Northern Territory Government

DEPARTMENT OF ARTS AND MUSEUMS

Dundee Beach Swivel Gun: Provenance Report

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MUSEUM AND ART GALLERY NORTHERN TERRITORY

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Prepared for Mrs Barbara Doukas and Christopher Doukas, by the Museum and Art Gallery of the Northern Territory

1.0 Introduction

On 2 January 2010, Christopher Doukas, (a 13-year-old at the time) found what appeared to be a 16-17th century bronze, breech loading swivel gun partly buried at low tide in sand and mud at Dundee Beach, southwest of Darwin (see Figure 1). After some Internet research, the Doukas family believed they had found a Portuguese 'cannon'.

On 22 August 2011 Mrs Barbara Doukas (Christopher's mother) contacted the Museum and Art Gallery of the Northern Territory (MAGNT) wanting to know if it could be authenticated and valued. Mrs Doukas was told that the museum did not value objects, but could help with authentication if she brought the gun into the museum so that it could be examined.

On 20 January 2012 Mrs Doukas brought the gun to the MAGNT for study and analysis with the hope of having the gun identified and its provenance established. Mrs Doukas was issued with a receipt.

On the 7 March 2012, the gun was photographed in detail by MAGNT staff (see Figure 2 and Appendix 1) and on the 11 March 2012 the gun was analysed using X-ray fluorescence (see Figure 3). On the 29 April 2012, the gun was examined by a conservator and a condition report written (see Appendix 2).

On the 11 April 2013 Mrs Doukas retrieved the swivel gun from the MAGNT. An outgoing receipt was provided, certifying that Mrs Doukas had collected the gun from the Museum and Art Gallery and that it was now in her custody.

On the 5 July 2013, David Steinberg from the Heritage Branch, Northern Territory Government, met Mrs Doukas and son Christopher at Dundee Beach and carried out a site inspection to locate the place where Christopher Doukas had discovered the swivel gun in 2010 (Steinberg 2013).

On the 22 July 2013 Mrs Doukas transferred custodianship of the swivel gun to Michael Owen (an independent heritage Consultant) for the purpose of undertaking non-invasive dating analysis – optically stimulated luminescence (OSL) and possibly Radiocarbon (C14) dating of the sand and (possible) organic material lodged inside the barrel done.

On the 24 July 2013 the swivel gun was shipped as accompanied luggage by plane to Canberra via Sydney. The proposal was to take the gun to Melbourne University where the sand inside the barrel would be dated using OSL by geochronologist Matt Cupper of Melbourne University.

The remainder of this report summarises the interim research done thus far at the MAGNT in order to identify and establish the most likely provenance of the gun.

Figure 1. Location map for Dundee Beach showing where the bronze breech loading swivel gun was found on the 2 January 2010 (pers. comm. Christopher Doukas 2012).

Figure 2. The Dundee Beach swivel gun photographed from three different angles - from above showing the 'topside', side view and the underside showing the patches of iron staining (photographs by Regis Martin).

2.0 Site Inspection

To date the site has not been inspected by MAGNT staff. However, while on a visit to the museum Christopher Doukas located the position where he found the gun on a Google Earth map of the Dundee Beach area. The location he identified placed the gun approximately at latitude 12º44'30''S and longitude 130º21'17"E (see Figure 1).

David Steinberg from the Northern Territory's Heritage Branch, was taken to the site where the gun was found by Christopher Doukas on 5 July 2013 and recorded the following position, latitude 12°44'26"S and longitude 130°21'17"E (Steinberg 2013: 4). The location recorded by Steinberg, compared remarkably well with the position previously marked on the Google Earth map by Christopher Doukas while at the museum.

Mike Owen a Darwin based heritage consultant (and personal friend of Mrs Doukas' late husband) also visited the site's approximate location and photographed the general area (see Figure 3).

Figure 3. Photograph taken at approximate location and general area where the gun is said to have been recovered (photograph by Mike Owen taken at 12º44'14"S and 130º21'17"E).

3.0 Chemical and material analysis to date

3.1 Chaplets

There are four small flat iron inclusions/protrusions (called chaplets) arranged opposite each other around the outer diameter of the barrel. They are located just forward of the breech. A small magnet about the size of a camera battery and a piece of mylar film was used to confirm their existence. The mylar film was placed between the magnet and the exposed end of the chaplet. It was moved backwards, forwards and sideways (on top of the chaplet). The magnet stayed in position, exhibiting magnetic attraction, despite the friction and pull created by moving mylar. The magnetic attraction however wasn't strong enough to hang on when tipped upside down. No other chaplets or magnetic attraction was found, however further testing should be done to confirm this.

