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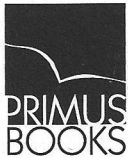

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12

Gunpowder, Firepower and the Portuguese in the Indian Ocean in the Sixteenth Century

Roger Lee de Jesus

A guerra e o comércio nos descobriram o que sabemos do Mundo
—GASPAR BARREIROS, *Chorographia de alguns lugares...*
Em Coimbra: por Joam Aluarez, 1561, fl. 159

SINCE THE OUTSET of the Portuguese presence in the Indian Ocean, military conflict marked the relations with local merchants and rulers. Gaspar Barreiros would state in 1561 that war and commerce were the two factors responsible for the Portuguese knowledge of the world, highlighting these as central values to the Portuguese expansion. The use of military forces for the control of several trade routes and for the defence of certain positions was vital to the King's policy. After the arrival in Lisbon of the *armada* of Pedro Álvares Cabral in 1501, carrying the information that most of the Asian trade was under the control of Muslim merchants, the need for guns and sails[1] came to be considered crucial to guarantee access to the Asian markets.[2] Portuguese ships were superior because of their matchless firepower, which merged the use of artillery with the speed and movements that these vessels were capable of.[3] There is evidence that this kind of weaponry was known in this Asian region even before the advent of the Portuguese but, as Sanjay Subrahmanyam and Geoffrey Parker have put it, they 'brought back something familiar in an unfamiliar form'.[4]

The aim of this essay is to analyse some aspects of the uses of gunpowder in South Asia during the sixteenth century, with the objective of demonstrating its main applications by Asiatic and Portuguese forces regarding field artillery, firearms and other devices as well as techniques, along several military campaigns. Firstly, the

dissemination of gunpowder weapons and their effectiveness will be briefly discussed. The use of gunpowder in the sieges of Diu (1538 and 1546) and of Chaul (1570–1) will then be examined, in order to show how central it was to those three military operations.

Although China developed gunpowder initially, its diffusion and impact in Europe was tremendous in the long term.[5] By the time the Portuguese arrived in the Indian Ocean, at the end of the fifteenth century, artillery was already in use in India. In the Indian subcontinent, knowledge about gunpowder and the associated technology came from different places. China was certainly the gateway of gunpowder into South Asia, probably during the Mongol invasions between the thirteenth and the fourteenth centuries;[6] and there is evidence of a rocket propelled by gunpowder called *ban*[7] in the fourteenth century. The Sultanate of Gujarat and the Vijayanagara Empire were central to the diffusion of this firepower from the Islamic states, such as the Ottomans, across India.[8] However, in Europe, gunpowder weapons evolved more rapidly during the fourteenth and the fifteenth centuries than anywhere else.[9] Therefore, the large bombards that were often built and used in India during the sixteenth and the seventeenth centuries did not have the same quality as in Europe, where there had been abandonment of the oversized dimensions as early as the first half of the fifteenth century. For instance, the Indian large guns known as Malik-i-Maidan (1548–9), the Lambacharri (1582) and the Landa Kesab (1646) in Bijapur[10], related more to Ottoman artillery than to Portuguese cannons.

The quality and effectiveness of those guns, although difficult to assess, can be the main difference between the Portuguese and the Indian artilleries of that time. The first aspect has to do with the poor quality of the alloys used and the deficiencies found in the foundry process.[11] This technical problem required correction during the long contact with the Portuguese and other Europeans, during the sixteenth and the seventeenth centuries. The major innovation brought to India by the Portuguese in this field was the development of wrought iron (since iron was a cheaper material) instead of bronze for making guns.[12] The second aspect concerned effectiveness, which linked directly to the first one, since a badly forged gun could hardly have been effective. Several Indian attacks on Portuguese ships and fortresses showed that gunpowder artillery did not work as expected.

