told 320

14 *Ibid.*, p. 181.
15 *Qing shengzu shilu*, 58:8.
16 Nan Huairen, *op. cit.*, p. 162.
17 *Qing shengzu shilu*, 66:13.
18 *Ibid.*, 83:1.



Ill. 51: Design of Verbiest's cannon presented to the emperor (Palace Museum, Beijing. Photo: courtesy of Shu Liguang).



Ill. 52: The *shenwei* cannon (*Qinding da Qing huidian tu wubei*, vol. 98).

cannons were planned to be cast, so that each section of the bannermen (consisting of eight sections) would receive forty cannons. On January 23, 1681 Verbiest tested a new type of cannon in Qinghe (Beijing). The emperor once more personally attended the testing, and pointed out that the principle of aiming was based on aligning the sights and the target. Verbiest was asked to do another experiment with his newly-made cannon in Yuqianshan to show the technique of alignment. On August 11, another 240 cannons, named *shenwei*, were cast under the supervision of Verbiest. The emperor then ordered Verbiest to carry out an experiment in the presence of the head of the Board of Works, Dang Guli, at the cannon site Lugouqiao. At the same time many soldiers were sent to attend this experiment, so that they could learn more about the technique of alignment. During a training period of three months (August 16 - November 14), a total of 21,600 shots were fired by 240 soldiers. The manoeuvre held on October 19 at the Lugouqiao cannon site, and attended by the emperor and his princes, was successful. The emperor said: "The cannons that you have cast have proved to be useful in Hunan, Guangdong, Shanxi and Jiangxi in the past years. Up to now I have not seen such an accuracy shown by cannons ever before." Having said this, he offered Verbiest his own sable coat as a gift of honor[19].

At the beginning of 1682 the Qing government turned its attention to the northeast border and prepared military actions to drive away Russian aggressors. In 1683 a meeting of the princes in charge of the administration was held to inspect the reserve of old cannons cast at the end of the Ming dynasty and at the beginning of the Qing dynasty. They planned to cast fifty-three new cannons to bring the total amount of cannons to eighty, so that ten cannons could be distributed to each section of the mandarin troops[20]. All these cannons were cast by Verbiest with the exception of a kind of 500 kg. bronze cannon ordered in 1687.

On July 28, 1686, Chancellor Zhao Chang delivered an order of the emperor to Verbiest which said: "Verbiest is ordered him to design a type of cannon, that is able to shoot 30 *jin* of cannonballs each time, and that is loaded on a chariot and attached to the bottom by a plate"[21]. Verbiest soon finished his design and presented it to the emperor through Chancellor Zhao (Ill. 51). The emperor examined the design

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19 Nan Huairen, *op. cit.*, pp. 169-170.

20 Xu Risheng, *op. cit.*, p. 3.

21 Nan Huairen, *op. cit.*, s.n.

and ordered to cast a model of it, as well as twelve or fifteen cannonballs. Verbiest was also asked to measure the distance of different degrees of slant, and of the time the cannonball took to hit its target[22]. This type of cannon, called *chongtian pao* and preserved in the Palace Museum of Beijing, is like a trench mortar with a large barrel. The cannon looks like an erected bell, injuring the enemy with a power through a sharply curved ballistic, just the same as a modern trench mortar does. It is loaded on a four-wheeled chariot, and differs from the other cannons in the barrel, which clearly consists of two parts: the muzzle and the bore. The cannon is put into operation by filling the bore with cannon powder, some wooden chips, and a small amount of moist soil. The cannonball is then put on the powder in the bore. The ball should be covered with powder, and the mouth of the barrel with moist soil, in order to avoid sparks. It is necessary to light the fuse of the cannonball first, and then quickly the fuse of the bore. The advantage - and at the same time, the strongest point of the cannon - is that the enemy is injured by the chips of the exploded cannonball[23].

Towards the end of his life Verbiest, having the title of engineer, cast sixty-one cannons named *wuchengyonggu*, and eighty cannons named *shengong*[24]. According to the *Xichao ding'an* and the *Qingchao wenxian tongkao* (General reference of documents of the Qing dynasty)[25], Verbiest had cast 513 cannons. In addition to the cannons recorded in the book *Nan xiansheng xingshu* (The Deeds of Master Verbiest), written by Xu Risheng (Tomas Pereira) and An Duo (Antoine Thomas), the total amount of cannons cast by Verbiest reached 566.

