**SALTFORD BRASS MILL PROJECT**

**METALLURGICAL ANALYSIS OF MANILLAS, ARM RINGS AND ANKLE RINGS**

**PRELIMINARY REPORT**

***Authors***

Anthony Coverdale. Saltford Brass Mill Project

Dr Tobias Skowronek. Deutsches Bergbau-Museum Bochum

***Synopsis***

*The collection of the Saltford Brass Mill Project includes two manillas, presumed to have been made by the Harford and Bristol Brass Company in the late 18th Century, two arm-rings and an ankle-ring, presumed to have been made in West Africa, recycling manillas or brass hollow-ware, and a manilla from the wreck of the Duoro, presumed to have been made in Birmingham. An opportunity arose to conduct a metallurgical analysis of the artefacts by the Deutsches Bergbau-Museum Bochum. This short paper summarises the background to the Saltford artefacts and the preliminary results of the metallurgical analysis.*

## Saltford Brass Mill Project Artefacts

The Saltford Brass Mill Project collection includes two manillas, an ankle ring and two arm ring which were in the possession of Alfred Cecil Davies, the son of Alfred Thomas Davies, the last owner of the Bristol Brass Company. The items (Appendix A) have cardboard tallies attached, printed with the name Harford & B. B. Co, and with a hand written description of the item on the reverse:

# 1: Manilla. Coinage of the Bonny District, Nigeria
# 2: Manilla. Coinage of the Ivory & Gold Coast
# 3: Man's Ankle Ring. Ivory & Gold Coast District
# 4: Man's Arm Ring
# 5: Woman's Arm Ring

The collection also includes a manilla from the wreck of the schooner Duoro, which was bound for Portugal out of Liverpool but which was lost in 1843 at Round Rock off the Scilly Isles. The ship had a cargo of textiles, munitions and a large number of manillas:

# 6: Manilla. From the wreck of the Duoro.

The Bristol Brass Company was established in 1702 but restructured in 1786 to become the Harford & Bristol Brass Company. The Harford family ran the business until 1836 when the company was sold. The company then went through a number of changes of ownership until 1925 when the company ceased trading, but continued to be known as the Harford & B.B.Co until its closure,

Such items would not have been made by the company during Alfred's life but there are records of the company making manillas in the late 1700s. It has always been assumed that the manillas date from this time and had been retained by the company as samples of their produce.

The Harford artefacts fall into two categories:

- Manillas # 1 and # 2: assumed to have been made by Harfords in Bristol and examples of the products produced by the company for sale to Merchant Venturers for use in trade with West African merchants, the manillas being the circulating currency of the various regions.
- Ankle Ring / Arm Rings # 3, # 4 # 5: assumed to have been made in West Africa and brought back to Bristol by merchant ship captains as examples of the type of ornamental bracelets being produced in Africa.

**Eighteenth Century Production of Manillas in England**

The development of the English brass industry is described in "The Red Gold of Africa" [Herbert, Ref A, 1984]. In the 1690s a series of fortuitous developments in the brass industry of Britain improved production. This eventually gave British manufacturers the edge in the brass trade in Africa which led to the development of the crescent-shaped and flared ended brass piece known as the Birmingham manilla. These were well-made and weighed about 90 grams though a larger pattern was about 300 grams. The trade in copper became enmeshed in the slave trade when Birmingham developed into a centre for finished brass wares. In 1767 a factory in Warrington was manufacturing manillas, in 1767 the Warmly company stock listed its Guinea manillas, and the Cheadle Brass Wire Company opened its Manilla House and Assay Office in 1790

There were six major centres of brass and copper production in the England in the 18th Century:

***Bristol***

- 1696: Conham Copper Works established. Abraham Elton & Gabriel Wayne.
- 1702: Bristol Brass Company established. Abraham Darby, later Nehemiah Champion.
- 1711: Crews Hole Copper Works opened. John & Thomas Coster.
- 1746: Warmley Brass Company established. William Champion. Bankruptcy 1768
- 1786: Bristol Brass Company restructured. Became Harford's & Bristol Brass Company.

***Warrington, Cheadle and Staffordshire***

- 1717: Copperworks established at Bank Quay, Warrington. Thomas Patten.
- 1719: Cheadle Company formed. Thomas Patten and associates.
- 1734: Cheadle Copper and Brass Company established, Staffordshire. Thomas Patten.

***Macclesfield***

- 1758: Charles Roe and Copper Company established at Macclesfield. Charles Roe.

***North Wales***

- 1768: Parys Mountain mine opened, leased to Charles Roe.
- 1783: Greenfield Copper and Brass Company established. Thomas Williams.
- 1785: Mona Mine Company established. Thomas Williams (The Copper King).