The quality and the type of gunpowder used can also be a key factor in explaining the low effectiveness of Indian guns and firearms. The mixture of sulphur, charcoal and saltpetre in the right proportions was not the only factor to influence success.[13] The corning of gunpowder

was the main reason why cannons were capable of stronger firepower in Europe during the fifteenth century. Although serpentine powder was simpler to produce (it simply required the ingredients to be mixed together), corned gunpowder was preferred over it mostly because of its higher potency.[14] However, it is not easy to determine whether the Portuguese and their opponents in the Indian Ocean used corned gunpowder, since sources are very scarce on this topic. The Portuguese documents related to the sixteenth century only mention '*pólvora de bombarda*' (bombard powder) and '*pólvora de espingarda*' (handgun powder), a distinction that is not entirely clear.[15] This has led some authors to assume that despite the new kind of gunpowder known to the Portuguese, it was not used in the empire due to logistical and technical difficulties.[16] Another hypothesis can, however, be admitted: these two terms, 'de espingarda' and 'de bombarda', could be used to distinguish serpentine gunpowder (resembling fine flour), used in handguns, and corned gunpowder (which was thicker), used in artillery. If this was indeed the case, then the Portuguese were already producing guns prepared for this new type of firepower. The Indian case is more difficult to assess. Despite the considerable quality of the common ingredients of this powder used, the flaws in the production process and high moisture levels resulted in low effectiveness.[17] In 1546, at the end of the second siege of Diu, the Portuguese governor, João de Castro, found a wide range of ingredients and instruments used to produce gunpowder in the Gujarati camp. This could be an indication that the besiegers had produced serpentine powder during the siege, since the process of corning was too long and complex to take place directly in the warfare theatres of that time.[18]

To ensure that there was achievement of real advantage in war, Portuguese gunners and matchlock-men were hired, either in a formal or an informal way, that is, as military assistance to a friendly ruler, or as paid mercenaries.[19] For the former case, an example can be cited of the expedition sent in 1535 by Governor Nuno da Cunha and commanded by Martim Afonso de Sousa, to assist Bahadur Shah, Sultan of Gujarat, against the Mughal expansion, which is an indication of the prestige that the Portuguese forces enjoyed.[20] As far as mercenary troops are concerned, they were found scattered around the Indian Peninsula and taking part in several campaigns. One notable example was the case of the twenty Portuguese *espingardeiros* (matchlock-men) involved in the Battle of Raichur, between the Vijayanagara Empire and the Sultanate of Bijapur, in 1520.[21] In the mid-sixteenth century, more than two thousand Portuguese military men served in several Asiatic states, and

this number would increase over the following decades.[22] Whenever possible, other Europeans were also hired. For instance, in 1502, two Christians (probably from the Italian Peninsula) entered the army of the Zamorin of Calicut, where they manufactured cannons and instructed their employers on the new forging techniques.[23]

It is reasonable to enquire if Portuguese firepower was really stronger than their opponents' were. While some sources, mostly chronicles, depict the Portuguese as being nearly unconquerable in their artillery, such evidence must be regarded with caution, so as to avoid what John Keegan has called the 'bullfrog effect'.[24] Those texts show the destroying capacity of guns against local ships and houses, but rarely when engaging enemies having similar firepower. The damage caused to Indian or Muslim ships, which were built differently than European ones and were more fragile, could never be the same had it been inflicted on other European navies. Even in the naval battle of Diu, in 1509, which opposed a Portuguese to a Mamluk fleet (made up of *naus* and galleys respectively), the former had much more firepower as they had already adapted to using broadside gunnery.[25] During the first siege of Diu, in which Ottoman faced a Portuguese fortress, these guns were unable to secure a Muslim victory. This relates to the low effectiveness of sixteenth-century artillery; it had limited reach, especially when fired from ships, which made it impossible to rely on for medium– to long distance shooting.[26] Evidence of this weakness could even be seen far away from India, with the Portuguese having been defeated several times off the coast of China by heavily gunned local junks.[27] The reason for this was not necessarily that the Chinese had better artillery, but that their fleet was much larger and ships were more resistant than the ships found in the Indian Ocean.

The effectiveness of firearms is even more difficult to analyse, since most sources are more detailed about artillery than they are about portable weapons. Still, there was extensive use of handguns by both sides. Several reports mention the firing of deadly shots in the aforementioned sieges. For example, the chronicler Leonardo Nunes, who was an eyewitness to the action on 26 July 1546, described how forty men under the command of António Peçanha shot down with handguns (*espingardaria*), two hundred opponents who attempted to climb the fortress walls.[28]

Considering what emerges in these records, it is certain that warfare evolved differently in Europe and India. After the arrival of the Portuguese, there was adoption and adaptation of new techniques and processes, according to need. Nevertheless, South Asian merchants and

rulers repeatedly tried to foil the Portuguese expansion along the Indian Ocean. The use of military forces was an alternative approach to trade war—that is, the shifting of maritime trade routes or other economic factors—to fight against this European presence. Although aware of the considerable military advantage of the Portuguese navy, thanks to its artillery, the *Estado da Índia* (State of India) was equally well aware of the threat of sieges during the sixteenth century.