Three types of cannons designed by Verbiest are mentioned in the *Qinding da Qing huidian* (Great Qing code approved by the emperor). The code, divided into 1590 volumes, consists partly of drawings and partly of calculations. This important imperial code was edited during the Kangxi reign, and enriched during the next reigns: the Yongzheng, the Qianlong, the Jiaqing, and the Guangxu reigns. These three selected cannons are mentioned in the code as follows: *shenwei*, *wuchengyonggu* and *shengong*.

22 *Ibid.*

23 *Qinding da Qing huidian tu wubei*, vols. 98, 100, s.n.

24 *Qingchao wenxian tongkao*, p. 6588.

25 Cf. vol. 194 chapter about Military Affairs, p. 6588.

The *shenwei* cannon

This cannon is shaped like a bamboo cap of a Chinese peasant. Its mouth is narrow and its rear part is large (Ill. 52). It weighs 400 *jin*, and measures 6.7 *chi* (1 *chi* = 0.31715 m, according to the measurement completed by the author with the authentic ruler preserved in the Palace Museum). The cannon is undecorated, but reinforced by five bronze rings. Near the mouth of the barrel is a gun sight, and the central part of the barrel's body is equipped with two bars. It bears the following inscription in Chinese:

> *Shenwei*, cast in 1681 in the Great Qing dynasty. For every shot 8 or 9 *liang* of cannon powder is used; a lead cannonball weighs 18 *liang*; the height of the gun sight is 00.7 *chi*; the engineer is Verbiest; the supervisors are Fa Bao, Qian Qibu, Tao Santai, Ningguta, Wu Ladai; the craftsmen are Li Wende and Yan Si.

The cannon is carried by a two-wheeled chariot, whose shaft measures 9.5 *chi*. It is undecorated, but a couple of rings are attached to the end of the shafts. The other data are all identical to the golden dragon chariot cannon approved by the emperor[26]. A target at a distance of 100 *gong* (about 200 m.) could be hit with 8 *liang* of cannon powder; at 150 *gong* with 9 *liang* of cannonpowder[27].

In the collection of the Palace Museum in Beijing there is a *shenwei* cannon cast in the Daoguang reign, bearing the following inscription:

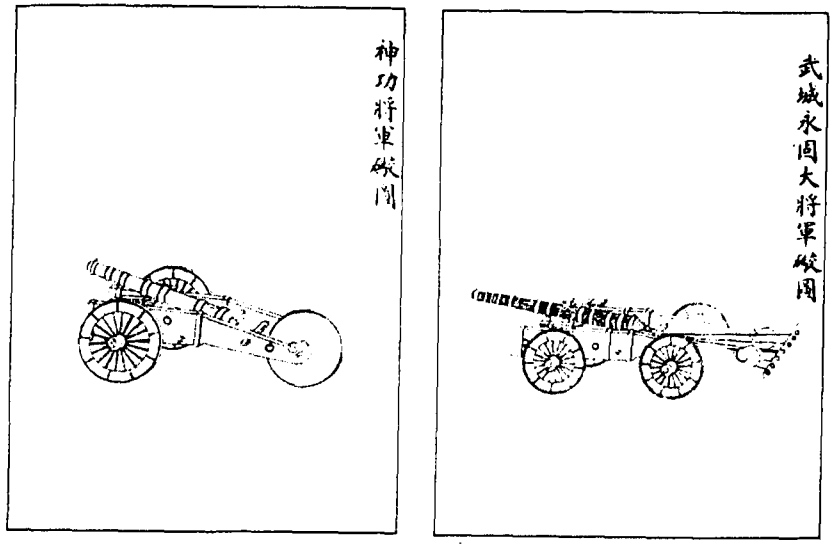
> *Shenwei* cast in the 22nd year of the Daoguang reign of the Great Qing dynasty. For every shot 8 or 9 *liang* of cannonpowder is used; the height of the gun sight is 10.11 *chi*; supervisors are Wu Fu, Guan Heng, Zeng Nian; the technician is Chen Laiming.