***Swansea***

- 1717: Llangyfelach copperworks established. Dr John Lane of Bristol.
- 1720: Cambrian Copper Works established. James Griffiths and Company.
- 1737: White Rock Copperworks established. Thomas Coster of Bristol.
- c.1749: Fforest Copperworks established. Lockwood, Morris & Co.
- 1755: Middle Bank Copper Works established. Chauncy Townsend.
- 1782: Middle Bank Copper Works expanded. Thomas Williams.
- 1790: Birmingham Mining & Copper Company established.
- c.1790: Fforest Copperworks leased to Harfords & BBC. Operated until 1820.
- 1793: Landore Copper Works established. Lockwood, Morris & Co.

***Birmingham***

- 1740: Turners Brass House established.
- 1767: Birmingham Patent for making Brass. William Champion.
- 1780: Birmingham Metal Company established.
- 1783: Thomas Bolton & Sons established.

A contemporary account of manilla production in Bristol and Birmingham has survived from 1866. W.C. Aitken described the production of manillas in "The History of Brass and Brass Manufacturers" [Aitken, Ref B, 1866]. The account (which includes terms, which have been redacted, that reflect the times but are unacceptable today) states:

> *"Immense quantities of a species of money, known as "Manillas", were at one time produced in Birmingham by casting. It closely resembled an object figured in Knight's Pictorial England (a species of ring money), and was exported to the Spanish settlements on the New and Old Calabar, and the Bonny Rivers in Africa. In addition to that produced in this town, it was largely manufactured by the Bristol house of Harfords, and by the Cheadle Company, and was cast of a metal composed of copper with a very large proportion of lead as an alloy, and hardened by arsenic.*
>
> *In an evil hour, however, a very sharp trader, not a little unscrupulous, animated by the desire to speedily rich, conceived the brilliant idea of producing these objects in cast iron, and coppering them over by the electro deposit process. On their arrival at their destination the deception was at once detected, the "Manilla" rejected, and they now lie bulked up by the side of the African river where they were disembarked, are "taboo" to the Africans, and remain a standing monument, not to the honour and probity of the exporter by whom they were sent out.*
>
> *This gave the quietus to the manufacture of "Manilla" money in Birmingham until very recently when the manufacture has been recommenced by Mr. Thomas Horne, in consequence of orders received for limited quantities. Once taken in however, the [redacted]" were not to be done a second time; with the order came the [redacted] "mint master" of the [redacted], who examined every example, rejecting those which were not satisfactory. No mean idea of*

*the quick perception of these [redacted] will be gathered from the fact that a few examples, slightly different in composition (which a Birmingham man would have passed over), and which, externally, formed no contrast to the bulk accepted, were at once thrown to one side, with an expressive "Ugh!" from the examiner. "Manillas," after being cast, were simply "shaken" in a revolving barrel, in order to remove the sand from the exterior, and to give an approximate degree of brightness, by a process generally adopted to brighten iron chain".*

Trade with Africa did continue after the abolition of slavery in 1807, one such example being the palm oil trade in which manillas of various types were traded for oil. Birmingham rose in ascendancy in the early 1800s, becoming the most significant city manufacturing brass wares in Europe. Most patterns of manilla were made in Birmingham but the most common piece exported from the city by 1836 appears to be of the smaller type, compared to the heavier Portuguese type of the 16th Century. A later type of manilla was the Okpoho (the Efik[1] word for brass) and many Okpoho manillas were salvaged from the wreck of the schooner Duoro; lost off the Isles of Scilly in 1843. The Saltford Brass Mill Project's collection includes one of these manillas.

**Metallurgical Analysis**

In 2021, the Project provided Dr Tobias Skowronek of the Deutsches Bergbau-Museum Bochum (Mining Museum, Bochum, Germany) with samples of the Saltford artefacts in support of his research into the metallic composition of manillas used for trade with West Africa in the eighteenth and early nineteenth centuries. The preliminary results of that analysis are at Table 5.

Dr Skowronek also analysed the lead isotopes present in the samples and compared the results with the Oxford Archaeological Lead Isotope Database (OXALID) for the British Isles [Rohl, 1996, Ref C][2]. Lead isotope analysis is a method of establishing the geographical origin of lead present in metals and other materials, for which minerals containing lead were used in their manufacture. The comparison permitted an assessment to be made of the source of lead present in the samples, the principal sources in England being the Mendip, the Peak District or the Northern Pennines.

This work builds upon earlier work carried out by Dr Skowronek in support of his PhD thesis [Ref D]

**Expectation**

The two sub-groups have different outward and stylistic appearances, the manillas being plain with a dark patina while the ankle and arm rinks are ornamented and are lighter in colour. The expectation was:

- The two sub-groups would have a different metallurgical composition.
- The manillas (#1 and #2) would have had a composition similar to that described by Aitken, i.e., copper with a very large proportion of lead as an alloy, and hardened by arsenic.
- The manillas may additionally have a significant proportion of antimony, nickel, cobalt and bismuth as it is believed that metallurgic wastes were used when casting manillas in the UK to reduce their production costs.

[1] The indigenous language of the Efik people of Nigeria

[2] The database contains data for the ores from the British Isles, obtained by Dr. Brenda Rohl in the Isotrace Laboratory in the years 1992 to 1996 as part of her DPhil thesis.

