Conservation and investigation of a child's leather shoe

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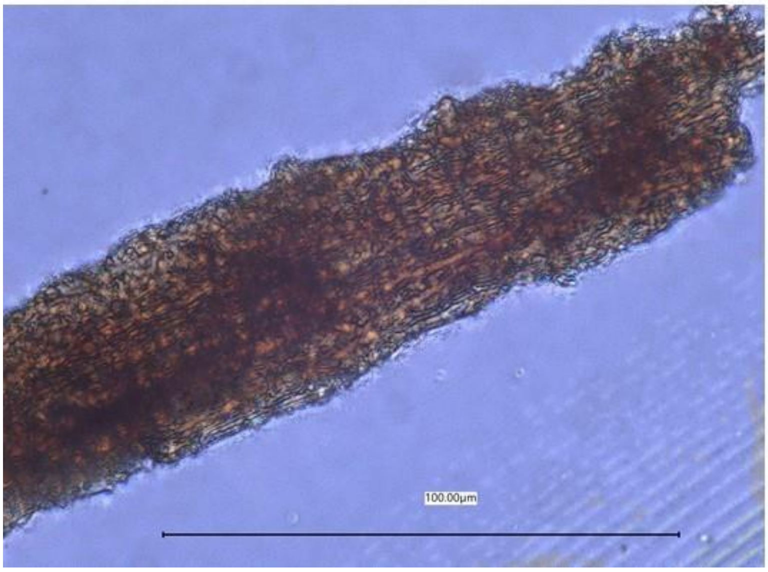

Research Report Series no. 67/2022

Shrewsbury Flaxmill Maltings
Shropshire

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NGR: SJ 49889 13852

ISSN 2059-4453 (Online)

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SUMMARY
This report covers the conservation and analytical work, as well as a finds appraisal of a child's shoe found during refurbishment works at Shrewsbury Flaxmill Maltings. The shoe forms part of a display at the new visitor experience and the results gained from the investigations informed this display.

CONTRIBUTORS
Quita Mould, Leather and Finds Specialist, undertook the finds appraisal and description of the shoe.
Francesca Gherardi, Materials Scientist, undertook the material analysis.
Gill Campbell, Archaeobotanist, undertook the fibre analysis.
Angela Middleton, Archaeological Conservator, undertook the conservation work.

ACKNOWLEDGEMENTS
We are grateful to Claire Nodder, Business Manager, Historic England, who brought the shoe to our attention and provided support throughout.
We are grateful to Rosie Bolton, Leather Conservation Centre, who provided advice on display conditions. Many thanks to AHRC (Arts and Humanities Research Council) for funding the purchase of the Keyence microscope through the CapCo (Capability for Collections) Fund (Award AH/V011758/1). Thanks also to Elizabeth Pearson for running the flax processing workshop for the Archaeobotany Working Group (AWG) in June 2019. The modern reference material used for comparison was obtained during this workshop.

ARCHIVE LOCATION
The shoe is on display at the visitor centre at Shrewsbury Flaxmill Maltings. The digital archive relating to the work presented in this report is held at Historic England, Fort Cumberland.

DATE OF Research
November 2021 – March 2022

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CONTENTS

1. INTRODUCTION

A child's shoe (#120) was found during building works at Shrewsbury Flaxmill Maltings in May 2019. The discovery was made by a JCB driver excavating a large drainage attenuation tank to the west of Nos 1 and 15, Spring Gardens. This area was developed as a small courtyard of terrace housing in the early 19th century, which became known as Haughmond Square. It was redeveloped after World War II with industrial sheds, which were demolished in the 1990s.

Shrewsbury Flaxmill Maltings is a site of internationally significant industrial heritage. It comprises eight listed buildings, including three at Grade I, two at Grade II* and three at Grade II. After a successful career in flax production starting in 1797, its use and purpose changed to malt production in 1897. The site closed in 1987 and remained derelict for many years. Historic England purchased the freehold for the Flaxmill Maltings in 2005 and entered a partnership with Shropshire Council and Friends of the Flaxmill Maltings to save this extraordinary site of industrial heritage.

A program of building works has been undertaken since, to bring this derelict building back into use. A new visitor experience, focussing on the history of the Flaxmill Maltings, forms part of the refurbishment. The leather shoe discussed here forms part of the display.

2. DESCRIPTION OF THE SHOE

The black leather shoe is of riveted construction using copper alloy rivets, with a low stacked leather heel, less than ½ inch high (Figures 1-3). As the upper has not survived the shoe style is unknown and it is difficult to date closely. The construction indicates it can date no earlier than the middle of the 19th century and what little remains may suggest a late Victorian or Edwardian date. Riveted construction was used on inexpensive footwear from the middle of the 19th century through to the middle years of the 20th century.

The remains of the shoe comprise the shoe bottom and part of the back of the upper (Figures 1-3). The shoe bottom is made straight, that is not shaped for a left or a right foot, with an oval/rounded toe, medium tread, waist and seat. The shoe bottom comprises a sole and insole, with a midsole or middle packing visible in section at the tread (Figure 3), and a low stacked leather heel c 8.20mm high. The sole has a single row of copper alloy rivets, 2mm in diameter and spaced c 5mm apart, around the perimeter (Figure 4). The heel comprises a top piece, worn down on the left side, and a single lift made of two pieces joining vertically down the middle, attached to the shoe bottom with iron nailing (Figure 4). A fragment of coarse woven textile, made from a loosely z-twisted coarse thread of tow flax (see below), adheres to the left side of the tread area of the insole. The textile appears to be incorporated into the seam at the toe so may be part of the construction, as such it may be part of a vamp lining or possibly an insock (a material inside the shoe, covering the insole). The shoe upper survives to a height of c 25+mm at the centre back, the remainder having been broken away and only visible around the edge of the toe and in the lasting seam. At centre back is the remains of the two quarters with a butted edge/flesh back seam, stitch length 1mm, machine stitched. The quarters are 1.5mm thick, no grain pattern is visible, black in colour, with a blue/grey colouration in areas likely to be the result of deterioration of a black dye or other surface treatment. Inside the quarters is a heel stiffener or other lining of sheep/goatskin c 1mm thick, flesh side inward to the foot. The top edges of both the quarters and heel stiffener/lining are broken. The dimensions are as follows: insole length 120mm, tread width 41mm, waist width 27mm, seat width 33mm, sole length c 145mm, tread width 48mm, waist width 31mm, seat width 40mm. The estimated modern equivalent size is child size 3(19).