The data on this cannon are almost the same as those on the *shenwei* cannon designed by Verbiest, except for the height of the gun sight, which is 0.04 *chi* higher than the one of Verbiest (Ill. 53). Here are the measurements of the *shenwei* cannon cast during the Daoguang reign:

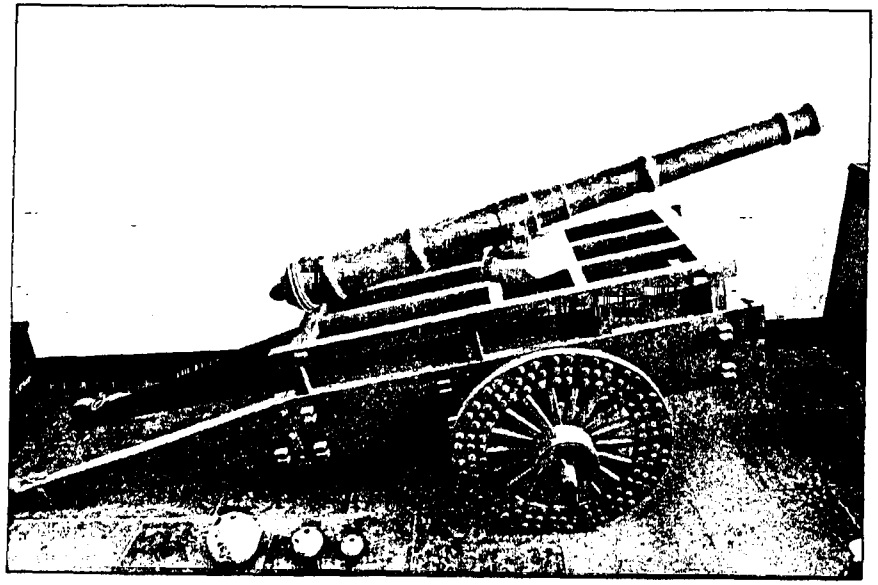
> Length: 213 cm. (= 6.7 *chi* in the Qing dynasty).
> The inner diameter of the barrel: 5.3 cm.
> The outer diameter of the barrel: 10.4 cm.
> The diameter at the end of the firegate: 19.2 cm.
> The length from the firegate to the mouth: 195.5 cm.
> The depth of the barrel: 196 cm.

26 *Qinding da Qing huidian tu wubei*, vol. 100, s.n.

27 *Qinding da Qing huidian shili. Gongbu Zhupao*, 894:1.



Ill. 53: The *shenwei* cannon (*Qinding da Qing huidian tu wubei*, vol. 98).



Ill. 54: The *wuchengyonggu* cannon
(Palace Museum, Beijing. Photo: courtesy of Shu Liguang).

These measurements are close to those of the *shenwei* cannon, described in *Da Qing huidian*[28]. Another proof that the Daoguang cannon is an imitation of Verbiest's cannon is based on a document of the manufacturing section of the Imperial Palace Bureau. During the Daoguang reign a *shenwei* cannon in the city of Qiqihar was to be replaced. The ministry of manufacturing set forth this demand to the emperor. Two months later the emperor replied: "I approve the casting of five cannons, following the model of the *shenwei* cannon of the Xianghuang troops, and by the data given in 'the Collection of the Designs of the Ceremonial Instruments'"[29]. This work was edited in 1759, and the cannon shown in this collection was cast under the supervision of Verbiest in 1681. We may therefore conclude that the *shenwei* cannon cast in the Daoguang reign is, indeed, an imitation of the one cast by Verbiest during the Kangxi reign. The cannon, made of bronze, is fine and beautifully shaped, reinforced by five rings at the mouth of the barrel to increase the resistance of the barrel against the pressure occurring by the explosion. When designing this cannon, Verbiest took into account the movement of the cannonball before it left the barrel, and the alteration of the inner pressure. The rear part is reinforced by two rings to concentrate the pressure of the explosion produced by the burning of the powder, and to prevent the rear part from breaking. The mouth of the barrel is also reinforced by two rings to prevent it from breaking at the moment the cannonball passes. The *shenwei* cannon cast by Verbiest has a record of firing off 300 to 400 shots without causing any damage to the cannon[30]. It is easy to imagine that these cannons were welcomed by the military. At the eve of the Yakesha War in 1683, there were twelve of these cannons in the city of Qiqihar alone[31].