The use of chaplets and their position within the cast matrix, and their placement along the length of the gun is consistent with Southeast Asian bronze gun manufacture (pers. comm. Jeremy Green).

Figure 4. A photograph showing the location of the chaplet 'spokes' (circled) protruding through the bronze casting just forward of the breech.

3.2 XRF and chemical analysis

Non-destructive XRF analysis was carried out by MAGNT staff under the tutorship of Bruce Kaiser, Chief Scientist for Bruker Elemental (http://www.bruker-axs.com/index.html) on 11 March 2012 .

Figure 5. Photographs showing the hand held XRF machine being used by MAGNT staff with Bruce Kaiser teaching the application of the software (photograph by Ellie Hayward 2012).

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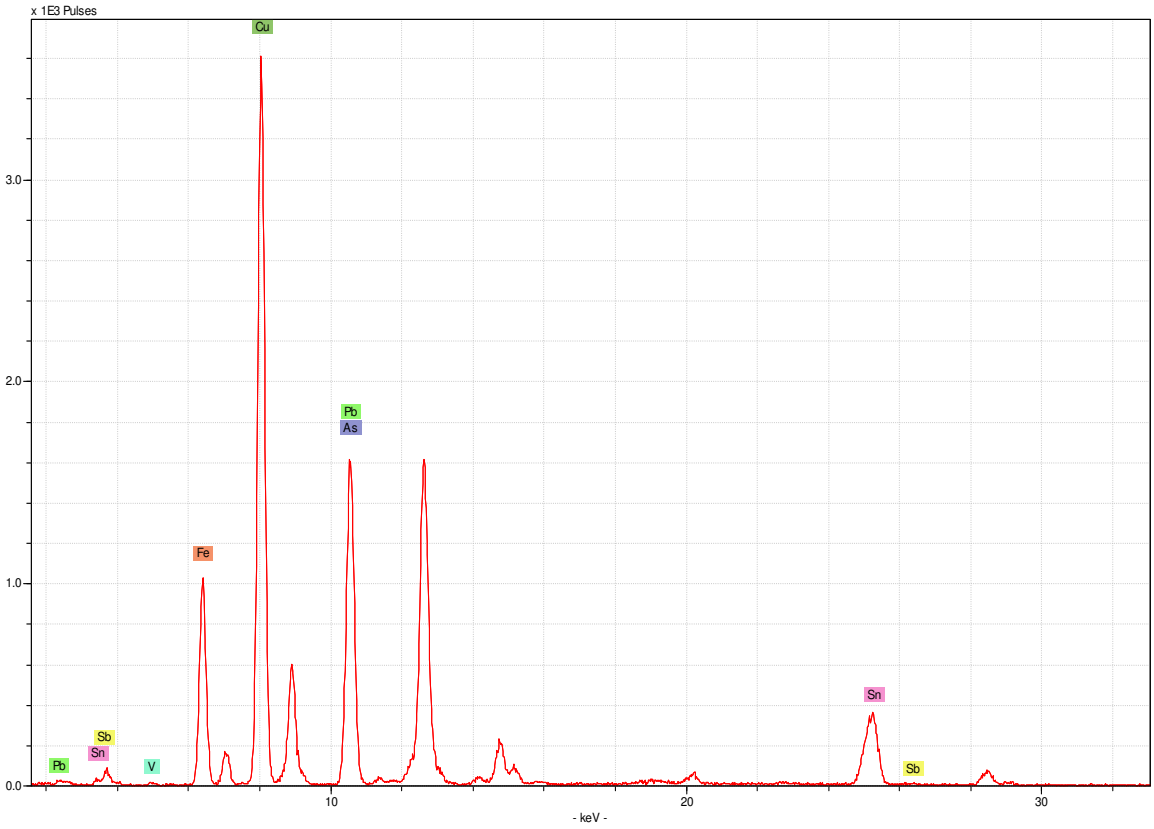

Figure 6. Spectra data showing the elemental composition of the area around the chaplet (note the high concentration of lead (Pb) and iron (Fe).

