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Wood identification of a historical wooden games ball

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Summary

A wooden games ball discovered during renovations at the National Trust's Quebec House, in Westerham, Kent, underwent wood identification in order to determine which wood it was constructed from and why, and to help formulate an appropriate scientific dating approach. This was supplemented by some basic description and recording. The ball was identified as being made from *Buxus* sp. (box) and had been subjected to areas of wood loss via beetle infestation at some point in its history. Box is a hard, dense wood, suitable for use in an impact ball game of some sort; speculation has been that it was used for (proto) cricket, although other games such as pall mall (an early form of croquet) used boxwood balls.

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For the images taken using the Keyence microscope, thanks to the AHRC for funding its purchase through the CapCo (Capability for Collections) Fund (Award AH/V011758/1).
Front cover image: The wooden games ball. Image: Z. Hazell © Historic England.

Archive location

The games ball is part of the National Trust's collection, and its permanent home is in Westerham House.

Date of research

This research was carried out between December 2023 and April 2024. This report was finalised in June 2024.

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1. Introduction

In 2017 renovations took place of the Grade II Listed cottage (ref. 1244134) located behind Grade I Listed Quebec House (ref. 1244133), in Westerham, Kent. Quebec House is the childhood home of General James Wolfe, who led British troops to victory in the ‘Seven Years War’ (AD 1756 to 1763) in Canada. The buildings and gardens are now owned and conserved by the National Trust. During the works, a wooden games ball was found in the bread oven of the cottage, and since its discovery it has been on display in the main house. The interest in it as a potential early example of a (proto-)cricket ball – the birthplace of cricket being SE England – led to it undergoing a series of analyses, including the wood identification work described in this report. As well as establishing its suitability for subsequent scientific dating, the work helped shed light on the possible original use of the ball.

2. Recording and description of the wooden ball

2.1 Size, shape and decoration

The ball is spherical, with its diameter measured as 91.97mm where complete (measured using digital Mitutoyo CD-8”CW callipers), and its circumference measured as 295mm (using a piece of string, then laid out against a tape measure). It is made from a single piece of wood, with the pith present approximately down the middle of the ball, with complete growth rings aligned concentrically outwards around it. Unfortunately, it was not possible to clearly distinguish all the rings for a ring count, although a minimum of between 60–70 rings were counted by eye. The wood itself is a pale, light brown colour internally. Remnants of the original outer surface suggest it was very smoothly finished, and of a darker colour (but it is unclear if this is dirt, or some form of original finishing/colouring). It has a series of 25 narrowly-spaced parallel engraved lines (each approximately 1.5mm apart, and making 24 ridges) running around a middle ‘equator’ line. The alignment of the band is oblique to the alignment of the pith axis, and therefore also to the growth rings. Some volume of the ball has been lost since its making and use, with what remaining weighing 203g.

2.2 General condition

The ball has dirt residue on its surface, comprising general dirt, roots and small patches of red brick dust. The wood has cracked radially in multiple places (with cracks measuring up to *c*. 3.6mm wide), and the eroded faces that result from the loss of wood are a mixture of smooth and uneven surfaces (see Figure 1). The loss of the wood volume is thought to result from insect damage, probably occurring post-depositionally; extensive insect galleries (channels) and frass are both present.

Figure 1: Image of the wooden ball, showing a selection of features as described in the text. Note: i) the location of the pith, with the concentric circular growth rings visible, ii) the paler interior of the wood, compared to the darker outer surface, iii) the multiple radial cracks, iv) the areas of insect damage, v) the band of parallel grooved line markings, and vi) the surface dirt, including a patch of red brick dust. Image: Z. Hazell © Historic England.

3. Wood identification

Prior to any sampling, the surfaces of the wooden ball were examined to see if any microscopic features necessary for a wood identification could be seen. It became evident that the dirt and degradation at the surface was obscuring features, and so some minor destructive sampling was necessary.

3.1 Wood identification methods

3.1.1 Sampling

The aim was to sample as minimally and as discreetly as possible, so a small fragment of wood was carefully detached from an already-damaged surface of the wooden ball using a scalpel.