The two sieges of Diu aimed to regain control over its fortress by the Sultanate of Gujarat, which had been delivered to the Portuguese in 1535 in exchange for military help against the Mughal expansion. The two attacks were mostly encouraged by Khwaja Safar, a merchant of European origin who served as a captain to the Sultan and the lord of Surat. As a representative of the economic interests connected to the maritime trade of Gujarat, Safar spent most of his resources fighting the Portuguese presence in Diu.[29]

The first siege, in 1538, was of special significance, since Sultan Suleiman the Magnificent had sent an Ottoman fleet to Diu.[30] Khwaja Safar had besieged the fortress during August of that year, holding ground until the arrival of the Ottoman expedition in September, which consisted of approximately five thousand men. Despite the constant attacks, the Portuguese were able to resist until the logistically exhausted Ottoman forces finally lifted the siege in November, thereby avoiding a battle with the fleet of Viceroy Garcia de Noronha. Eight years later, in 1546, Khwaja Safar organized for a more challenging siege with the assistance of the Sultan of Gujarat, Mahmud Shah III.[31] The forces of the Sultanate, reinforced by mercenaries coming mostly from the Arabian Peninsula, began the siege in April. The arrival of monsoon made it difficult to obtain logistical supplies from the southern forts, such as Bassein, Chaul and Goa. The protracted six and a half months of siege reduced most of the curtain walls into a pile of stone, including the complete destruction of one of the bastions. Nearly fifteen thousand men besieged a poorly defended Diu, manned by a mere five hundred to one thousand men at arms. The operation ended in battle when on 10 November, Governor João de Castro managed, to win due to a skilful tactic, thanks to which about twenty thousand men under the Gujarati flag (though not all entered the fight), were defeated at the hands of two thousand Portuguese.[32]

In both the sieges, the role of artillery and firearms was central to the Portuguese victory. In the first example, the most powerful Islamic state of the time sent a large set of cannons and a group of purpose-trained artillerymen. The excellent quality of gunners caused much

damage to the fortress, despite the short time of this operation, i.e. only three months. The quality of some of these guns can easily be seen from the so-called, 'Peça de Diu', a cannon captured from the Ottomans after their retreat and sent to Lisbon because of its colossal size. It is now kept at the Military Museum of Lisbon.[33]

The siege of Chaul of 1570–1 is another famous example in the combined military history of the Portuguese and the Indian Sultanates. The Sultan of Ahmadnagar, Murtaza Nizam Shah I, as the head of approximately one hundred thousand men and significant artillery, led the operation. An initial three hundred men defended the fortress of Chaul from December to July, through the building of barricades and other structures to resist the firepower (which nevertheless destroyed several bastions). The main advantage of the Portuguese consisted in the superior quality and effectiveness of their firearms, and in their naval power, which allowed small reinforcements to arrive during the siege.[34]

These operations demonstrate the considerable firepower of some Indian sultanates. However, in the first two sieges mentioned above, the effectiveness of their artillery was not enough to open a breach in the walls. For instance, after the Portuguese victory at Diu, in 1546, more than thirty guns were found in the Gujarati camp, confirming the information found in the chronicle sources that the besiegers had a large artillery battery.[35] The destruction was considerable but additional elements were still needed, such as firearms and other devices, to make sure that gunpowder weapons would be effective. In Chaul, despite their strong firepower, the besiegers abandoned the operation due to internal and logistical problems, namely the transporting of iron, gunpowder and other supplies through the Western Ghats.[36]