The average composition of the gun excluding the areas around the chaplets where the inclusion of iron is present is approximately 60% copper, 27% lead and 15% tin. The gun is unusually high in lead, somewhere between 20-30%. This is well outside the usual composition found in modern bronze (typically 88% copper [Cu] and 12% tin [Sn]). The high concentrations of lead would make the gun malleable (rather than brittle) and could explain the bend in the barrel.

The gun appears to be quite old. The general mottled look on the surface is consistent with corrosion of the segregated alloy mixture over a long period of time. The wear around the edges of the trunions and the partial exposure of the chaplet together with depressions on the underside in the areas of iron staining indicates that there has been considerable erosion over time.

	Mn	Fe	Cu	As	Pb	Sn	Sb
End of muzzle 1	0.0	0.6	55.3	0.2	30.5	19.1	0.04
End of muzzle 2	0.0	0.6	60.5	0.1	28.5	9.5	0.12
End of muzzle 3	0.0	0.5	62.9	0.0	27.0	10.9	0.14
Forward of breech (top side)	0.0	0.5	68.1	0.1	21.4	18.0	0.09
mid barrel (underside)	0.0	0.7	56.2	0.1	30.2	18.2	0.06
Chaplet (and area around)	0.6	10.3	30.2	0.0	43.3	18.1	0.12

Figure 7. Table of results showing elemental composition from the Spectra data obtained from the XRF analysis (Kaiser, pers.comm).

On the underside of the gun (see Figure 2), there are large patches of iron staining. XRF data of this area revealed that it was high in iron, much higher than the other areas tested. This could be due to 'iron plating' laid down during an electro-chemical phase. The underside is much more corroded than top side. This may indicate that the gun was lying in contact with iron some time in its past, causing the bronze to corrode sacrificially.

4.0 Similar breech loading swivel guns in other collections

There are relatively few examples of breech loading bronze swivel guns with good provenance in museum collections or in other collections (antique dealers for example) with which to compare the Dundee Beach gun.

There are several Portuguese bronze swivel guns in various collections in Europe, in particular Portugal, and in other places, such as Macau in China and Goa and Cochin in India (Smith 1995). There are also a few provenanced examples from Portuguese shipwrecks such as the *São João* (1552) lost off the Natal south coast near Port Edward, South Africa and in the Seychelles (Auret and Meggs 1982, Meggs 1984, Blake and Green 1986). To date, none of the known Portuguese examples match stylistically the shape or ‘weight’ of the Dundee Beach bronze swivel gun.

The relative length (and width) of the barrel of the Portuguese swivel gun, and its breech chamber, compared with the same relative dimensions of the Dundee Beach swivel gun, are quite different (see Figure 8). The Dundee Beach gun is clearly much more elongated and less 'robust' in form.

Figure 8. A drawing of a (typical Portuguese) bronze breech loading swivel gun recovered from the *São João* (1552) shipwreck (after Maggs 1984 & Burger 2003) and a photograph of the Dundee Beach bronze breech loading swivel gun scaled to a similar size for comparison.

The Dundee Beach swivel gun does not resemble any of the known Portuguese examples, and according to Alexandre Monteiro, of the *Instituto de Arqueologia e Paleociências*, in Lisbon, Portugal does not resemble any Portuguese swivel gun that he knows of (pers. comm. Alexandre Monteiro 2012).

4.1 Bali Museum swivel gun

One example that is similar to the Dundee Beach swivel gun, however, is located at the Bali Museum in Denpasar, on Bali in Indonesia. The Bali Museum gun, however, is considerably longer and has a bore diameter almost twice that of the Dundee Beach gun (see Figures 9 and 10).

The Bali Museum gun is in very good condition considering it is displayed in the open and is exposed to the weather (see Figure 9). A cursory inspection of it did not locate any chaplets, but this should be verified using magnets, since the iron chaplet may be lying beneath the surface of the bronze.

Figure 9. The Bali Museum swivel gun on display in the museum grounds, Denpasar, Bali, Indonesia (photograph Paul Clark 2013).

Dundee Beach bronze swivel gun		**Bali Museum bronze swivel gun**	
Length	1074 mm	Length	1833 mm
Bore	22 mm	Bore	43 mm
Tiller	missing	Tiller	315 mm
Widest part	81 mm (at the base ring)	Widest part	190 mm (at the base ring)

Figure 10. Comparative dimensions of the Dundee Beach and Bali museum bronze breech loading swivel guns.