The *wuchengyonggu* cannon

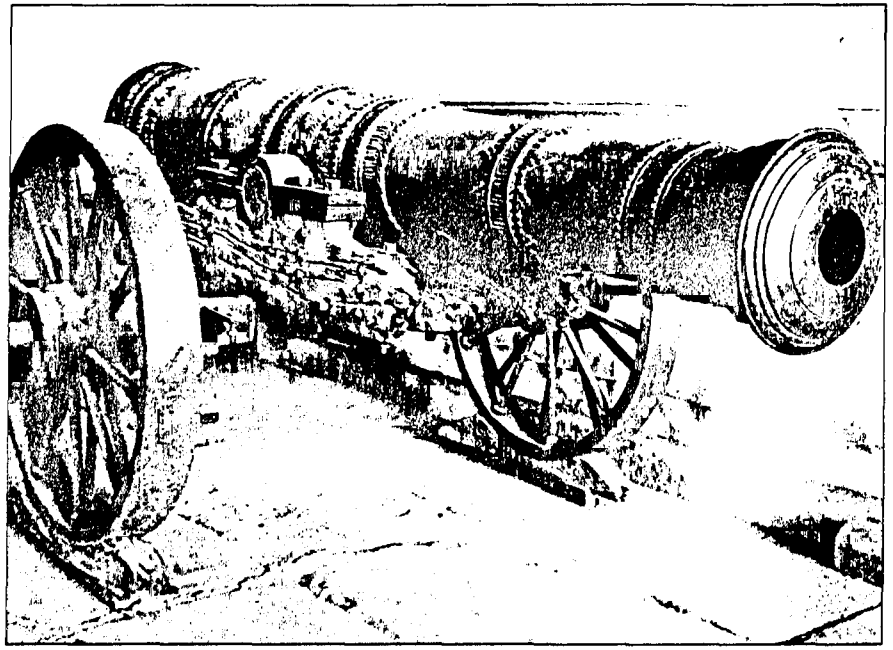
The rear part is a little wider than the mouth of the barrel. It weighs between 3600 and 7000 *jin* (3.5 ton); it measures between 9.6 and 11.1 *chi*. It is beautifully ornamented, and is reinforced by ten rings. The

28 Cf. vol. 100 in the part on armament.

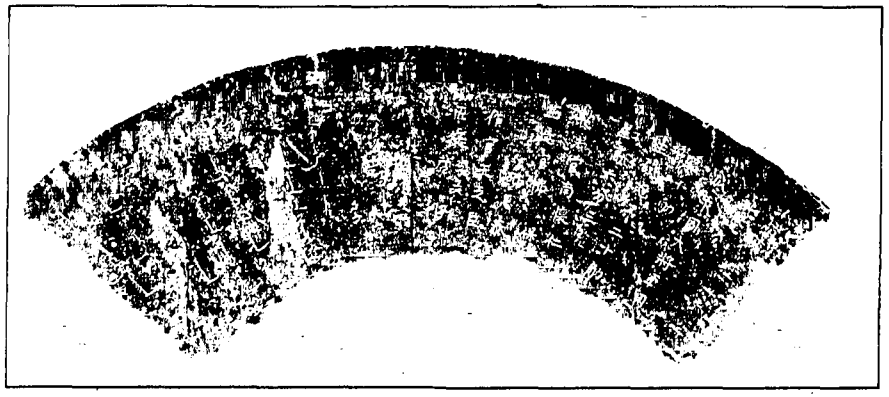
29 *Qing neiwufu Yangxin dian zao banchu ge zuocheng zuohuoji Qingdang*, April 1840, n° 3013, s.n.

30 Nan Huairen, *op. cit.*, p. 168.

31 *Qing neiwufu*, *op. cit.*, s.n.



Ill. 55: The *wuchengyonggu* cannon
(Museum of Chinese History, Beijing. Photo: courtesy of Su Liguang).