The use of gunpowder was not restricted to artillery or firearms. It is often overlooked, the usage of gunpowder in incendiary and explosive devices, which had considerable importance in warfare. That is the case with fire pots, known as *alcanzias*, or more commonly in the Portuguese sources as *panelas de pólvora* (pots of gunpowder). They were empty projectiles, most of them ceramic, sometimes filled with incendiary material like gunpowder, sometimes with flammable products, such as naphtha. These objects were ignited by means of a short fuse, and could be thrown by muscular propulsion or by siege engines.[37] The effects were devastating, burning the soldiers and leaving them badly injured. The role played by these kind of bombs in the sieges mentioned was central. The rescue armada sent to fight off the first besiegers of Diu was composed of 119 ships from Goa and carried 2,600 fire pots;[38] a

chronicler who witnessed the second siege said that those injured from these devices were six fold more than those wounded by firearms.[39] At the end of the second attack on Diu, after the battle and the escape of most of the Gujarat forces, nearly 8,000 fire pots were found in the besiegers' camp, of which 400 remained filled with gunpowder and ready for use.[40] The same technique was used in the siege of Chaul, where the fire pots prevented the advance of the Ahmadnagar forces, after some bastions had been destroyed and enemy soldiers had entered the Portuguese fort.[41] There was adoption of alternative solutions when such devices went missing. During the siege of 1546, after all the fire pots had been used, the captain, João de Mascarenhas, created a new type of weapon by assembling two roof tiles together with pitch, filling in the object with gunpowder, and then using a wick to set it off.[42] It is possible that other devices were used in these sieges, such as fire arrows or fire lances (both weapons were well known in Portugal as well as India), but it is difficult to find any direct references to them in the sources.

There was eminent usage of gunpowder in the explosive mines. The use of mines during sieges is very old, dating from antiquity. The main goal was to weaken the walls, by burning the foundations and causing these structures to collapse, thus opening a breach in the defence system. The use of gunpowder in mines led to an increase in the destructive power of this technique.[43] The fortress of Diu was extensively undermined in 1546, destroying the bastion of *S. João* and in the process killing more than fifty soldiers, including the son of Governor Fernando de Castro.[44] The Ottomans frequently used this technique,[45] which probably became an influence on Indian warfare. There were five Ottoman engineers in the employment of Khwaja Safar during the second siege of Diu, and this thus proves the use of mine technology. These mercenaries in particular may also have been responsible for the use of the *sabats* by the Gujarat forces, a technique used in Mughal sieges as well.[46]

* * *

At some levels, Portuguese presence in the Indian Ocean undoubtedly influenced South Asian warfare. The adoption and adaptation of the new gunpowder technology through Portuguese or any other local agents was responsible for the dissemination of more effective weaponry. It is difficult to accept the idea of a 'military revolution' taking place in South Asia in this period,[47] nor even the concept of a gunpowder saga sweeping the Indian Peninsula with the rise of the Mughal Empire.[48]

Rather, the increasing firepower of the European wars reached Asia in a different guise, and it evolved in a different way. For instance, as Jean Deloche concludes, in the field of military architecture—contrary to the European model of a fortress, in which the development of artillery caused curtain walls and towers to be lowered, in order to reduce the surface exposed to heavy gunfire—most Indian rulers preferred to rely on stronger walls, adapting them to better withstand gunpowder warfare.[49]

The sieges of Diu and Chaul provide valuable case studies for tracing the military history of Portugal and Asia. More than pointing to a European superiority, they show that the military activity of the Indian sultanates was almost on par with the Portuguese. These Indian operations should not be dismissed as outright defeats—they put the *Estado da Índia* on alert, forcing the Portuguese governors and the viceroys in Goa, to become directly involved in the logistics and supply of the fortresses under attack, and in some cases even to take part in the fighting. The Portuguese victory was unplanned and in fact, was far less predictable than it might be supposed. Moreover, the use of gunpowder was always conditioned by what John Keegan has called 'permanently operating factors', such as the weather.[50] However, the facts point to a strong chain of command, organization and a working maritime line of supply being equally decisive. In all, gunpowder was not the key factor to decide war, even if some sources may imply otherwise. Reflecting on the psychological effect of powder (probably more so than its material effect), a chronicler of the second siege of Diu recounts how it seemed, from the roar of gunpowder, fire that the sky was crumbling down and the earth being destroyed by the falling debris.[51]

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Notes

1. To use the expression of Carlo Cippola, *Guns, Sails, and Empires: Technological Innovation and the Early Phases of European Expansion, 1400-1700*, New York: Pantheon Books, 1965.