4.2 Ternate shipwreck swivel guns

There are three guns from an unidentified shipwreck reputed to be located off the island of Ternate, in the Maluku Islands (Moluccas) located in the north eastern part of Indonesia which are remarkably similar in style and form to the Dundee Beach swivel gun. These guns (for the purpose of this report) are known as the 'Ternate guns 1, 2 & 3', and although currently not for sale, have been exhibited on the *Wisma Antik* (an antique dealer) website (http://www.wisma.com.au/index.html) for at least the last 18 months (see Figures 11, 12 and 13).

Figure 11. Ternate gun No 1: length 25 1/2" [648 mm], the smallest of the three bronze swivel guns from *Wisma Antik* collection (http://www.wisma.com.au/index.html).

Figure 12. Ternate gun No 2: length 35 1/2" [902 mm] the longest (and the closest in size to the Dundee Beach example) of the three bronze swivel guns from *Wisma Antik* collection (http://www.wisma.com.au/index.html).

Figure 13. Ternate gun No3: length 34 1/2" [876 mm] the most 'robust' of the three bronze swivel guns from *Wisma Antik* collection (http://www.wisma.com.au/index.html).

According to *Wisma Antik*, the guns are reported to be Portuguese guns, found on a Portuguese shipwreck (c.1589-1600). *Wisma Antik* also suggests that because of their small size, they may have been made for trade, or were used as samples by a Portuguese salesman working for a gun company in Portugal (http://www.wisma.com.au/cannons-and-shipwrecks.html). The guns clearly have been in the ocean for some time, but their clamed Portuguese provenance, from a Portuguese shipwreck, is hypothetical as the claim is not supported with any evidence thus far. Even if the shipwreck, from which they are supposed to have come, is identified as a Portuguese vessel, it does not necessarily mean that the guns themselves were Portuguese (i.e. made in Portugal).

5.0 A definition of a Portuguese and SEA swivel guns

It is clear from the research done thus far that there are several interpretations and some confusion about what is meant by a Portuguese gun. For the purpose of this report and for future discussion of small bronze swivel guns (both breech and muzzleloaders) the following definitions are proposed.

1. **Portuguese swivel guns**
   Those made in Portugal and or those made at the Royal foundries in Macau and Goa by Portuguese artisans. These guns are those that have verifiable markings that attest to their provenance, or are those without markings (but have provenance) which conform morphologically and stylistically to others that have markings, i.e. Benin City gun (southern Nigeria see Smith 1995), *São Bento* swivel gun (South Africa).

2. **Portuguese style swivel guns (copies)**
   Those made in Southeast Asian foundries by (unofficial) Portuguese, and/or Southeast Asian artisans. These guns are those that on the balance of probability, are good, or similar copies of Portuguese guns (i.e. type 1), but exhibit Southeast Asian casting techniques and chaplet arrangements. More than likely they were cast somewhere in Southeast Asia, but could have been made in Macau or Goa and transhipped, i.e. Dundee Beach swivel gun, Ternate swivel gun 1 and 3 etc.

3. **Asian/European hybrid swivel guns**
   Those made in Southeast Asian foundries by Southeast Asian artisans i.e., using Southeast Asian casting techniques, but have some European influence. These guns have typical

Southeast Asian scroll decorations, tumpal style triangular ornamentation, crocodile or Chinese dragons etc., (see appendix 4) but they also have European structural elements such as lifting dolphins and cascabel. In the literature presented by euro-centric antique dealers and treasure hunters, these guns are often advertised as 'European guns with Asian influence'. In reality, however, they are Asian guns (since they are made in SEA by Southeast Asian artisans), with European influence.

4. **SEA swivel guns**
   These guns are cast in Southeast Asian foundries, by Southeast Asian artisans. They exhibit typical Southeast Asian casting techniques and decoration. In SEA they are known by a variety of names such as *lantaka*, *bedil*, *lela*, *coak*, and *meriam*. Typical decorations are floral scrolls, tumpal motifs, crocodiles, and/or Chinese dragons, however, they do not have European structural elements and usually do not have European styled decoration.

