

Preliminary analysis of the early handheld guns recovered from shipwrecks plying the seas of the pre-colonial Philippines, c.1400 – c.1600

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ABSTRACT

This study presents seven early handheld guns also known as “handgonnes” or hand cannons recovered from shipwrecks plying the seas of the pre-colonial Philippines. In this paper, three guns HHG-001, HHG-002, and HHG-003, feature shorter and stubby barrels with prominent reinforced sections, bulbous breech regions, and flared muzzles. The flared muzzles of these guns are typical of a blunderbuss type and or dart-firing guns of the fourteenth and fifteenth centuries. The remaining handheld guns HHG-004, HHG-005, HHG-006, and HHG-007, on the other hand, are tapered gun barrels without prominent reinforcement rings, and unflared muzzles that are probably designed for a single bullet and long-range firing. The smallest unflared muzzle gun HHG-005 measures only 39.1 cm long with a 1.31 cm bore diameter. While HHG-007 is the heaviest with a prominently thick gun barrel probably designed to withstand more powder charges.

Compositional analysis using Portable X-Ray Fluorescence Spectroscopy showed that most of these guns were made of leaded tin bronze alloys. Comprised mainly of 37.77% to 83.57% copper, 3.11% to 22.41% tin, and 0.87% to 47.72% lead with other trace elements including arsenic, bismuth, nickel, and manganese, among others. The discovery of these guns in various merchant ships such as those of the Santa Cruz, Pandanan, and Lena Shoal shipwrecks is clear evidence of their use by the early seafaring merchants. The use of pXRF also revealed traces of possible black powder elements such as sulphur and potassium thereby suggesting the actual usage of these guns that warrants further investigation. Despite their size and offensive functions against pirates and crews of enemy ships, firing them would have been intimidating.

Keywords: Seagoing firearms, handheld guns

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INTRODUCTION

Small artillery pieces are among the few of the vast number of archaeological materials discovered from most of the maritime and underwater sites in the Philippines. The archaeological excavation of the *San Diego* shipwreck in Fortune Island, Batangas for example, yielded thousands of lead musket balls, along with a few corroded iron pieces, barrels of rifles, arquebuses, and spring shots (Reverseau 1996; Alba et al. 1993; Alvarez 1992; Conese 1992; Cuevas 1992). *San Diego* was a Manila galleon sunk by the Dutch ship *Mauritius* during their naval battle on December 14, 1600. Interestingly, historical accounts have mentioned the vessel's long-range, large artillery became inconsequential as the fighting occurred onboard using hand-to-hand combat, thereby employing small firearms such as arquebuses and rifles along with the other handheld weapons (Desroches et al.

1996). Several projectiles and small caliber firearms were also discovered in other shipwreck sites in the country.

These early handheld guns served as pieces of evidence that provide insights into how these firearms were possibly manufactured and used onboard the merchant vessels plying the seas during the pre-colonial period of the Philippines. The case studies discussed here include significant guns from the Pandanan, Lena Shoal, and Santa Cruz shipwrecks. First is a bronze early handheld gun from the Pandanan shipwreck, a middle to late fifteenth century Southeast Asian merchant vessel (*see* Orillaneda 2016a, 2016b; Tanaka and Dizon 2011; Dizon 1996, 1994; Peralta 1996; Cuevas 1995; Alba 1995). Second, are five early handheld guns, recovered from the Lena Shoal shipwreck, a possible Chinese-Southeast Asian hybrid junk that sank around 1490 off the island of Busuanga in the Philippines (*see* Orillaneda 2016a; Dizon 2003; Conese 1997; Goddio 2000; Lopez-Martin 2002). The third and final is a bronze early handheld gun from the Santa Cruz shipwreck, a possible late fifteenth to early sixteenth century hybrid ship of the South China Sea Shipbuilding Tradition (*see* Orillaneda 2016a, 2016b, 2012, 2008).

In this study, compositional analysis using Portable X-Ray Fluorescence Spectroscopy (pXRF) aimed to reveal the materials used in manufacturing these guns. Moreover, the discovery of these guns on board merchant ships such as those of the Santa Cruz, Pandanan, and Lena Shoal shipwrecks suggests their usage by early seafaring merchants. Hence, the use of pXRF also aimed to determine possible evidence of their usage.