3.1.2 Laboratory methods

Using a double-edged razor blade, the sample of wood was carefully squared off to produce smooth surfaces of the transverse section (TS), radial longitudinal section (RLS) and tangential longitudinal section (TLS); the three planes required for a wood identification. These external surfaces were then examined using the light reflective setting of Historic England's Keyence digital microscope set-up[1], at magnifications of between x20 and x1000. Images of key features were taken using the Keyence size-calibrated imaging software, especially the stacked images facility.

Although most of the wood anatomical features were sufficiently visible on this 'mini wood block', a slightly different approach was needed to see the perforation plates more clearly. For this, a small piece of the original subsample was soaked in distilled water overnight to become soft enough to thin section by hand using a double-edged razor blade. The thin sections were temporarily mounted in water between a glass microscope slide and cover slip, and examined using a high power light transmitting microscope (a Leitz Dialux 20 EB) at magnifications of between x50 and x500. Some images were subsequently taken using the light transmitting option on the Keyence digital microscope.

3.1.3 Wood identification

The wood was identified using a combination of the descriptions and keys produced by Schweingruber (1990), Gale and Cutler (2000) and Hather (2000), and the online database *InsideWood* (https://insidewood.lib.ncsu.edu/). Identification was possible to

[1] VHX-7000 main unit, VHX-7100 head, and VHX-S750E stand system.

genus level, as is standard for wood identifications on the basis of microscopic wood anatomical features alone.

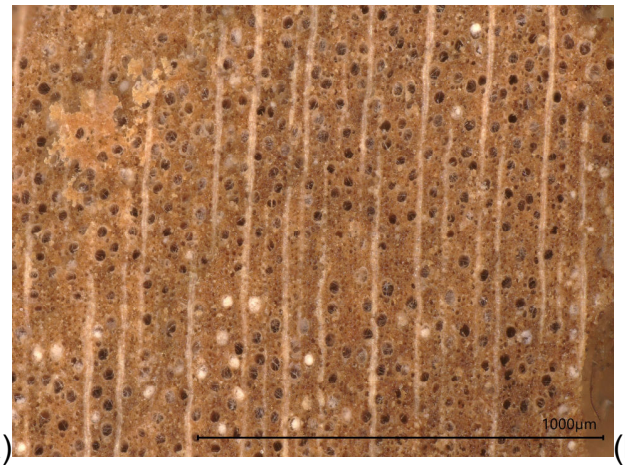
4. Results

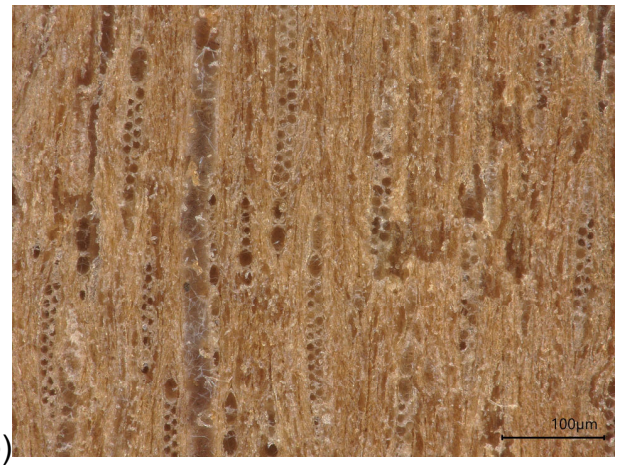
4.1 Wood identification

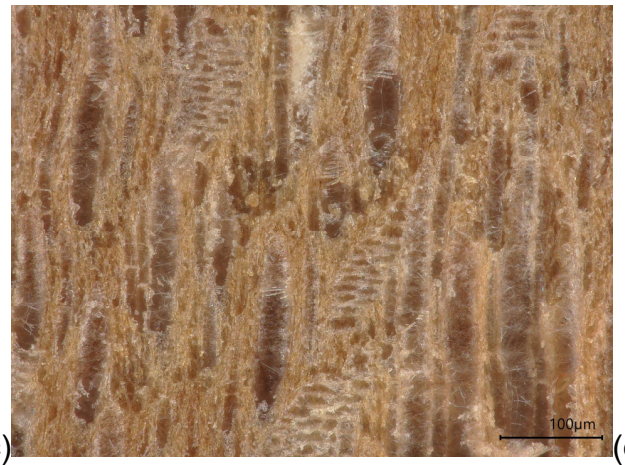
The wood was identified as *Buxus* sp. (box) based on the following anatomical features visible in the planes:

- TS (Figure 2a): diffuse porous vessel distribution, with round, very small vessels that were solitary and evenly spaced.
- TLS (Figure 2b): rays were predominantly biseriate (i.e. two cells wide) recorded as being between 8 and 18 cells high. Their ray cells were heterogeneous – a mix of very neat, very round cells, together with larger triangular and oval cells at the ends (sometimes as short 'tails'). Very occasional uniseriate rays were present (i.e. one cell wide) which had oval/elongated cells, 2 to 3 cells high.
- RLS (Figure 2c): scalariform perforation plates; a few complete plates were seen, which had from 7/8 to 9/10 bars. The rest were incomplete.

The small size of the available fragment made it difficult to get very fine thin sections. This, together with the poor condition of the wood's features, meant that it was particularly hard to find complete perforation plates (Figure 2d); in most cases they were incomplete and/or with broken bars.

(a) 

(b) 

(c) 

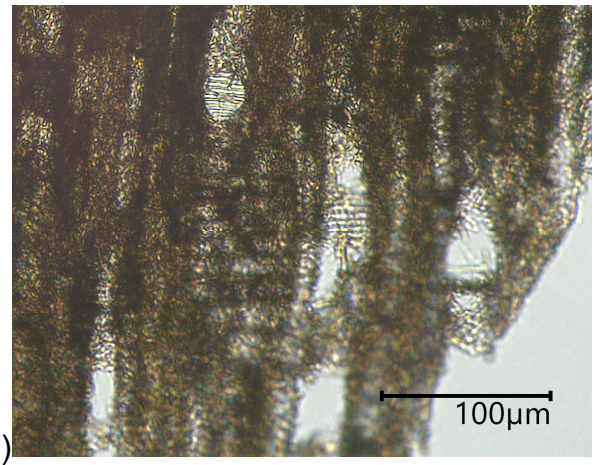
(d) 

Figure 2: A selection of images showing the microscopic anatomical features.
Surface images (a to c) of the ‘mini wood block’ show: (a) TS (the cross-section) – the very small, neat and solitary vessels, (b) TLS – the biseriate rays with heterogeneous ray cells, (c) RLS – incomplete scalariform perforation plates and fungal hyphae. (d) shows the RLS – a complete scalariform perforation plate (with either 7 or 8 bars present) preserved on a waterlogged thin section. Images: Z. Hazell © Historic England.

4.2 Other observations

Lots of fungal hyphae were observed in the vessels, and insect frass was present in the insect galleries (see Figure 3). Although it is not clear how recent the insect damage is, it is likely to have occurred following deposition. The diameter of the galleries was recorded in three places from the image, using the Keyence VHX software, as 0.585, 0.593, and 0.592mm, giving an average of 0.6mm (1dp). Fragments of the frass were also measured as 0.105, 0.116, and 0.141mm, averaging 0.1mm (1dp).

Figure 3: Image of an exposed, eroded face of the wooden ball, showing frass-filled insect tunnels. Image: Z. Hazell © Historic England.

5. Discussion

5.1 Box and its selection

Box (*Buxus* sp.) is an evergreen hardwood (angiosperm) shrub/small tree in the Buxaceae family, of which only the species *Buxus sempervirens* (L.) (box) is considered native to the British Isles. It has a very limited distribution in the UK, growing on chalk and limestone geologies of south east England – which includes West Kent (Stace 2010: 122), and therefore inferred to be the species of this artefact. In Europe, two species of box are present: *B. sempervirens* and *B. balearica* (Lam.), of which the former is the most common (Gale and Cutler 2000: 54). The latter is found in the Mediterranean including Spain and North Africa. See Di Domenico *et al* (2012: figure 1) for a map of both species' modern distributions.