6.0 Probable origin and provenance of the Dundee Beach swivel gun

The breech loading swivel guns were possibly introduced into SEA by the Portuguese and Spanish during the early 1500s. However, this is not conclusive and the breech loader may well have found its way into the region earlier, via Chinese or Arab/Indian contacts. Further research is required to clarify this question.

However, when Europeans first arrived in the SEA region in the early 16th century the muzzle loading cannon was already in existence and the use of gunpowder was widely known. In the Philippines the Spanish attributed the existence of the Moro *lantaka* (small swivel gun) to Borneo or Chinese manufacture (Krieger 1926). The Moro *lantaka*, or culverins as they were known by the Spanish, were small swivel guns with a bore of one to two inches, mounted on stockades, forts and war perahu. Malays of western Malaysia employed similar cannon. When the Portuguese took Malacca in 1511, the Malays defended the town with cannon (*bombardia*) and small hand-guns (Gibson-Hill 1953). It is clear therefore (from numerous references, see bibliography) that small cannon were in use throughout most of SEA, but specifically in Malaysia, Brunei, Java and the Philippines by the time the Europeans arrived.

Matthew Finders recorded the use of small cannon on board Macassan perahu off the Northern Territory coast in 1803 (Flinders 1814) and Alfred Searcy also noted their use on large dredging canoes fitted with a single outriggers (Searcy 1909). Vosmaer (1839) writes that Macassan trepang fishers sometimes took their small cannon ashore with them in order to fortify the stockades they built near their processing camps to defend themselves against hostile Aborigines. Dyer (c.1930), when writing about a visit to the Milingimbi Methodist Mission (formerly a large Macassan camp with numerous Tamarind trees) explains how numerous the Macassans once were in the area. He also notes the use of small cannon by Macassans, in particular the bronze breechloader.

> Usually they were armed with little breech-loading bronze cannon of about two inches bore, of a type originally copied from the 16th century Portuguese explorers and never subsequently altered. (Dyer c.1930: 64)

The historical evidence, therefore, for the presence and use of small swivel guns in SEA, eastern Indonesia and in particular, on and off the coast of the Northern Territory during the last few hundred years is fairly conclusive. It is certainly more than likely, that with approximately 62 shipwrecks during 127 years of Macassan voyaging to the Northern Territory coast (Clark 2012), some small cannon were lost at sea. Together with the possibility that some of the cannon taken

ashore to fortify processing camps may have also been lost it is, therefore, more than likely that the Dundee Beach swivel gun is of SEA and in particular, Macassan origin.

7.0 Conclusion

The Dundee Beach, bronze, breech loading swivel gun, was almost certainly manufactured in Southeast Asia and more than likely in Indonesia. There is nothing in its chemical composition, its style, or form that matches authenticated Portuguese breech loading swivel guns.

More than likely, the Dundee Beach swivel gun was brought onto the Northern Australian coast by Macassans and lost, either by shipwreck, a canoe misadventure, or after having been taken ashore, perhaps to be used in defence while collecting water. The possibility of the gun being used for the fortification of a trepang processing camp seems unlikely, as the Dundee area is very exposed and not known to have had trepang resources in the past during the Macassan era (1780 –1907), or in contemporary times.

8.0 Recommendations

It is imperative, therefore, that a detailed site inspection and survey of the beach area and the hinterland where the gun was found is undertaken. It seems unlikely that the swivel gun has come from a shipwreck that was lost sometime in the past on Dundee Beach, as one would expect more material to have come to the attention of visitors over the years. However, this possibility should not be ruled out as it is a plausible explanation for the guns presence. It should be tested by conducting an underwater survey (utilising remote sensing equipment) of the area immediately seaward of where the gun was found. A coastal survey for Macassan sites in the general vicinity of where the gun was found, particularly where water sources and mangroves are found should also be conducted.

Further analysis of the chemical nature of the swivel gun should also be carried out, particularly wet chemical analysis and perhaps Inductively Coupled Plasma Mass Spectrometry' (ICP-MS) in order to get more accurate percentages of the metal composition. Permission to carry out this work was previously obtained from Mrs Doukas, but MAGNT did not have the staff or the resources to carry out the work at the time. An X-ray of the gun also needs to be taken, in order to confirm the diameter of the bore and see if there are any other chaplets within the body of the alloy. Optically stimulated luminescence (OSL) and Radiocarbon (C14) dating of the sand and (possible) organic material lodged inside the barrel, should also be done to try and establish the time when the gun was lost. The possibility of sourcing the origin of the tin [Sn] contained within the gun should also be explored.

