



FIREARMS II. PRODUCTION OF CANNON AND MUSKETS

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It is now known that some fifty cannons were made in Persia between 920/1514 and 930/1523, during the reign of Shah Esmā'īl I (q.v), following an Ottoman model (Bacqué-Grammont, p. 166). By the last quarter of the 16th century, cannon-making was so common that cannons were constructed even on the spot during siege operations (Eskandar Beg, p. 319, Monajjem Yazdī, p. 257). Muskets, with matchlock (*fatīla*) and trigger (*māša*), were very common even before the ascension of Shah 'Abbās I (q.v.; 996-1038/1587-1628), but certainly fewer in number. In 1002/1593, Shah 'Abbās had 15,000 musketeers in Isfahan who fired their muskets simultaneously (*ba māša resānīda*) during a ceremony (Afūšta'ī Naṭanzī, pp. 192, 539). Nonetheless, sources describing the fabrication of these weapons during the Safavid period are rare. The only significant document on cannon-making from that time is a manuscript written by a certain Solaymān, who was a *qūrčī-e meẓrāq* (javelin bearer?) in the Safavid army, and preserved at the Library of the University of Tehran (MS. 2085; facs. ed. in Bayānī). Unfortunately, no Persian text dealing with musket-making is known to us. However there are a few references in travel accounts by various Europeans which shed some light on their manufacture. In the Qajar period, contemporary European techniques of gun-making were



introduced, but older techniques and indigeneous methods were also present.

Cannon-making. The manuscript on cannon-making mentioned above contains four chapters, each divided into sections. The author relies on his own experience, supplemented by what was probably an established method of cannon fabrication. Although his technique of mold-making is totally different from what was known in Europe, as described by Vannoccio Biringuccio (pp. 235-36) or Surirey de Saint Rémy (II, pp. 53-4), whose books were published respectively in 1540 and 1697, there is much similarity in their techniques concerning, for example, patterning or accessories fabrication.

According to this text, every cannon casting needed the preparation of three principal pieces: The mold (*tanūra*), which made the outside jacket; the core, built up of clay on a spindle (*mīl*), which was fixed in the center of the mold in order to create the cannon barrel after its removal; and finally the breech (*sendān*), which closed the mold underneath. Of these, only the breech was made by sand-casting. A wooden pattern was turned on a lathe and forced onto a tub of sand (*darīča-ye rīg*) to imprint its form in it. The breech was made by pouring molten metal into the sand mold.

The preparation of the mold was the most important element in cannon-making. In the incomplete first part of the manuscript, the author discusses the details of making of a wooden pattern (*čub-e qāleb*). On the basis of a manuscript illustration (Plate IV), it appears that an exact measurement was made, probably to determine the places for the projecting parts of the cannon. According to the author, the pattern was made from willow, poplar, or juniper wood and was turned on a lathe (*ḵarrāṭī*). It was partially hollowed out to facilitate burning it later in the process. The trunnions (*bāzū*), which formed the axis on which the cannon would pivot, were fixed to the pattern to complete it. As the author mentions, three different sizes of the pattern could be prepared for large, medium, and small cannons. It is not clear if these different sizes corresponded to what in the literature of the time were called *tūp*, *žarbzan*, and *bādalīj*.

The author then describes the molding process. The first step consisted of the preparation of a special clay of following composition: three parts of fine-grained fire-clay from Naṭanz, two parts of ordinary clay, half a part of ashes, and half a part of sand mixed with dung, goat's hair, and cat-tail (*lū'ī*). To this mixture water was added, and it was trampled for a day. Then a round furnace (*kūra*) was made of brick with an opening at its bottom for feeding the



fire and a hole at the top. One end of the wooden pattern would be fixed in this hole, and the other one in the crossbeam (*sarandāz*) of a gallows-like structure whose upright posts were fixed at each side of the furnace. Then the pattern was molded. The whole mold was made up of smaller molds (*tanūra*), the number of which depended on the length of the cannon, constructed upon each other, one mold a day, to cover the pattern entirely. Then fire was applied to the opening of the furnace in order to burn away the wooden pattern. Next, all the small molds were dismantled one by one from the furnace (Plate V). Finally, the core mold was made. In order to facilitate the molding, an iron rectangular spindle was grooved by filing. The spindle was divided, according to its length, into different sections. Each day a section was molded to the desired caliber of the cannon (Plate VI).

All the small molds were then reassembled in a pit to form the whole mold. The breech and the core were put in place, and the mold had to be reinforced by brickwork all around. One end of a clay conduit (*nāvdān*) was put above the mold, while its other end was placed under the outlet (*rāh-e gošād*) of the melting pot. The mold was then filled with molten material which had the following composition: 100 parts of copper, 10 parts of tin, and 8 parts of brass. After a few days the spindle was taken out of the mold, and the cannon was finished (Plate VII).