Ill. 56: Inscription on the *wuchengyonggu* cannon
(Museum of Chinese History, Beijing. Photo: courtesy of Su Liguang).

cannon sight is near to the mouth of the barrel (Ill. 54). On both sides of the barrel is engraved the name of the cannon, as well as ballistic data:

> *Wuchengyonggu* cannon cast in 1689. For every shot ten *jin* of cannon powder is used; a cannonball weighs twenty *jin*; the height of the cannon sight is 4.9 *fen*; the engineer is Verbiest; supervisors are Fa Bao and Shuo Sitai; the chief of the craftsmen is Wang Zhichen; the craftsmen are Li Wende and Yan Si.

The inscription is in both Manchu and Chinese. For a smaller type of this cannon, five *jin* of cannon powder is necessary, and an iron cannonball of ten *jin*. The cannon is loaded on a four-wheeled chariot; the length of the shaft is fifteen *chi*, reinforced by seven iron rings. The other data are identical to the *shenwei* cannon[32]. In the collection of the Chinese History Museum in Beijing, there is an authentic model of this type of cannon (Ill. 55) bearing the following inscription (Ill. 56):

> *Wuchengyonggu* cannon cast in 1689 in the Great Qing dynasty. For every shot ten *jin* of cannon powder is used; a cannonball weighs twenty *jin*; the height of the cannon sight is 6.3 *fen*; the engineer is Verbiest; the supervisors are Fa Bao and Shuo Sitai; the chief of the craftsmen is Wang Zhichen; the craftsmen are Li Wende and Yan Si.

The only difference between the two inscriptions lies in the height of the cannon sight (the height of the first cannon being 1.4 *fen* smaller than that of the cannon preserved in the History Museum of Beijing). Here are its measurements:

> The outer diameter: 46.15 cm.
> The diameter of the barrel of the rear part: 52.87 cm.
> The diameter of the barrel: 15.5 cm.
> The general length: 362 cm.
> The weight of the cannon: 4 tons.
> The length of the barrel: 330 cm.
> The diameter of the wheel of the chariot: 120 cm.
> The width of the wheel: 15 cm.

The remaining part of the chariot has been proved to be the rear part. The model was preserved in the court of the Embassy of Germany, located in Dongjiaominxiang Street in Beijing. In 1946 it was collected by the Museum of History, the present Museum of Chinese History.

The casting technique of this huge and beautifully ornamented cannon, which bears the name of Verbiest, proved to be of the highest level

32 *Qinding da Qing huidian tu*, *op. cit.*, s.n.

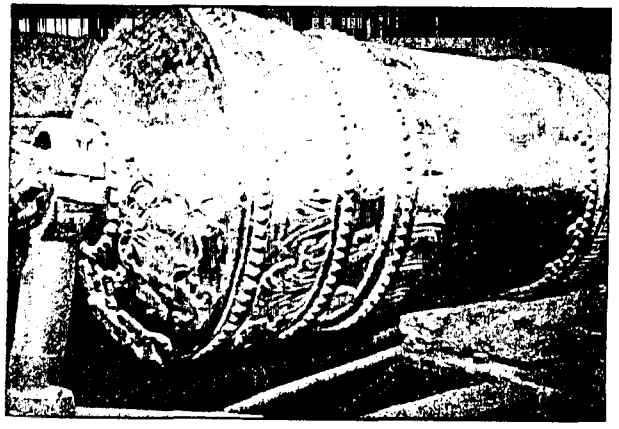
in the history of ancient China's cannon-casting. This combination of Verbiest's knowledge and Chinese craftsmanship is a historical testimony of the scientific and technological exchange between China and the West. It has been selected to belong to the most important national collection of antique objects.

The *shengong* cannon

The mouth of the barrel is a little narrower than the rear part, which is shaped in the form of a bamboo cap of a peasant in the south of China (Ill. 57). Its weight is 1000 *jin*, and its length is seven *chi*. It is not ornamented, but has five rings as a means of reinforcement. The cannon sight is near to the mouth of the barrel, and bears the following inscription in Chinese:

> *Shengong* cannon cast in 1689 in the Great Qing. For every shot one *jin* twelve *liang* of cannon powder is used; a cannonball weighs 3.5 *jin*; the height of the cannon sight is 4 *fen*; the engineer is Verbiest; the supervisors are Fa Bao and Shuo Sitai; the chief of the craftsmen is Wang Zhichen; the craftsmen are Li Wende and Yan Si.