Desalination treatment is recommended to remove all the salts from the swivel gun and gloves should be worn for all manual handling to minimise any future contamination.

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Appendix 1. Contact sheet Dundee Beach Bronze breech loading Swivel Gun[1]

BSG_01.jpg

BSG_02.jpg

BSG_03.jpg

BSG_04.jpg

BSG_05.jpg

BSG_06.jpg

BSG_07.jpg

BSG_08.jpg

BSG_09.jpg

BSG_10.jpg

BSG_11.jpg

BSG_12.jpg

[1] All photographs by Regis Martin 2012

BSG_13.jpg

BSG_14.jpg

BSG_15.jpg

BSG_16.jpg

BSG_17.jpg

Appendix 2. Conservation report: Breech-loading swivel gun

Description:
Small, cast copper-alloy cannon with a calibre of 22mm. The gun is of a size to make it portable and it would probably have been mounted on the deck railing of a sailing ship on a swivel stand to enable a wide arc of movement. It fired small calibre shot and is of the type used as short-range antipersonnel ordnance. It is designed to have a mug-shaped chamber filled with gun powder and a projectile loaded into the breech opening and then blocked with a pin or wedge across the back (through the two square holes) before firing.
It was reportedly recovered from an intertidal zone on the Northern Territory's Dundee Beach, south-west of Darwin.
Hand-held XRF spectroscopic elemental analysis of the surface has indicated a high lead content, and this is consistent with the weight of the object. Adding lead to bronzes (where the lead is distributed as fine globules throughout the copper-tin matrix) lessens the strength and also therefore the shock- and wear-resistance of the gun, but enhances the casting characteristics, corrosion resistance, and the 'plasticity' (having some self-lubricating properties and allowing for some misalignment). Variation of alloy components in XRF results in different surface locations on the gun may indicate poor mixing of the alloying metals prior to casting or differential erosion and/or dealloying of the surface through galvanic corrosion reactions during burial in the marine environment.
The remnants of four iron alloy chaplets from the casting process are detectable on the surface behind the trunnions and forward of the breech opening.

Condition:
The gun exhibits overall corrosion and surface pitting with embedded sand and marine gravels consistent with immersion in the sea for an extended period. There are also some thicker clumps of corrosion products incorporating trapped sand particles on the barrel surface. A marine shell is firmly wedged in one of the rectangular blocking holes at the rear of the breech.
The gun's surface is extensively dented and the barrel is distorted (curved) along its length, consistent with a high lead content metal (i.e. less strong; more plastic).
Wear on high points / projections such as the trunnions, swivel boss, and rings is fairly minimal and less than would be expected for partial burial in an abrasive sandy environment where scour would be expected to abrade the corroded surface to expose more bare (and oxidised) metal at these points. However, the exposed brown oxidised metal surface is visible at both ends of the gun, and a scratched and abraded area at the muzzle rim shows the non-oxidised yellowish base metal.
Overall, the gun's corroded surface has a smooth, almost burnished, appearance suggesting it has received considerable handling with unprotected (greasy) hands following its recovery. Some scuffing and paint deposits are also due to recent poor handling.
There is some variation in appearance and nature of the corrosion layers on different areas of the gun's surface so these are individually described in more detail, below.

Upper surface:
Corrosion products are green over a red-brown oxidised metal surface. The gun appears to be stable but there are two bright green corrosion spots (9x4mm and 7x4mm) approx. 185mm from the muzzle that may be active. Under magnification, sand can be seen on various areas of the surface, such as embedded:

- in rings and 'incisions' behind the trunnions
- around the perimeter of the swivel boss
- in two 'incised' lines around the cascabel-type protrusion behind the breech, and in the hole at its end.

Lower surface:
The underside of the gun is less pitted and more eroded and worn than the upper side, suggesting this was the exposed and more abraded side during burial/semi-burial. Corrosion products are patchy red-brown (copper oxides), green (copper carbonates, chlorides, etc.) and orange-red overall. Some of the orange-red colour can be attributed to iron staining (from corroding Fe objects in close proximity in the burial environment) but much of the variation is due to differential wear and more physical erosion than corrosion of these areas.