The wood structure of box – in particular the fact that it is very dense with very small vessels ('close-grained') – makes it hard and resilient, and therefore ideal as a wooden games ball which would likely have had to withstand repeated impact. It was also a wood that would have been growing locally in this area of Kent and so readily available.

On mainland Europe, the prehistoric use of boxwood is recognised and has been reviewed by Piqué *et al* (2021). Historically, box was used extensively by the Romans in Italy, with its use for hedges and topiary in formal gardens extending to Roman Britain. In terms of artefactual use, there are records of it being used in a variety of objects, including writing tablets, storage boxes, combs, printing blocks, and musical flutes/pipes (Braimbridge 2013).

5.2 Examples of wooden games balls

Whilst not a primary aim of this report, brief consideration is given here to examples of early wooden games balls recovered from archaeological/early historic contexts. Based on initial enquiries, no similar objects are known to be held in English Heritage's Collection (Thompson, pers. comm, February 2024).

In England, a wooden bowling ball made of *Fraxinus* sp. (ash) was found at Coppergate, York, in a 15th century deposit (Rogers 2017: 8) – but it was a slightly different shape, described as "a cylinder with rounded ends". This description seems not too dissimilar to a Tudor bowling ball found during the London Crossrail excavations, and reported as being made of *Lignum vitae* (see https://www.philippagregory.com/news/tudor-bowling-ball).

In terms of the use of box for wooden games balls, an early historical description of the game ‘pall mall’ (‘palemaille’) by Cotgrave (1611) – a game thought to be a precursor to croquet – reports the use of a boxwood ball[2]. The book on croquet by Jaques (1886:14) discusses the advantage of boxwood croquet balls over beech (and other woods), and states (*ibid*: 13–14) that whilst the ball should be no smaller than 3 3/8” (85.72mm), it is advisable to be no less than 3 5/8” (92.10mm) – which is not only the same size as the Quebec House ball, but also modern croquet balls, which must be between 91.3 and 92.9mm (Croquet England, 2024). Furthermore, historical advertisements for croquet sets[3] are for balls (and mallets) of boxwood, offering sets of differing size balls.

A solid wood construction contrasts with modern cricket balls which are made with a cork core, ‘quilted’ with string, and then finished with the outer leather layer sewn together (see the 1956 film: https://www.youtube.com/watch?v=ATdP82zEW8U).

5.3 Further work

Imaging the internal structure of the ball, using micro-CT scanning, could help provide information on:

- the construction of the ball; the wood structure and its growth patterns – e.g. the number of growth rings, and their width (i.e. rates of growth);
- condition and integrity of the object e.g. the character and extent of internal damage from the cracking and/or the insect damage; and
- identification of the insects.

Further research into equivalent historical wooden games balls could provide some insight into the use of this particular ball; particularly whether it is a proto-cricket ball, or whether it was made for another game.

[2] “Palemaille: f. A game, wherein a round box bowle is with a mallet strucke through a high arch of yron (standing at either end of an alley one) which he that can do at the fewest blowes, or at the number agreed on, winnes.”

[3] For example, see sets advertised in the frontispiece of Jones Whitmore (1868) as supplied by James Buchanan (Piccadilly, London) and Jaques and Son (Hatton Garden, London).

6. Summary and concluding remarks

A historical wooden games ball, found during property renovations at Quebec House, was analysed for a wood identification and found to be *Buxus* sp. (box) (boxwood). The ball is currently in a stable condition, yet it has undergone some degradation, including cracking and insect damage, and it would also benefit from a gentle surface clean to remove superficial dirt.

There is great interest around the wooden ball's potential age, however boxwood is not suitable for dendrochronological dating. This means that an alternative method will be required, of which radiocarbon dating is an option. As this would require destructive sampling, the results of micro-CT imaging of the internal structure of the ball could help inform suitable sampling locations if the decision were taken to do so in the future. The same images will also provide information on the internal condition and integrity of the ball.

More work is needed to find comparable wooden games balls, either from more-recent archaeological contexts or those held in modern historical collections, to help shed further light on this ball and its use in games of the period.

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