The cannon (Ill. 54, left side) is loaded on a three-wheeled chariot, supported by iron chains, and the length of the shaft, between which a board is located, is 10.2 *chi*. The other data are identical to those of the *shenweiwudi* cannon[33].



Ill. 57: The *shengong* cannon
(Museum of Chinese History, Beijing. Photo: courtesy of Su Liguang).

33 *Ibid.*

All of these three cannons belong to the type of front loaded cannons, although differences among them do occur. The cannon powder and the cannonballs are put into the cannon directly through the mouth of the barrel and lit by a fuse. The cannons were always cast in bronze. Towards and under the central part of the barrel are situated two axles which support, balance and adjust the slant, and at the same time enlarge the cannon's power and its movability. From the inscriptions we learn that all these cannons were cast by the craftsman Li Wende and his co-workers. The author also found his name in an inscription on a *weiyuan* cannon cast in 1690 and in 1718, and preserved in the Palace Museum in Beijing. Besides the name of Li appearing in the inscription, the name of the cannon-casting factory in Jingshan, Beijing, where Li worked, was also mentioned. We therefore are convinced that these cannons were all cast in this factory.

III.
Verbiest's Important Work on Cannons: *Shenwei tushuo*

On January 27, 1682 Verbiest dedicated his book *Shenwei tushuo* to the emperor. This book, described by Verbiest in another work entitled *Xichao ding'an*, explains the theory and the method of firing cannons. The work is divided into twenty-six subheads and contains forty-four figures, as well as some formulas of calculations. Dr. John Lee pointed out in his famous book *A History of Science and Technology in China*[34], that Verbiest's work seemed to have been destroyed, for no trace at all could be found of it, neither in China nor anywhere else in the world. The only reference we have is the book *Xing xing zhi litui* (Ratiocination of Figures and Characters), written by Verbiest himself in 1683, twenty-one pages long and divided into sixteen small subheads. In it Verbiest set forth his method of correcting the slant of the cannonball by bringing the sights in line with the target in order to fix the position of the barrel. Other works, such as *Paodan gaodu biao* (A list of the height of the cannonballs), *Paodan qizhi suo xing qingke miao wei zhi biao* (A comparative list of distances, heights and the time it takes a cannonball to cross them), and *Paodan yuandu bili biao* (The ratio of the cannonball and its distance), *Tuizhong wu dao yuanjin gaodi zhi yi* (An Instrument Describing the Trajectories and Ballistics of Cannon-

34 John Lee, *A History of Science and Technology in China*, vol. 7, pp. 398, 598.

balls), and *Sanlu fa* (The Method of Three Ratios), all offered important research material for Verbiest's *Zhunpao zhi fa* (Methods for Sighting).

The *Zhunpao zhi fa* is composed of two kinds of contents. A greater accuracy of shooting became possible by correcting the slant of the cannonball by means of aligning the sights and the target. The front cannon sight, called the "star," is in alignment with the backsight, called the *dou*. The frontsight is attached to the ring near the mouth of the barrel, and the backsight, to the rear part of the barrel[35]. Restricted by the time in which Verbiest lived, it was very difficult to cast barrels of an equal thickness. If the left side of the barrel would be thicker and heavier than the right side, the cannonball would surely turn to the left[36]. The cannons should therefore be corrected before being delivered, by simply adjusting the position of the sights. The position is corrected as follows: first attach a couple of sights with wax to the barrel, then aim and fire at the target[37]. Measure the distance between the ballistic point and the target, thus modifying the position of the sights according to the measurements[38]. The position of the sights can also be corrected by using the method of the three ratios, e.g., take a hundred *chi* from the backsight to the target as the first ratio, the wrong rate (ranging from four *chi* left from the target) of the ballistic point as ratio 2, and a distance of six *chi* between the sights as ratio 3, then calculate the correct position using the formula of Verbiest given in his *Sanlu fa* (Method of Three Ratios)[39]:

$$\frac{\text{ratio 2 x ratio 3}}{\text{ratio 1}}$$

The result is the correct position of the sight. Move the cannon sight in wax according to the result mentioned above to the left side, and try again in a different site. The theory is explained in his work *Jihe yuanben* (The Theory of Geometry), exercise 4 and 2, volume 6[40].