Inside breech:
Corrosion products are noticeably different within the breech opening to the other surfaces of the gun. They are red-brown overall with very little trace of green, indicating that the environment there has been different. The overall appearance and the nature of the surface when viewed under high magnification—a fine, even, translucent colourless layer with embedded sand—suggests that something was inside the breech during most of the gun's immersion in the corrosive marine environment, most likely the breech chamber. The pin or wedge that secures the chamber in the breech for firing was not present, allowing the chamber to fall out and be lost and for corrosion and marine accretions to build up in the two holes through which the pin would pass.
Inside bore: The bore is open at the breech end but blocked approx. 50 mm from the muzzle opening with what appears to be mud in the form of nests deposited by a mud wasp. The fine surface corrosion layer incorporates fine sand. A noticeable black surface deposit within the bore may be associated with use (i.e. smoke / gunpowder residues).

Treatment:
A precautionary desalination treatment is recommended. This should be undertaken in several successive baths of deionised water, monitoring chloride ion release as a guide to salts' diffusion rates and completion of treatment.
Localised application of a 3% w/v benzotriazole (BTA) solution to the two bright green corrosion spots described above is recommended to assist with stabilisation. (An overall BTA treatment is not advisable as the gun may be returned to its finders and handled extensively by them in the future.)
Handling with gloves is recommended to minimise future contamination.

Sue Bassett
29 April 2012

Appendix 3. Contact sheet Bali Museum Bronze breech loading Swivel Gun[2]

DSCN0732.JPG

DSCN0733.JPG

DSCN0734.JPG

DSCN0735.JPG

DSCN0736.JPG

DSCN0737.JPG

DSCN0738.JPG

DSCN0739.JPG

DSCN0740.JPG

DSCN0741.JPG

DSCN0742.JPG

DSCN0743.JPG

[2] all photographs by Paul Clark 2013

DSCN0744.JPG

DSCN0745.JPG

DSCN0746.JPG

DSCN0868.JPG

DSCN0869.JPG

DSCN0870.JPG

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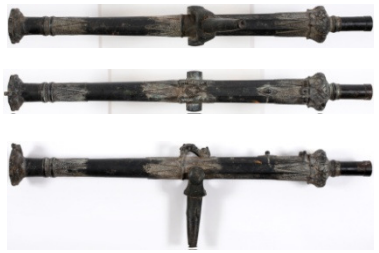
DSCN0880.JPG

DSCN0881.JPG

DSCN0882.JPG

APPENDIX 4 – Swivel guns in the MAGNT collection.

Coll #	*Title*	*Description*	*Date*	*Image*
IND 00295	Swivel gun [bronze] Known as *lantaka* in the Philippines, *bedil* in Brunei, and *lela* in Malaysia and Indonesia. [purchased from Lou Marchant] MS R7.B2.S5	Bronze swivel gun , without the customary yoke (chagak) and spike. Maker and age unknown. Round in cross-section. Little ornamentation. Damage to rear tubular projection. Length: 112 0 mm Diameter at touch hole: Bore:	?	
IND 00364	Swivel gun [bronze] Known as *lantaka* in the Philippines, *bedil* in Brunei, and *lela* in Malaysia and Indonesia. [purchased from Lou Marchant] ARM floor	Bronze swivel gun, with yoke (chagak) and spike. Maker and age unknown. Octagonal in cross-section. In good condition. Length: 1200 mm Diameter at touch hole: Bore:	?	
IND 00371	Swivel gun [bronze] Known as *lantaka* in the Philippines, *bedil* in Brunei, and *lela* in Malaysia and Indonesia . [purchased from Alan Wall] MS 7.3.5	Bronze swivel gun, without yoke (chagak) and spike. Maker and age unknown. Round in cross-section. Length: 880 mm Diameter at touch hole: Bore:	?	
IND 00373	Swivel gun [bronze] Known as *lantaka* in the Philippines, *bedil* in Brunei, and *lela* in Malaysia and Indonesia [purchased from Jerry Williams] MS 7.3.5	Bronze swivel gun, with yoke (chagak) and part of spike. Maker and age unknown. Round in cross-section. Length: 770 mm Diameter at touch hole: Bore:	?	