METHODOLOGY

Seven early handheld guns were measured to determine length, width, diameters, and calibers: HHG-001, HHG-002, HHG-003, HHG-004, HHG-005, HHG-006, and HHG-007. The gun length was measured with rulers, tape measures, and a digital caliper (Fujiwara) with a nominal accuracy of ± 0.01 mm. The terms *hand cannon* and *hand gonne* and sometimes handgonnes or handguns are already used interchangeably in the past referring to the early small-caliber handheld guns (*e.g.* Peralta 1996). To avoid confusion, the abbreviation HHG for “handheld guns” were used to code each artifact from HHG-001 to HHG-007.

X-Ray Fluorescence Spectroscopy Analysis

The composition analysis of the early handheld guns was conducted using portable X-Ray Fluorescence Spectroscopy (pXRF) of Olympus Vanta C Series Philippines with rhodium and tungsten anodes at 50 KeV. The analysis was conducted at the Lithics Laboratory of the University of the Philippines School of Archaeology (UPSA). For guns, HHG-001, HHG-002, and HHG-003, the data/spectra were recorded for approximately 180 s directly at the surfaces of the tiller, bulbous region, barrel, and muzzle. For guns HHG-004, HHG-005, HHG-006, and HHG-007, the spectra were also recorded for approximately 180 s on the surfaces of the tiller, the reinforcement region, the barrel, and the muzzle. Additionally, spectra were also recorded for approximately 180 s on the surfaces of the touch holes, handles, sights, and 5th reinforcement rings for all the guns where applicable.

RESULTS AND DISCUSSIONS

This paper presents the early handheld guns recovered from the Pandanan, Lena Shoal, and Santa Cruz shipwrecks as shown in Table 1. These guns were categorized into two groups based on their possible usage: 1) close-range guns – these guns feature shorter and stubby barrels with prominent reinforced sections, bulbous breech, and flared muzzle regions, including HHG-001, HHG-002, and HHG-003; and, 2) long-range guns – these guns feature relatively longer and tapered gun barrels without prominent reinforcement rings, and unflared muzzles probably designed for a single bullet and long-range firing, including HHG-004, HHG-005, HHG-006, and HHG-007.

Table 1. Early handheld guns recovered from shipwrecks plying the seas of the pre-colonial Philippines with gun lengths and bore diameters.

Sample Code	Shipwreck Site	Bore Diameter (cm)	Gun lengths (cm)			
			Barrel	Chamber	Tiller	Total
HHG-001	Pandanan Shoal	2.37	19.3	5.2	2.6	27.1
HHG-002	Lena Shoal	2.51	20.9	7.6	4.8	33.3
HHG-003	Lena Shoal	3.26	20.8	5.4	9.2	35.4
HHG-004	Lena Shoal	2.33	40.2	12.7	8.2	61.1
	Len					
HHG-005	Lena Shoal	1.31	26.0	9.0	4.1	39.1
HHG-006	Santa Cruz	2.08	45.2	16.4	3.2	64.8
				Len		
HHG-007	Lena Shoal	2.78	40.4	16.4	3.9	60.7

Descriptions of the Guns

Early Handheld Gun No. 1 (HHG-001)

Recovered from the Pandanan shipwreck, this gun (Fig. 1, left) was thought to belong to small caliber cannons such as the *lantakas* and *rentakas* among others as most of its features are typical of the early handheld guns (Peralta 1996). The gun is about 27.1 cm long with a 2.37 cm bore diameter with prominent reinforcement rings. The tiller at the rear end is approximately 2.6 cm in length with only about 1.2 cm deep socket. This is too shallow to hold the tiller firmly without falling off, suggesting the gun was probably stocked-mounted (Peralta 1996). Wooden tillers, however, were mostly secured by iron straps or slotted into the end of the breech (Lepage 2005). Houston and Stroyan (2014) also described a similar hand cannon fired with a trestle-like stand. In that case, the tiller no longer needed to carry the entire weight of the gun; instead, it served as a handle when the cannon tube became too hot to hold after firing several shots (Lepage 2005). The flared muzzle of the gun is also indicative of other small caliber cannons such as a blunderbuss type and or dart-firing guns of the fourteenth and fifteenth centuries CE (Lopez-Martin 2002; Peralta 1996; Powell 2010, 1095).