**Manillas #1, #2 and #6**

Manillas #1 and #2 are mixed copper alloys (Table 5). Both are good quality, easy castable, alloys, comparable to the standard Bristol brass but with added lead so that it can flow easily when recast. The manillas contain higher levels of lead but do not contain significant levels of arsenic antimony, nickel, cobalt or bismuth.

| | wt.-% Cu | wt.-% Zn | wt.-% Pb | wt.-% Sn | wt.-% As |
|---|---|---|---|---|---|
| **#1** | 60.0 | 6.0 | 23.10 | 3.88 | 0.29 |
| **#2** | 47.0 | 31.9 | 8.67 | 2.52 | 0.25 |

Table 1. Extract - Bergbau-Museum Analysis – Manillas #1 and #2

Manilla #1

Manilla #1 is a low zinc brass (60% copper / 6% zinc) with a large proportion of lead (23.1%), presumably used to create an easily castable alloy. The alloy also contains 3.9% tin but has only a low concentration of arsenic (0.29%). Other metals are present in trace quantities only.

Comparison with the OXALID database shows that the lead in Manilla #1 has strong similarities with lead from the Merehead Quarry at East Cranmore, Somerset near Shepton Mallet in the Mendip, where lead was mined in the 17th and 18th centuries. It would therefore seem probable that manillas were cast in Bristol, possible sites being Baptist Mills, Warmley or Keynsham.

Manilla #2

Manilla #2 is a higher zinc brass (47% copper / 31.9% zinc) with 8.7% lead and 2.52% tin but a low concentration of arsenic (0.25%). The composition is broadly similar to the 16th Century Portuguese Manillas or "tacoais" analysed by Dr Rolf Denk. [Denk, Ref E, 2017]. The composition of two “tacoais” type manillas recovered the wreck of the Flemish cargo ship, known as an Urca, lost off Getaria Bay in Northern Spain in 1524 are shown at Table 2. The “tacoais” are nominally 70:20 brass with 10% lead.

| | wt.-% Cu | wt.-% Zn | wt.-% Pb | wt.-% Sn | wt.-% As |
|---|---|---|---|---|---|
| | 68.60 | 20.60 | 10.50 | | |
| | 65.74 | 23.15 | 11.11 | | |

Table 2. Analysis of 16th Century “tacoais” type manillas – R Denk

The lead in Manilla #2 is from a Precambrian mineralized ore, sources of which do not exist in Great Britain or continental Europe. Precambrian lead exists in Australia, Cuba or Chile; hence the lead was imported which possibly points to the manilla being cast in Swansea where Harford’s operated the Fforest Copper Smelting works from c.1790 to 1820.

Manilla #6

Manilla #6, the Okpoho manilla recovered from the Duoro, is of similar size, weight and style to Manilla #1. Three other manillas recovered from the Duoro in the collection of the British Museum were analysed by Craddock & Hook in 1995[3] and recorded by Denk [Ref E].

Craddock & Hook’s analysis (Table 3) shows that Saltford’s Manilla #1 has similar metallurgy to the Duoro manillas, having a high concentration of copper and lead, and a low concentration of arsenic. But they differ in that the Duoro manillas have negligeable zinc (hence are not a brass), have a lower concentration of tin and have a small but significant concentration of antimony.

[3] P.T Craddock & D Hook. Department of Scientific Research. British Museum

| | wt.-% Cu | wt.-% Zn | wt.-% Pb | wt.-% Sn | wt.-% As | wt.-% Fe | wt.-% Sb |
|---|---|---|---|---|---|---|---|
| | 61.9 | >0.008 | 30.8 | 0.6 | 0.05 | 0.02 | 4.01 |
| | 65.6 | >0.008 | 29.1 | 0.4 | 0.05 | 0.03 | 4.42 |
| | 66.7 | >0.008 | 25.3 | 0.9 | 0.06 | 0.02 | 4.40 |

Table 3. Analysis of manillas recovered from the Duoro – Craddock & Hook. 1995

Manilla #6 has not yet been analysed by the Deutsches Bergbau-Museum Bochum. It is planned to carry out that analysis using the same techniques as #1 to #5, to compare its composition with that observed by Craddock and Hook and compare the lead isotope fingerprint with the OXALID database.

**Rings #3, #4 and #5**

Rings #3 to #5 are all brasses with a zinc concentration ranging between 13% and 27% (Table 5):

- Ring #3 is a 70:30 brass, (70% copper / 27% zinc) with a small proportion of lead (2.14%).
- Ring #4 is a lower zinc brass (78% copper / 20.4% zinc) with a small proportion of lead (1.42%).
- Ring #5 is a is lower zinc brass (75% copper / 13.1% zinc) with a small proportion of lead (2.09%).