In order to aim at a further target (within the maximum range of shooting), under the condition that the weight of the cannonball, as well

35 Nan Huairen, *Xing xing zhi litui* (Ratiocination on Figures and Characters), p. 19.

36 *Ibid.*, p. 18.

37 *Ibid.*, pp. 18-19.

38 *Ibid.*, p. 20.

39 *Ibid.*, p. 20.

40 *Ibid.*, p. 19.

as the weight of the cannon powder and the ballistic time of the cannonball are constant, and the degree of the slant is forty-five, the distance from the point of impact can then either be found by checking the list drawn by Verbiest: *Paodan qizhi suo xing qingke miao wei zhi biao* (A comparative list of distances and the time it takes cannonballs to cross them), or by calculating according to the formula of the *Sanlu fa* (Method of three ratios), ranging from the degree of the slant 1-45, or 45-89. In practice, the soldiers could easily obtain a greater accuracy when they knew the distance between the target and the position of the cannon and the slant of the cannon. The slant of the cannon could be adjusted with an instrument invented by Verbiest. Undoubtedly *Paodan gaodu biao* (A list of the height of cannonballs) and *Paodan qizhi suo xing qingke miao wei zhi biao* must be familiar.

IV.
The Position of Verbiest in Chinese History and the Development of the Cannons

Gunpowder was invented in China before 808 A.D. At the beginning of the tenth century gunpowder had already been used for military purposes. Soon after the casting of the first primitive gun (*tuhuoqiang*) in 1259, which could fire bullets, metal gun barrels appeared. In the Song dynasty burning firearms and explosive firearms, as well as barrel shaped shooting weapons, appeared. Even primitive missiles pushed by a jet with burning powder came into use. The power of firearms had been raised greatly by using bronze to cast barrels. In this way, the use of heavier cannonballs and more powder became possible. In the Yuan and Ming dynasties firearms (*huotong*) were cast and used in large quantities.

Chinese gunpowder and firearms found their way to European countries via the Arabic countries in the twelfth and thirteenth centuries. Guns developed much faster in Europe than in China, but western firearms and casting techniques were introduced in China only from the beginning of the sixteenth century. Among them, the French mechanic gun, the *niaotong* (bird shooting gun), and the Dutch cannon had known a great influence. In the last years of the Ming dynasty Xu Guangqi and Li Zhizao had been ordered by the government to cast a large quantity of Dutch cannons to be used in the war against the Houjin invaders. The introduction of western firearms and casting techniques had pushed the development of the technology of cannon-casting and the military

industry to a high level at the end of the Ming dynasty. The latest development of early Chinese cannons was during the Qing dynasty. The Qing cannon-casting industry passed successively the stages of creation (1616-1661), growth (1662-1795), and decay (after 1795). By the middle of the nineteenth century early Chinese cannons had all been replaced by modern ones.

The casting of ancient cannons reached its peak in the Kangxi reign. In meeting the need to crush the rebellion, as well as to resist the invaders and to unify the country, cannons had been cast on a large scale. Not only was the amount of cast cannons enormous, but also the level of casting techniques, the variety of the cannons, and the quality of the cannons had been proved to the utmost. Over a period of fifty years of the Kangxi reign, 905 cannons had been cast[41]. More than half of them were designed by, and cast under the supervision of Verbiest. Their perfect technique, their beautiful shape, and their solid body were never to be equalled by the cannons of later reigns. The most impressive cannon preserved is the *wuchengyonggu* cannon, which bears the engraved name of Verbiest. Of these 905 cannons, only 201 cannons weigh more than 250 kg., compared to the lighter cannons, which weigh less than 250 kg. Of the 704 light cannons, one-third were designed by Verbiest and cast under his supervision. The data above show that Verbiest was creatively devoted to the casting of low-weight and easily transportable cannons, thus meeting the practical needs of warfare of the Qing dynasty.

Besides having contributed to the improvement of the Qing cannons, Verbiest also carried out systematic research, and wrote various essays on methods for sighting. The influence of his book, *Shenwei tushuo*, was also proved by an investigation done by the author of the files of the manufacturing section of the imperial court, in which a commentary on aiming and aligning said the following: "The keys to accurate shooting are the slant of the cannon and the right position of sights; only then does the occurrence of mistakes become impossible." These words reflect the influence of Verbiest's writings[42]. We can say, therefore, that Verbiest was beyond doubt a very important figure in the history of the development of ancient China's cannons, and also in the history of the transfer of western science and technology to China.