Coll #	*Title*	*Description*	*Date*	*Image*
IND 00700	Swivel gun [bronze] Known as *lantaka* in the Philippines, *bedil* in Brunei, and *lela* in Malaysia and Indonesia [purchased from Neville Coyne] ARM floor	Bronze swivel gun, with yoke (chagak) and spike. Maker and age unknown. Octagonal in cross-section. Length: 1200 mm Diameter at touch hole: Bore:		
IND 00701	Swivel gun [bronze] Known as *lantaka* in the Philippines, *bedil* in Brunei, and *lela* in Malaysia and Indonesia [purchased from Lou Marchant] MS 7.3.5	Bronze swivel gun, with yoke (chagak) and spike. Maker and age unknown. Maker and age unknown. Distended decorative muzzle, twin handles in the shape of dolphins, crocodile carved on rear top of barrel. Round in cross-section. Length: 780 mm Diameter at touch hole: Bore:		
IND 01515	Swivel gun [bronze] Known as *lantaka* in the Philippines, *bedil* in Brunei, and *lela* in Malaysia and Indonesia [purchased from Gus Withnall] ARM floor	Lela or swivel gun (lantaka is the term used in the Philippines) with the customary yoke (chagak) and spike. Maker and age unknown. Elaborately decorated (in brass?), twin handles in the shape of dolphins. Round in cross-section. Length: 1500 mm Diameter at touch hole: Bore:	?	

Appendix 5 – <u>XRF – Net Photon data</u> [seven bronze swivel guns & one small bronze cannon from the MAGNT collection] – 3 September 2012

	Ti K12	Cr K12	Fe K12	Cu K12	Zn K12	Pb L1	As K12	Sb K12	Sn K12	Ag K12
SEA 295_1 Tiller Socket	692	323	43863	8606719	158688	196573	42499	3484	230681	17712
SEA 295_2 near yoke	1213	304	49369	9556978	207071	102311	46147	2086	162890	10180
SEA 295_3 Muzzle	1066	657	75726	7434215	154617	256828	55646	3083	298900	10911
SEA 364_1 Tiller Socket	912	39	99856	5882236	2683544	333581	29148	8594	87432	3791
SEA 364_2 near yoke	844	132	96445	5259907	3026151	533971	33301	16875	58505	4107
SEA 364_3 Muzzle	965	301	236469	4114938	2530780	396544	28116	10554	28218	3239
SEA 371_1 Tiller Socket	802	526	42139	8870210	158123	128341	6802	-49	284910	3321
SEA 371_2 near yoke	575	525	24750	9008274	125284	51189	2783	-8	306478	3303
SEA 371_3 Muzzle	1173	828	58006	7237795	117543	129755	8556	-6	386277	3516
SEA 373_1 Tiller Socket	1008	680	97717	7482443	2205556	151120	10559	1221	70949	4158
SEA 373_2 near yoke	1091	176	93344	6455919	2348898	239658	10948	1057	139732	4039
SEA 373_3 Muzzle	1200	306	90891	6143185	2527753	156566	8479	893	98053	4032
SEA 700_1 Tiller Socket	1396	654	135143	3092310	7751383	77399	3710	756	1243	4183
SEA 700_2 near yoke	1548	436	77534	4107788	7397127	21010	718	143	780	3816
SEA 700_3 Muzzle	11826	618	101700	5940707	5050797	38770	5188	89	1141	4456
SEA 701_1 Tiller Socket	1494	428	165755	7036497	2845710	171796	22318	7101	15981	4160
SEA 701_2 near yoke	862	341	121123	5508972	2064892	125013	14293	4209	12824	2888
SEA 701_3 Muzzle	738	175	394294	6562794	2401043	324428	28480	8201	24581	3799
SEA 1515_1 Tiller Socket	1391	253	222110	7478997	2844855	220829	18687	14270	50897	4007
SEA 1515_2 near yoke	913	479	174985	6153099	1162446	544061	26866	12711	44139	3108
SEA 1515_3 Muzzle	2359	302	85538	7461671	2635081	189400	13579	11011	43857	4194
SEA 1516_1 Tiller Socket	759	15890	38780	8593590	43994	86740	314414	6946	238605	8646
SEA 1516_2 near yoke	3014	321	22119	8330260	49619	117942	317222	6901	274171	6430
SEA 1516_3 Muzzle	2036	134	130129	7129537	58446	83215	206793	5950	195734	7537

XRF – Photon Spectra