2. For this phase of the Portuguese expansion and the use of gunpowder weapons, see Vítor Luís Gaspar Rodrigues, *A Evolução da Arte da Guerra dos Portugueses no Oriente (1498-1622)*, Lisbon: Instituto de Investigação Científica Tropical, 1998, pp. 95–117; Kenneth Warren Chase, *Firearms: A Global History to 1700*, Cambridge: CUP, 2003, pp. 134–6.
3. John F. Guilmartin, Jr., 'The military revolution: origins and first tests abroad', in *The Military Revolution Debate: Readings on the Military Transformation of Early Modern Europe*, ed. Clifford J. Rogers, Boulder: Westview Press, 1995, p. 317.
4. Sanjay Subrahmanyam and Geoffrey Parker, 'Arms and the Asian: Revisiting European firearms and their place in Early Modern Asia', *Review of Culture*, vol. 26, Macau, 2009, p. 14.
5. About gunpowder and its use, the following are useful: the classical study of J.R. Partington, *A History of Greek Fire and Gunpowder*, Baltimore and London: Johns Hopkins University Press, 1998; updated information is obtainable in Robert Douglas Smith, *The Oxford Encyclopedia of Medieval Warfare and Military Technology*, ed. J. Rogers, vol. I, New York: OUP, 2010, pp. 81–7, and vol. II, pp. 231–2, s.v. 'Artillery' and 'Gunpowder in Clifford'; Kelly DeVries and Robert Douglas Smith, *Medieval Military Technology*, Toronto: University of Toronto Press, 2012, pp. 137–63.
6. Peter Lorge, *The Asian Military Revolution: From Gunpowder to the Bomb*, Cambridge: CUP, 2008, pp. 117–18.
7. Irfan Habib, *Technology in Medieval India, c. 650-1750*, Aligarh Historians Society, 2008, p. 90; Iqtidar Alam Khan, *Gunpowder and Firearms: Warfare in Medieval India*, New Delhi: OUP, 2004, pp. 23–4.
8. Jagadish Narayan Sarkar, *The Art of War in Medieval India*, New Delhi: Munshiram Manoharlal, 1984, p. 133. On the role of gunpowder in the Ottoman Empire, see Douglas E. Streusand, *Islamic Gunpowder Empires: Ottomans, Safavids, and Mughals*, Boulder: Westview Press, 2010; and on its importance to the diffusion of firearms, see Salih Ozbarän, 'Ottomans and the diffusion of fire-arms around the Indian Ocean', in *Ottoman Expansion Towards the Indian Ocean in the 16th Century*, Istanbul: Istanbul Bilgi University Press, 2009, pp. 273–82.
9. Kelly DeVries, 'Gunpowder weapons at the siege of Constantinople, 1453', in *War and Society in the Eastern Mediterranean, 7th–15th Centuries*, ed. Yaacov Lev, Leiden: Brill, 1997, pp. 353–4.
10. R. Balasubramaniam, *The Saga of Indian Cannons*, New Delhi: Aryan Books International, 2008, pp. 27, 33, 127.
11. Iqtidar Alam Khan, *Gunpowder and Firearms*, p. 61; Balasubramaniam, *The Saga of Indian Cannons*, pp. 81, 83. Balasubramaniam does highlight the quality of Indian guns, showing that the foundries could also create (though less frequently) good artillery, comparable to European standards.
12. Iqtidar Alam Khan, *Gunpowder and Firearms*, pp. 59–61. On wrought iron cannons, see Robert Douglas Smith, 'The technology of wrought-iron

artillery', *Royal Armouries Yearbook*, vol. 5, 2000, pp. 68–79; Robert Douglas Smith and Kelly DeVries, *The Artillery of the Dukes of Burgundy, 1367-1477*, Rochester: Boydell Press, 2005, pp. 238–9.