41 *Qingchao wenxian tongkao*, pp. 6587-6589.

42 *Qing neiwufu Yangxin dian zao banchu ge zuocheng zuohuoji Qingdang, qiangpao chu* (September 1767), n° 3284, s.n.

BEIJING PRECURSOR[1]

J. DITLEV SCHEEL (1918-1992)

Jorgen Ditlev Scheel entered the Foreign Service of Denmark in 1943 and was posted to Bern and London. Between 1961 and 1979 he was consul general in Canada and ambassador in Tunisia, Algeria, Libya, Colombia, Ecuador, Panama, Costa Rica and Nicaragua. He contributed to general and specialized publications on automotive history and automobile technology. Since 1988 he was a contributing editor of "Automobile Quarterly." He died on February 14, 1992 in Green Valley, Ontario, Canada.

The first, documented, automotive machine was built and run in Beijing 300 years ago. Great care has been taken with the phrasing of this statement, and the choice of words is stressed intentionally.

First is defined by reliable dictionaries as "being number one in a countable series; earliest in time." *Documented* should exclude all the splendid, fiery chariots and similar conveyances met in myths and prophecies, secular or religious. Countless inventive tales in folklore or literature are also left out. *Automotive* means, according to Webster's[2], "containing within itself the means of propulsion." That excludes machines propelled by outside forces such as wind, beasts of burden, or hidden muscular power. *Machine*, a word of joint Greek (*mechane*) and Latin (*machina*) roots, originally described "a ... constructed thing ... conveyance, vehicle ... and assemblage of parts ... that transmit forces, motion ... one to another in some pre-determined manner."

1 Excerpts of my 1984 monograph on the Verbiest vehicle were first published in "Precursor from Peking. Meet Ferdinand Verbiest, Seventeenth-century Missionary, Diplomat, Astronomer and Automotive Engineer", *Automobile Quarterly*, 23:3 (1985), 268-275.

2 *Webster's Third New International Dictionary* (Boston, 1966), s.v. "automotive."

紀念南懷仁

逝世三百周年學術會議

一九八八年
九月十二日

MONUMENTA SERICA MONOGRAPH SERIES
XXX

Ferdinand Verbiest
(1623-1688)
Jesuit Missionary, Scientist, Engineer and Diplomat

Edited by
JOHN W. WITEK, S.J.

Jointly published by
Institut Monumenta Serica, Sankt Augustin
and
Ferdinand Verbiest Foundation, Leuven

Steyler Verlag ■ Nettetal
1994

Sumptibus Societatis Verbi Divini (S.V.D.)

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

Ferdinand Verbiest : (1623-1688) Jesuit missionary, scientist, engineer and diplomat / jointly publ. by Institut Monumenta Serica, Sankt Augustin and Ferdinand Verbiest Foundation, Leuven. Ed. by John W. Witek. - Nettetal: Steyler Verl., 1994.
(Monumenta Serica Monograph Series; 30)
ISBN 3-8050-0328-5
NE: Witek, John W. [Hrsg.]; Institut Monumenta Serica <Sankt Augustin>; GT

Editorial assistance: CHRISTIANE VANDENBOGAERT (Leuven); BARBARA HOSTER and ROMAN MALEK, S.V.D. (Sankt Augustin)
Set by: Ferdinand Verbiest Foundation (Leuven) and ROMAN MALEK (St. Augustin)
Printed by: Drukkereij Steijl
Distributed by: Steyler Verlag, Postfach 24 60, D-41311 Nettetal, Germany.

ISBN 3-8050-0328-5
ISSN 0179-261X

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ARSI	Archivum Romanum Societatis Jesu (Rome)
BN	Bibliothèque Nationale (Paris)
C.I.C.M.	*Congregatio Immaculati Cordis Mariae*, Scheut
Jap. Sin.	*Japonica-Sinica*, Section ARSI
KH	K'ang-hsi (used with year, month and day)
O.F.M.	*Ordo Fratrum Minorum*, Franciscans
O.P.	*Ordo (Fratrum) Predicatorum*, Dominicans
S.J.	*Societas Jesu*, Jesuits

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