Early Handheld Gun No. 2 (HHG-002)

This gun is approximately 33.3 cm in length with a 2.51 cm bore diameter, recovered from the Lena Shoal shipwreck (Fig. 1, middle) (Lopez-Martin 2002). Similar to HHG-001, it is a muzzle-loading gun with prominent wide bands of reinforcement rings from the tiller toward the muzzle (*see* Lopez-Martin 2002). Also similar to HHG-001, its flared-shaped muzzle is indicative of dart-firing guns used from 1464-1496 CE on China's interior frontiers and in merchant junks against pirate attacks (Lopez-Martin 2002, Powell 2010, 1095). The rear end is also fixed with a tiller of about 4.8 cm in length with a 2.0 cm deep socket, probably deep enough to hold the wooden tiller attachment without falling off. In contrast to the HHG-001, however, this gun was also fixed with a "lug" or handle to add ease in handling and or aiming targets.



Figure 1. Early handheld guns with flared muzzles: HHG-001 (left), recovered from the Pandanan shipwreck (IV-1993-V-1152), with prominent reinforcement rings and a “lug” probably as the gun’s rear sight; HHG-002 (middle), recovered from the Lena Shoal shipwreck (IV-93-H-2901) with prominent reinforcement rings and a handle; HHG-003 (right), recovered from the Lena Shoal shipwreck (IV-93-H-4011) with prominent reinforcement rings.

Early Handheld Gun No. 3 (HHG-003)

This gun is approximately 35.4 cm in length with a 3.26 cm bore diameter and was recovered from the Lena Shoal shipwreck (Lopez-Martin 2002). Similar to HHG-001 and HHG-002, it is a muzzle-loading gun with prominent wide bands of reinforcement rings and a flared muzzle (Fig. 1, right). Flared muzzles of early handheld guns were intended to scatter the shots at close range and to ease loading (DK Publishing 2006, 247). However, HHG-003’s flared muzzle is narrower compared to those of the HHG-001, and HHG-002, thereby suggesting this gun is probably more effective when shot from a distance. Moreover, the rear end is also fixed with a prominent 9.2 cm tiller socket and a “lug” or handle to add ease in handling and or aiming targets.

Early Handheld Gun No. 4 (HHG-004)

This handheld gun measured about 61.1 cm long with approximately 2.33 cm bore diameter, also recovered from the Lena Shoal shipwreck (Fig. 2a) (Goddio 2000). The barrel is slightly tapering towards the muzzle with a maximum diameter of 3.7 cm and a minimum diameter of 3.1 cm. The vent or the touch hole is located approximately 19.7 cm centimeters from the rear end with a simple spherical reinforcement. The stock or tiller socket at the rear end is prominently longer, measuring about 8.2 cm, suggesting a firm attachment of a wooden tiller. The remains of a possible wooden tiller can still be seen attached inside the rear end socket proposing that the gun was not stock-mounted.

Early Handheld Gun No. 5 (HHG-005)

This gun was also recovered from the Lena Shoal shipwreck, measuring about 39.1 cm long with approximately 1.31 cm bore diameter (Fig. 2b). The barrel is slightly tapering towards the muzzle with a maximum diameter of 2.0 cm and a minimum diameter of 2.2 cm. The vent or the touch hole is located approximately 4.2 centimeters from the rear end with a simple leaf-like or diamond shape design. The stock or tiller socket at the rear end is relatively longer, measuring 4.1 cm also suggesting a firm attachment of a wooden tiller. A tiny sized-gun can surely be easier to aim and fire.

Early Handheld Gun No. 6 (HHG-006)

The early handheld gun recovered from the Santa Cruz shipwreck is similar to the gun recovered from the Lena Shoal shipwreck, HHG-004. This gun is the longest, measuring about 64.8 cm long with approximately 2.08 cm bore diameter (Fig. 2c). The larger barrel is also slightly tapering towards the muzzle with a maximum diameter of 3.58 cm and a minimum diameter of 2.84 cm. The touch hole is approximately 3.2 cm centimeters from the rear end with a leaf-like or diamond-shaped reinforcement. The remains of the tiller socket at the rear end seem to have been broken, measuring only about 3.2 cm. The tiller socket was possibly longer for a firm tiller attachment.