13. DeVries and Smith, *Medieval Military Technology*, p. 152.
14. Bert S. Hall, *Weapons and Warfare in Renaissance Europe: Gunpowder, Technology, and Tactics*, Baltimore: Johns Hopkins University Press, 1997; Idem, 'The corning of gunpowder and the development of firearms in the Renaissance', in *Gunpowder: The History of an International Technology*, ed. Brenda J. Buchanan, Bath: Bath University Press, 1996, pp. 87–120; DeVries and Smith, *Medieval Military Technology*, pp. 152–3.
15. The same distinction was used in fifteenth-century Burgundy, Smith and DeVries, *The Artillery of the Dukes of Burgundy*, pp. 45–6.
16. José Virgílio Pissarra, 'Armamento Naval', in *Navios, marinheiros e arte de navegar, 1500-1668*, História da Marinha Portuguesa, ed. Francisco Contente Domingues, Lisbon: Academia de Marinha, 2012, pp. 157–8.
17. Jos Gommans, *Mughal Warfare: Indian Frontiers and Highroads to Empire, 1500-1700*, London/New York: Routledge, 2002, pp. 150–1.
18. Hall, *Weapons and warfare*, p. 89.
19. See Maria Augusta Lima Cruz, 'Exiles and renegades in early sixteenth century Portuguese India', *Indian Economic Social History Review*, vol. 23, no. 3, 1986, pp. 249–62, and G.V. Scammell, 'European Exiles, Renegades and Outlaws and the Maritime Economy of Asia c.1500-1750', *Modern Asian Studies*, vol. 26, no. 4, 1992, pp. 641–61.
20. See Alexandra Pelúcia, *Martim Afonso de Sousa e a sua linhagem: Trajectórias de uma elite no Império de D. João III e de D. Sebastião*, Lisbon: CHAM, 2009, p. 165.
21. Richard M. Eaton, '"Kiss My Foot", Said the King: Firearms, Diplomacy, and the Battle for Raichur, 1520', *Modern Asian Studies*, vol. 43, no. 1, 2008, p. 304.
22. See Sanjay Subrahmanyam, 'The Kagemusha Effect: The Portuguese firearms and the state in early modern south India', *Moyen Orient & Océan Indien*, vol. IV, 1987, p. 105.
23. See Vitorino Magalhães Godinho, *Os Descobrimentos e a Economia Mundial*, vol. 3, Lisbon: Editorial Presença, 1987, p. 96.
24. That is to say, to add to the dimension of an achievement to increase someone's reputation; John Keegan, *The Face of Battle: A Study of Agincourt, Waterloo and the Somme*, New York: Viking Press, 1976.
25. José Virgílio Pissarra, *Chaul e Diu, 1508 e 1509: O domínio do Índico*, Lisbon: Tribuna da História, 2002.
26. See Pissarra, 'Armamento Naval', pp. 164–5. About the concept of effectiveness, see Kelly DeVries, 'Catapults Are Not Atomic Bombs: Towards a Redefinition of "Effectiveness" in Premodern Military Technology', *War in History*, vol. 4, no. 4, 1997, pp. 454–70.
27. Rodrigues, *A evolução da arte da guerra*, p. 24; João Paulo Oliveira e

Costa, 'A Coroa portuguesa e a China (1508-1531): Do sonho manuelino ao realismo joanino', in *Estudos de História do relacionamento luso-chinês (séculos XVI-XIX)*, ed. António Vasconcelos de Saldanha and Jorge Manuel dos Santos Alves, Macau: Instituto Português do Oriente, pp. 11–84, especially Document 7.