Stylistically, the rings all appear to have been made in West Africa, however the lead isotope analysis show the presence of European lead, probably from the Northern Pennines. It is therefore postulated that the metal originated from one of the northern brass companies in England but that they were made in West Africa by re-casting imported manillas or hollow-ware which was mixed with local copper.

| | wt.-% Cu | wt.-% Zn | wt.-% Pb | wt.-% Sn | wt.-% As |
|---|---|---|---|---|---|
| **#3** | 70.0 | 27.0 | 2.14 | 0.02 | 0.083 |
| **#4** | 78.0 | 20.4 | 1.42 | 0.40 | 0.089 |
| **#5** | 75.0 | 13.1 | 2.09 | 2.00 | 0.16 |

Table 4. Extract - Bergbau-Museum Analysis – Rings #3 to #5

| | wt.-% Cu | wt.-% Zn | wt.-% Pb | wt.-% Sn | | wt.-% As | wt.-% Sb | wt.-% Ni | wt.-% Co | wt.-% Bi | | wt.-% Fe | wt.-% Ag | wt.-% Te | wt.-% P | wt.-% S | wt.-% Se |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **#1** | 60.0 | 6.0 | 23.10 | 3.88 | | 0.29 | 0.21 | 0.086 | 0.0023 | 0.06 | | 0.44 | 0.048 | 0.0011 | 0.0047 | 0.11 | 0.0017 |
| **#2** | 47.0 | 31.9 | 8.67 | 2.52 | | 0.25 | 0.39 | 0.11 | 0.0047 | 0.023 | | 0.47 | 0.036 | 0.0008 | 0.011 | 0.024 | <0.001 |
| **#3** | 70.0 | 27.0 | 2.14 | 0.02 | | 0.083 | 0.012 | 0.056 | 0.00036 | 0.018 | | 0.14 | 0.035 | 0.0023 | 0.003 | 0.022 | 0.0043 |
| **#4** | 78.0 | 20.4 | 1.42 | 0.40 | | 0.089 | 0.018 | 0.07 | 0.0004 | 0.026 | | 0.14 | 0.027 | 0.0014 | 0.0024 | 0.047 | 0.0034 |
| **#5** | 75.0 | 13.1 | 2.09 | 2.00 | | 0.16 | 0.033 | 0.1 | 0.0011 | 0.026 | | 0.28 | 0.032 | 0.0019 | 0.0021 | 0.072 | <0.001 |

Table 5. Bergbau-Museum Metallurgical Analysis

**References**


A. Red Gold of Africa – Copper in Precolonial History and Culture. Eugenia W. Herbert. 1984

B. Brass and Brass Manufacturers. The early history of the metal; the introduction of the manufacture of brass into England; its development; introduction into Birmingham; progressive and present condition of the manufacture. W.C. Aitken. 1866

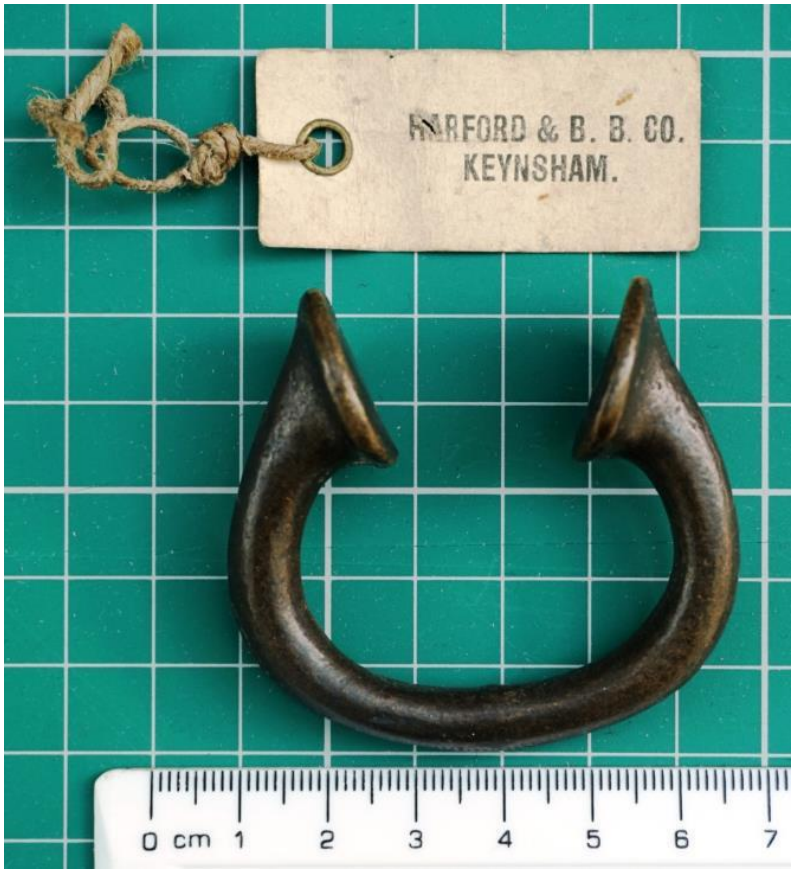
C. Oxford Archaeological Lead Isotope Database. Rohl, B.M. 1996. Lead isotope data from the Isotrace Laboratory, Oxford: *Archaeometry* data base 2, galena from Britain and Ireland. *Archaeometry* 38 (1). 165-180. Website: https://oxalid.arch.ox.ac.uk - OXALID The Oxford Isotrace Lead.