Despite the availability of a technical text such as this, the chancellor of Shah Solṭān Ḥosayn (1105-35 /1694-1722) sent a letter to Louis XIV of France requesting several makers of cannons and other firearms (Qā'em-maqāmī, p. 114). During the reign of Nāder Shah (1148-60/1736-47), material and craftsman for gun-making were also summoned to Marv in preparation for a campaign in Central Asia (Marvī, pp. 911-12), but no technical information about this is available. In the Qajar period new techniques of cannon making were introduced from Europe by Prince 'Abbās Mīrzā. The core mold was no longer employed, and the cannon barrel was bored with a boring mill constructed according to European models. The improvement in technical performance was remarkable. If a cannon during Nāder Shah's campaign against the Afghans needed 20 to 30 persons to be loaded and fired and 100 to be carried, the new ones needed only 4 to 5 persons and 4 horses (Donbolī, pp. 133-34). In this period some books on artillery were translated from European languages into Persian (Afšār, pp. 90-91), but they contained little or no information about cannon making (e.g., Māzandarānī).

Musket making. The best description of musket-making is found in the travel



account of Jean Chardin (q.v.), who visited Persia in the second half of the 17th century. Persian muskets, according to him, were all match-locks (Chardin III, p. 558), as at the end of the 16th century when 300 musketeers from Isfahan ignited their matches before attacking the Uzbeks (Eskandar Beg, p. 466). According to Chardin, the barrels of these muskets were heavy, thick, and damascened. The barrel was bored with a boring mill. The breech was welded to the barrel and was not screwed to it. The pan, with grooves in its inside and not bigger than the small fingernail, was solidly fastened to the barrel and possessed no cover. A serpentine (which gripped the match between its two jaws) was lowered with a simple and not carefully filed trigger (Chardin IV, pp. 137-38, cf. Tavernier, p. 319) in order to thrust the glowing end of the match into the pan and fire the priming powder which the pan contained. In the 19th century, Captain Massalski described the manufacture of damascened gun barrels and confirmed that this technique was introduced in Persia two hundred years earlier, therefore roughly at the same time as Chardin's visits to Persia. The damascene steel strips were welded to an iron rod to form the barrel which was then bored, removing this rod completely (Massalski, pp. 305-8).

Damascene (*jowhar-dār*) muskets on the models of Ḥasan Jazāyerī and Mūsā, two Turkish gun-makers, were fabricated at the beginning of the 19th century at Tabrīz (Donbolī, p. 133). These *jazāyerī* muskets were employed in Nāder Shah's army. They were heavy muskets which were fixed on tripods, and the soldiers armed with them were called *jazāyerčīān* (Marvī, p. 1154 and Rīāḥī's note, p. 1205). A group of these soldiers was under the command of Gorgīn Beg Gorjī in 1127/1715 (Ḳātūnābādī, pp. 567-68). These guns were also known to Persians in 1035/1625, although used by Ottomans, and were matchlocks (Eskandar Beg, p. 1052). The so-called Afghan stock, with a slender, curved butt, is also distinguishable in a number of the miniatures in the manuscript of the *Tārīḳ-e jahāngošā-ye nāderī* by Mīrzā Mahdī Astarābādī (q.v.) copied in 1171/1757 (e.g., Astarābādī, p. 299). In the same epoch, a gun-maker of Kermān, Qolī Tofang-sāz, reportedly made muskets with a range of 1500 paces (Wazīrī, pp. 589-90), which seems exaggerated. It is not clear whether these muskets were rifled or not, or if other types of gunlocks were made besides matchlocks. At the beginning of the 19th century, flintlocks were imported from Europe and then were adjusted to the Persian-made muskets (Meen and Tushingham, p. 91). Then different gun production techniques were introduced from Europe. At Tabrīz, the Persian gun-makers fabricated twenty thousand muskets after an English model (Donbolī, p. 133). Later, entire gun



and bullet factories were imported, in 1276/1859 and in 1303/1885 respectively, and installed at Tehran. Guns from these factories were rifled (*kān-dār*) and were produced at a rate of a thousand a month (E'temād-al-Salṭana, *Ma'āter wa'l-āṭār*, p. 99, p. 114; cf. Maḥbūbī Ardakānī, I, pp. 196-208 for more information concerning the development of gun-making in Qajar Persia). Meanwhile, indigeneous experiments and fabrications were continued. A breech-loaded rifle (*tofang-e tah-por*) was devised by Moḥammad Ja'far Astarābādī and offered to Nāṣer-al-Dīn Shah (Maḥbūbī Ardakānī, I, p. 207). In 1323/1905 at Tabrīz, Mašhadī Ja'far Kayyāṭ-bāšī constructed a kind of automatic gun which shot 70 times a minute. Its mechanism was based on that of the shuttle (*mākū*) of a sewing machine (Rīāzī Heravī, p. 161). However, these individual initiatives were not taken seriously, and guns and gun factories continued to be imported.

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Plate IV. Pattern for construction of cannon. After Solaymān Qūrčī, MS Tehran, Ketāb-kāna-ye markazī-e Dāneşgāh-e Tehrān, 2085, f. 1.

Plate V. Furnace and small moulds stacked vertically. After Solaymān Qūrčī.

Plate VI. Spindle and clay covering. After Solaymān Qūrčī.



Plate VII. Furnace, pit, conduit, roller, and measuring instruments used in manufacture of a finished cannon. After Solaymān Qūrčī.