28. Roger Lee de Jesus, *O Segundo Cerco de Diu: Estudo de História Política e Militar*, MA dissertation, Coimbra: University of Coimbra, 2012, p. 113. Portuguese sources refer to handguns as espingardas or arcabuzes (arquebuses), the difference between the two not always being clear.
29. About this man, see K.S. Mathew, 'Khwaja Safar and the Indo-Portuguese Trade' in *Portuguese and the Sultanate of Gujarat, 1500-1573*, Delhi: Mittal, 1986, pp. 41–53.
30. For this expedition, see Dejanirah Couto, 'No Rasto de Hadim Suleimão Pacha: Alguns aspectos do comércio do Mar Vermelho nos anos de 1538-1540', in *A Carreira Da Índia E a Rota Dos Estreitos. Actas do VIII Seminário Internacional de História Indo-Portuguesa*, Angra do Heroísmo: s.n., 1998, pp. 483–508; Giancarlo Casale, *The Ottoman Age of Exploration*, New York: OUP, 2010, pp. 53–65.
31. Safar would lose his life to a Portuguese firearm during the siege.
32. On the second siege, see de Jesus, *O Segundo Cerco de Diu*.
33. As with other guns kept in the same museum, this one has an inscription in Arabic, designed to highlight Muslim determination when fighting the Christians. See Gastão de Melo de Matos, 'Memória sôbre o alcance das armas usadas nos séculos XV a XVIII', *Anais da Academia Portuguesa da História*, vol. IX, 1945, p. 124 f.; and David Lopes and F.M. Esteves Pereira, *A peça de Diu: Memória destinada à X sessão do Congresso Internacional dos Orientalistas*, Lisbon: Imprensa Nacional, 1892.
34. For the siege itself, see R.O.W. Goertz, 'Attack and defense techniques in the siege of Chaul, 1570-1571', in *II Seminário Internacional de História Indo–Portuguesa: Actas*, ed. Luís de Albuquerque and Inácio Guerreiro, Lisbon: IICT, 1985, pp. 265–92; and for the political context an update in Nuno Vila-Santa, *A Casa de Atouguia, os últimos Avis e o Império. Dinâmicas entrecruzadas na carreira de D. Luís de Ataíde (1516-1581)*, PhD thesis, Lisbon: New University of Lisbon, 2013, pp. 165–83.
35. de Jesus, *O Segundo Cerco de Diu*, p. 132.
36. Goertz, 'Attack and defense techniques in the siege of Chaul', p. 282.
37. See the article by Colin J.M. Martin, 'Incendiary Weapons from the Spanish Armada Wreck La Trinidad Valencera, 1588', *International Journal of Nautical Archaeology*, vol. 23, no. 3, 1994, pp. 207–17. The Medieval Gunpowder Research Group from the Middelaldercentret, Nykøbing, Denmark, has done complementary research about these devices, analysing their makeup, usage, and the difficulty in recreating these weapons, http://www.leeds.ac.uk/ims/fieldsofconflict/Report9.pdf, accessed 17 November 2017.

38. Arquivo Nacional, Torre do Tombo (Portuguese national archive, Lisbon), *Colecção São Lourenço*, Livro 4, fol. 250.
39. de Jesus, *O Segundo Cerco de Diu*, p. 114.
40. António Baião, *História Quinhentista (inédita) do segundo cêrco de Diu*, Coimbra: Imprensa da Universidade, 1927, p. 336.
41. Goertz, 'Attack and defense techniques in the siege of Chaul', p. 280.
42. de Jesus, *O Segundo Cerco de Diu*, p. 114.
43. Kenneth Wiggins, *Siege Mines and Underground Warfare*, Princes Risborough: Shire, 2003; Partington, *A History of Greek Fire and Gunpowder*, pp. 171–4.
44. de Jesus, *O Segundo Cerco de Diu*, pp. 65–7. The explosion was so powerful that even today (after the reconstruction of the fortress, between 1546 and 1547) no evidence can be found of this bastion in the remaining military structure.
45. Gábor Ágoston, *Guns for the Sultan: Military power and the weapons industry in the Ottoman Empire*, Cambridge: CUP, 2005, p. 42.
46. As explained by Pratyay Nath, a sabat was a 'zigzag way dug in the ground, beginning at a musket shot away from the fort. The soil dug up to construct it would be arrayed on both its sides in the form of walls. The top of this double-walled trench would be provided with a roof of wooden planks fastened with each other and covered with raw hides. In this way, the approach party would be able to near the fortifications without being hit by projectiles coming from inside the fort', *Mughal Warfare, 1495-1612: Modalities, Logistics and Geography*, New Delhi: Jawaharlal Nehru University, MA dissertation, 2010, p. 145. The technique was used in Diu to create passages from the Gujarati camp to the Portuguese walls.
47. Lorge, The Asian Military Revolution, p. 112: 'there really was no [military] revolution to speak of before 1750' in South Asia. The author uses the concept of a 'military revolution' as developed by Geoffrey Parker, in *The Military Revolution: Military Innovation and the Rise of the West, 1500-1800*, 2nd edn, Cambridge: CUP, 1996.
48. The multiple Mughal sieges do not reflect any gunpowder saga, since Mughal cannons did not blast away any fort and the impact was more psychological than real, Nath, *Mughal Warfare*, p. 148.
49. Jean Deloche, *Studies in Fortification in India*, Pondicherry: Institut Français de Pondichéry, 2007, p. 235.
50. John Keegan, *A History of Warfare*, New York: Vintage Books, 1993, p. 63.
51. Fernando de *Castro, Crónica do Vice-Rei D. João de Castro*. Tomar: ESTT/CNCDP, 1995, p. 185.