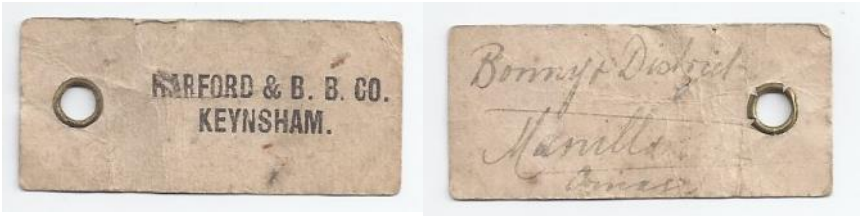
D. Geochemical characterisation of non-ferrous metal bars and semi-finished products of the early modern period to answer historical issues. Dr Tobias Skowronek. Faculty of Earth Science, Ruhr University, Bochum. PhD Dissertation. 2021

E. The West African Manilla Currency. Dr Rolf Denk. Tredition. 2021

# Appendix A  Saltford Brass Mill Project – Manillas and Rings

## # 1:  Manilla.  Currency of Bonny District, Nigeria




Inscription on cardboard tally attached to manilla:

*Harford & B. B. Co.*

*Bonny & District, Manilla, Coinage*

Diameter:  6cm

Weight: 74g

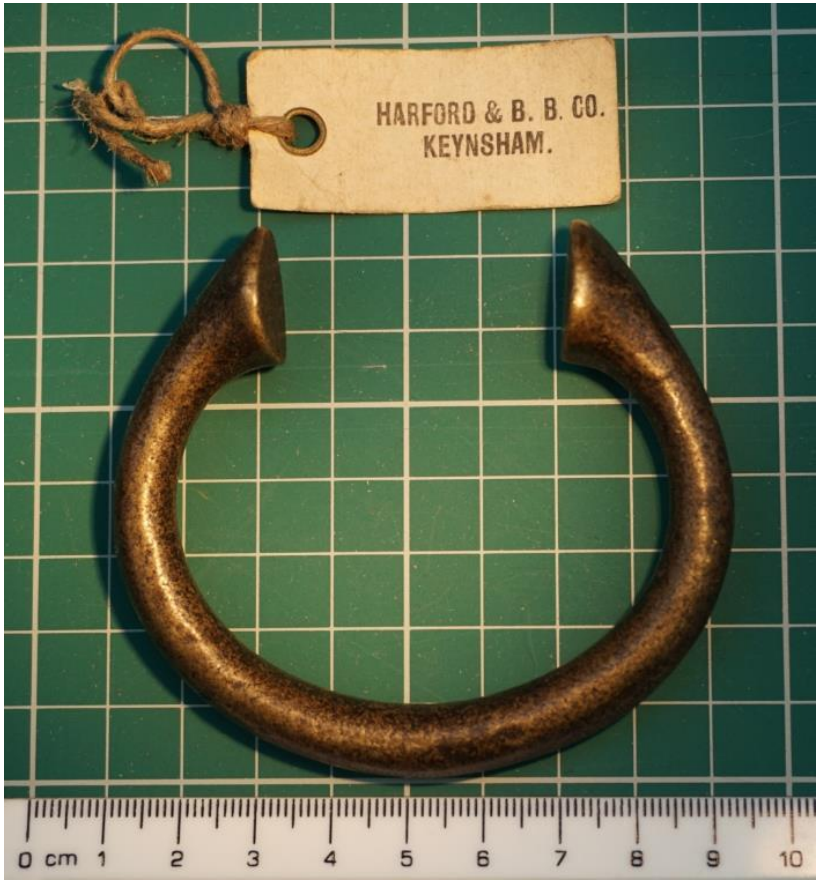
Cast copper alloy showing visible casting seams.

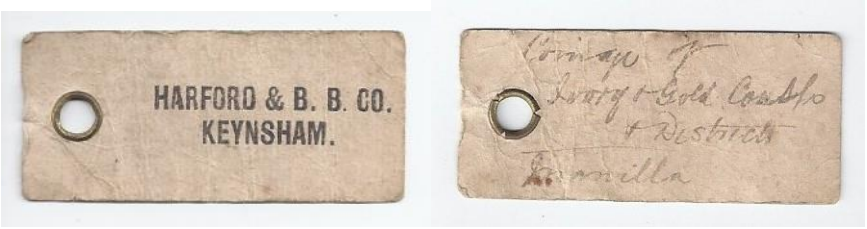
From a collection made by Alfred Cecil Davies, son of the last manager of the Bristol Brass Company (1903-1925).  Harford & B.B. Co. - Harford & Bristol Brass Company - operated from 1786 until 1836.  Manilla production would have stopped by 1807, the year of the Slave Trade Act.