Early Handheld Gun No. 7 (HHG-007)

This gun is the heaviest and largest of all five guns recovered from the Lena Shoal shipwreck (Fig. 2d). It measures about 60.7 cm long and has a 2.78 cm bore diameter. The gun barrel is relatively thick, about 1.71 cm, which is probably designed to withstand more powder charges to propel a relatively bigger caliber bullet. The touch hole is approximately 3.9 cm centimeters from the rear end with a leaf-like or diamond-shaped reinforcement similar to that of HHG-006. The tiller socket is also short, suggesting a need for reinforcement straps and or added support stand when firing. A similar gun of Chinese origin from the fourteenth to fifteenth centuries was also found in the Molucca Sea in the Dutch Indies (McLachlan 2010).



Figure 2. Early handheld guns with unflared muzzles: HHG-004 (A), recovered from the Lena Shoal shipwreck (IV-93-H-0342) with a tapered gun barrel; HHG-005 (B), recovered from the Lena Shoal shipwreck (IV-93-H-3417) with a tapered gun barrel; HHG-006 (C), recovered from the Santa Cruz shipwreck (III-2001-Z-NA) with a tapered gun barrel; HHG-007 (D), recovered from the Lena Shoal shipwreck (IV-1993-H-NA) with a relatively thick gun barrel and of a higher caliber.

X-Ray Fluorescence Spectroscopy (XRF) Analysis

Results from compositional analysis using pXRF revealed most of these guns were primarily a ternary alloy of Cu, Pb, and Sn (*e.g.* Pollard and Liu 2023). Comprised mainly of 37.77 percent to 83.57 percent copper, 3.11 percent to 22.41 percent tin, and 0.87 percent to 47.72 percent lead with other trace elements including arsenic, bismuth, nickel, and manganese, among others (Table 2). Pollard and Liu (2023) also noted that the sum of all three metal components of ternary alloys is usually around 98 percent. Our research, however, provided a range between the sums of 94.20 percent to 98.38 percent.

Table 2. Percent composition of major and minor elements of the seven early handheld guns using pXRF.

Sample Code	Percent Composition of Elements (Barrel)							
	Cu	Sn	Pb	As	Bi	Ni	Mn	OE
HHG-001	40.71	22.41	31.76	2.89	0.26	0.05	0.01	1.91
		22.4095						
		22.4095						
		22.4095						
HHG-002	83.57	12.65	0.87	0.45	1.04	0.09	0.03	1.31
HHG-003	81.75	11.31	4.59	0.59	0.88	0.09	0.04	0.74
HHG-004	74.91	14.70	8.77	<LOD	0.66	0.06	0.02	0.88
HHG-005	77.81	14.31	5.40	0.26	0.83	0.07	0.02	1.30
HHG-006	37.77	8.71	47.72	4.20	<LOD	<LOD	0.01	1.59
HHG-007	47.48	3.11	47.05	0.82	<LOD	0.03	0.01	1.59

Note: Copper (Cu), Tin (Sn), Lead (Pb), Arsenic (As), Bismuth (Bi), Nickel (Ni), Manganese (Mn), and Other Elements (OE).

Interestingly, the use of pXRF also revealed traces of possible black powder elements thereby suggesting the actual usage of these guns and warranting further investigation into firing guns and recording residue. Trace amounts of sulphur and potassium were recorded on the surfaces of the muzzle and tiller of the early handheld gun HHG-001. Traces of sulphur were also recorded on the surfaces of the touchhole, handle, and muzzle of the early handheld gun HHG-003. These results further showed the importance of gunpowder and its use in most seagoing firearms (e.g., Kozari and Vizy 2013; McLachlan 2010; Khan 2004; Andaya 1992). The discovery of the early handheld guns from the shipwrecks plying the seas of the pre-colonial Philippines affirms the use of seagoing firearms. Records on the use of these light guns against pirates and crews of enemy ships were already known in merchant ships as early as the fourteenth century (Lepage, 2005). Their discovery onboard various merchant ships such as those of the Santa Cruz, Pandanan, and Lena Shoal shipwrecks is clear evidence of their use by the early seafaring merchants. Despite their size and offensive functions against pirates and crews of enemy ships, firing them would have been intimidating (McLachlan 2010; Lepage 2005).

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