Assumed made in Keynsham between 1786 and 1807.

| | wt.-% Cu | wt.-% Zn | wt.-% Pb | wt.-% Sn | wt.-% As |
|---|---|---|---|---|---|
| **#1** | 60.0 | 6.0 | 23.10 | 3.88 | 0.29 |

**# 2: Manilla. Currency of Ivory & Gold Coast**




Inscription on cardboard tally attached to manilla:

*Harford & B. B. Co.*

*Coinage of Ivory & Gold Coast & District, Manilla*

Diameter: 8cm

Weight: 115g

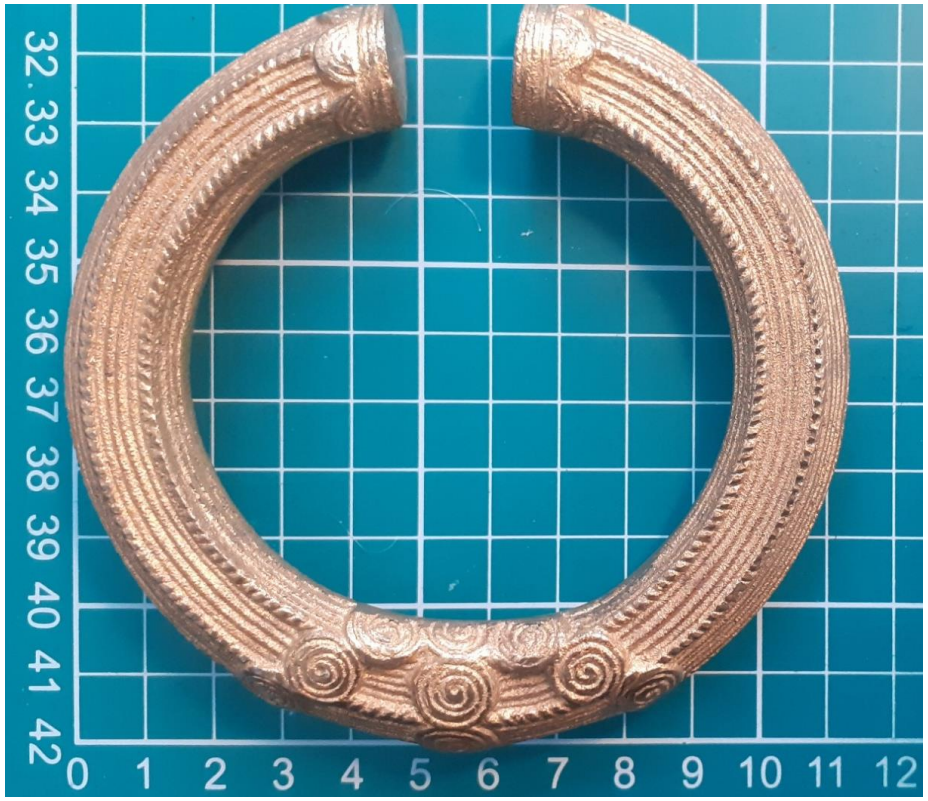
Cast copper alloy showing visible casting seams.

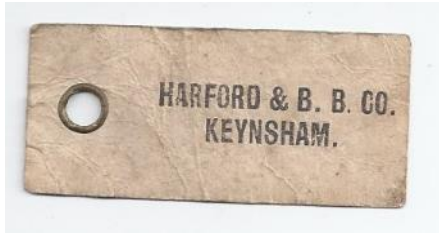
From a collection made by Alfred Cecil Davies, son of the last manager of the Bristol Brass Company (1903-1925). Harford & B.B. Co. - Harford & Bristol Brass Company - operated from 1786 until 1836. Manilla production would have stopped by 1807, the year of the Slave Trade Act.

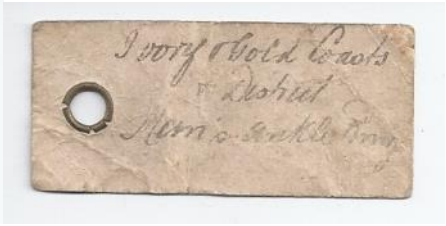
Assumed made in Keynsham between 1786 and 1807.

| | wt.-% Cu | wt.-% Zn | wt.-% Pb | wt.-% Sn | wt.-% As |
|---|---|---|---|---|---|
| **#2** | 47.0 | 31.9 | 8.67 | 2.52 | 0.25 |

**# 3: Man's Ankle Ring**



Inscription on cardboard tally attached to ankle ring:

*Harford & B. B. Co.*

*Ivory or Gold Coast & District. Man's Ankle Ring*

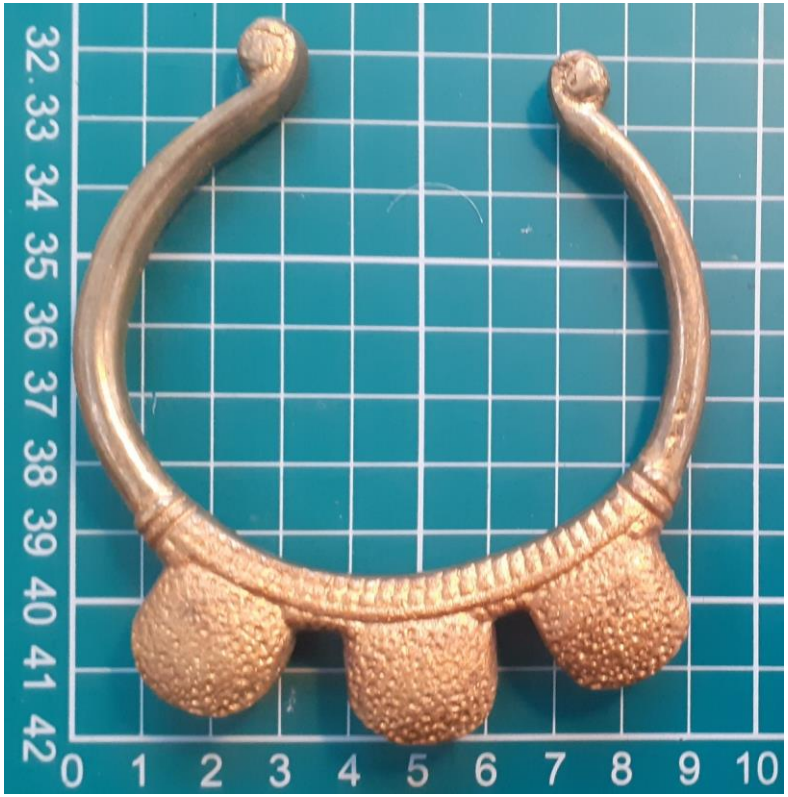
Diameter: 11cm

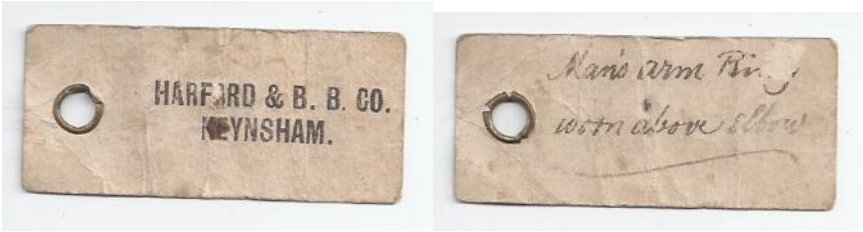
Weight: 419g Solid

From a collection made by Alfred Cecil Davies, son of the last manager of the Bristol Brass Company (1903-1925). Harford & B.B. Co. - Harford & Bristol Brass Company - operated from 1786 until 1836. Rings are unlike the manillas make in England for export, being jewellery as opposed to coinage. Speculation that it may have been made in Africa and sent back to Bristol.

| | wt.-% Cu | wt.-% Zn | wt.-% Pb | wt.-% Sn | wt.-% As |
|---|---|---|---|---|---|
| **#3** | 70.0 | 27.0 | 2.14 | 0.02 | 0.083 |

**# 4: Man's Arm Ring**




Inscription on cardboard tally attached to arm ring:

*Harford & B. B. Co.*

*Man's Arm Ring, worn above elbow*

Diameter: 9cm

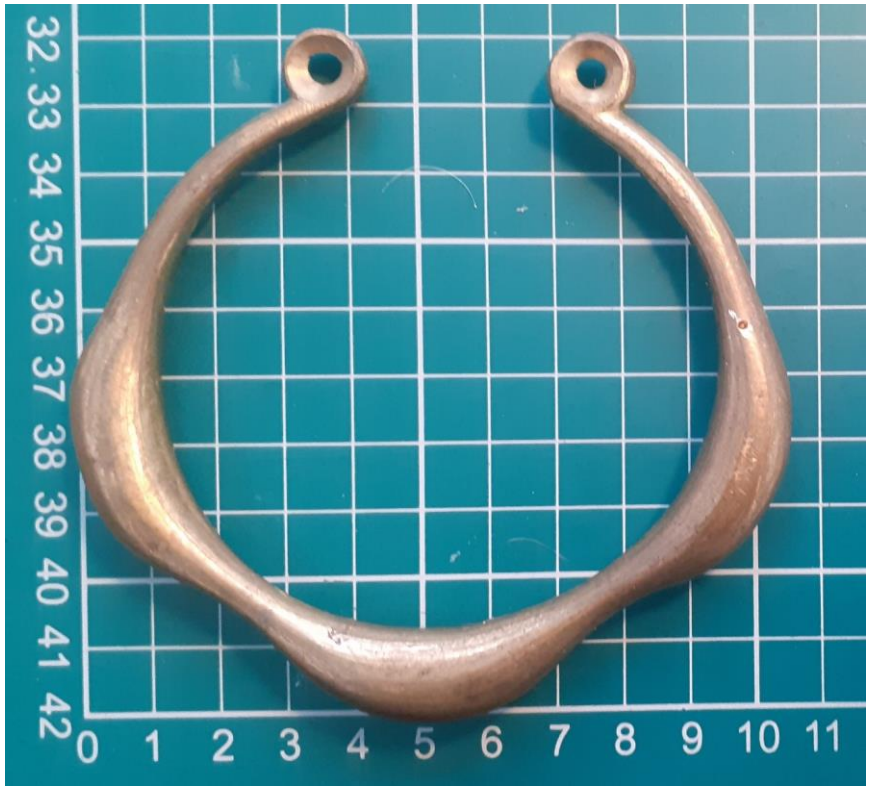
Weight: 126g

Arm ring incorporates three bells

From a collection made by Alfred Cecil Davies, son of the last manager of the Bristol Brass Company (1903-1925). Harford & B.B. Co. - Harford & Bristol Brass Company - operated from 1786 until 1836. Rings are unlike the manillas make in England for export, being jewellery as opposed to coinage. Speculation that it may have been made in Africa and sent back to Bristol.

| | wt.-% Cu | wt.-% Zn | wt.-% Pb | wt.-% Sn | wt.-% As |
|---|---|---|---|---|---|
| **#4** | 78.0 | 20.4 | 1.42 | 0.40 | 0.089 |

**# 5: Woman's Armlet**






Inscription on cardboard tally attached to arm ring:

*Harford & B. B. Co.*

*Woman's Arm Ring: worn above the elbow*

Diameter: 10cm

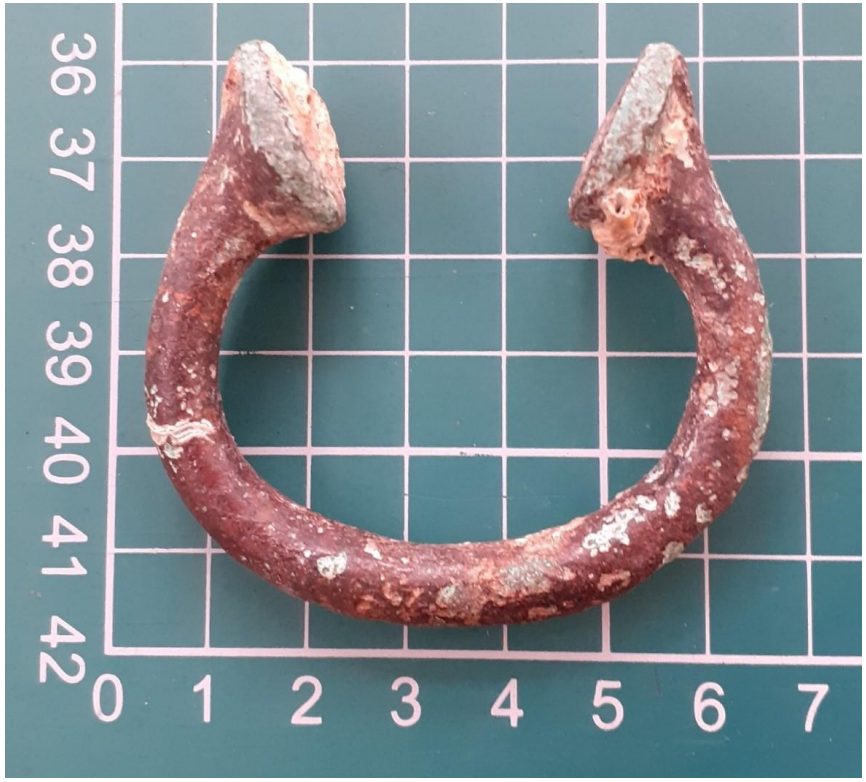
Weight: 93g

Arm ring incorporates three bells

From a collection made by Alfred Cecil Davies, son of the last manager of the Bristol Brass Company (1903-1925). Harford & B.B. Co. - Harford & Bristol Brass Company - operated from 1786 until 1836. Rings are unlike the manillas make in England for export, being jewellery as opposed to coinage. Speculation that it may have been made in Africa and sent back to Bristol.

| | wt.-% Cu | wt.-% Zn | wt.-% Pb | wt.-% Sn | wt.-% As |
|---|---|---|---|---|---|
| **#5** | 75.0 | 13.1 | 2.09 | 2.00 | 0.16 |

**#6: Manilla from the wreck of the Duoro**




Manilla from the wreck of the schooner Duoro, bound for Portugal out of Liverpool but which was lost in 1843 at Round Rock off the Scilly Isles.

The ship had a cargo of textiles, munitions and a large number of manillas.

Diameter:  6cm

Weight: 75g

Very similar to Manilla #1, currency of Bonny & District

| | wt.% Cu | wt.% Zn | wt.% Pb | wt.% Sn | wt.% As | wt.% Fe | wt.-% Sb |
|---|---|---|---|---|---|---|---|
| | 61.9 | >0.008 | 30.8 | 0.6 | 0.05 | 0.02 | 4.01 |
| | 65.6 | >0.008 | 29.1 | 0.4 | 0.05 | 0.03 | 4.42 |
| | 66.7 | >0.008 | 25.3 | 0.9 | 0.06 | 0.02 | 4.40 |

Analysis of manillas recovered from the Duoro, Craddock & Hook.
1995