An area of coarsely woven textile is present adhering to the upper face of the insole at the tread and extends into the sole seam in one small area at the toe. The leather is too brittle to allow investigation as to whether it is stitched into the seam. The fibres were identified as tow flax (see section 4). If the textile is incorporated into the seam it comes from a shoe lining, if it lies above the seam it may be from an insock. Possible textile is visible between the small amount of vamp remaining above the lasting margin at the toe and the insole (Figure 7) suggesting it to be a vamp lining.

3. CONSERVATION

Conservation work was undertaken at Historic England's Fort Cumberland Laboratories, Portsmouth.

Condition

The shoe was covered in loose soil and powdery, orange corrosion products. Areas were the upper survived, were covered in a grey/ green deposit on the outside of the shoe (area of the front/ toe and quarter). The heel (single lift) had become detached. The shoe was dry and the leather was stiff and brittle. A coarse fabric in plain weave was sitting on the insole towards the front of the shoe. This was extremely fragile. The front/ toe part is bent upwards. Several cracks are present on the insole, mainly concentrated towards the front/ toe part of the shoe.

Remains of metal rivets were observed on the sole and have been imaged on an X-radiograph. This confirmed the use of both, copper alloy and iron rivets. Whilst the copper alloy rivets were preserved well, the iron rivets have corroded away, leaving corrosion filled holes behind (Figure 4).

Figure 1: Shoe #120 before conservation, top view.

Figure 2: Shoe #120 before conservation, bottom view.

Figure 3: Shoe #120 before conservation, side view.

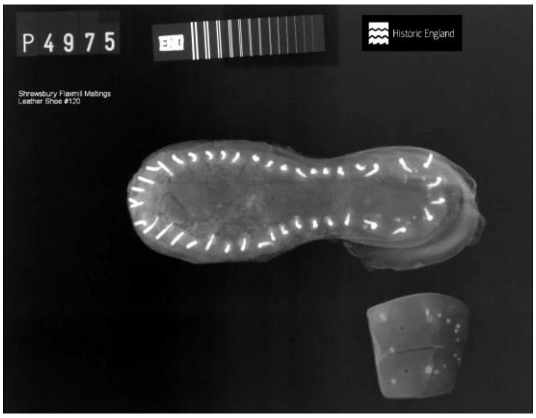

Figure 4: X-radiograph of shoe #120, showing the copper alloy rivets around the sole of the shoe and remains of iron nails around the heel.

Cleaning and repair

The soil and corrosion products were removed with a combination of soft brushes, air puffers and 50:50 Ethanol: Water with cotton swabs. This proved useful in removing the loose soil and the powdery corrosion products. Extra care was taken around the area of the coarse textile, as to not disturb or dislodge it.

It was not possible to clean the grey/ green deposit using the above methods. It could be reduced mechanically with a wooden skewer or a blunt scalpel blade. A sample was analysed to establish its composition (see section 5).

The heel was reattached to the bottom of the sole with PVA (polyvinyl acetate).

Figure 5: Shoe #120 after cleaning, top view.

Figure 6: Shoe #120 after cleaning, bottom view.

Figure 7: Shoe #120, after cleaning, detail of fabric.

Figure 8: Shoe #120 after cleaning, side view.

Figure 9: Shoe #120 after conservation, bottom view.

Figure 10: Shoe #120 after conservation, side view.

4. TEXTILE ANALYSIS

Methods

The plain-woven coarse textile was examined using a Keyence VHX7000 3-D digital microscope and imaging system and with reference to the identification manual published by The Textile Institute (1965) and the modern comparative fibre collection held by Historic England at Fort Cumberland. As the textile was very dried out, 2mm samples of the fibres were taken from broken pieces of the textile and re-hydrated in distilled water for 48 hours. These samples were then mounted in distilled water on standard microscope slides and examined using transmitted light at magnifications up to x2500.

Results

Examination of the textile *in-situ* showed that it was a plain weave made using a loosely z-twisted coarse thread (Gleba and Mannering 2012, 11) of incompletely processed plant fibre (Figure 11).

Figure 11: Coarse textile showing the weakly z-twist partly processed plant fibre thread used in its construction. (x120 magnification)

The fibres of the textile were composed of inner plant stem with the layer of fibre bundles showing up as a strong 'jigsaw' pattern with an underlying woody core visible beneath this layer (Figure 12). These features are also evident in modern tow-flax fibres (Figure 13) showing that the thread used to make the textile is tow-flax.

Tow-flax fibre is a coarse fibre that is produced as a by-product during the processing of flax to produce linen fibre. When the flax is hackled to remove any adhering stem cortex and produce a pure linen fibre (line) ready for spinning (see Pals and van Dierendonck 1988; Baines 1998, 6), shorter flax fibres with some stem cortex tissue still present are produced as a by-product (Figure 14). These coarse fibres, known as tow fibres or tow -flax, were used to make a variety of products, including clothing, sacking and rope (Baines 1998, 20).

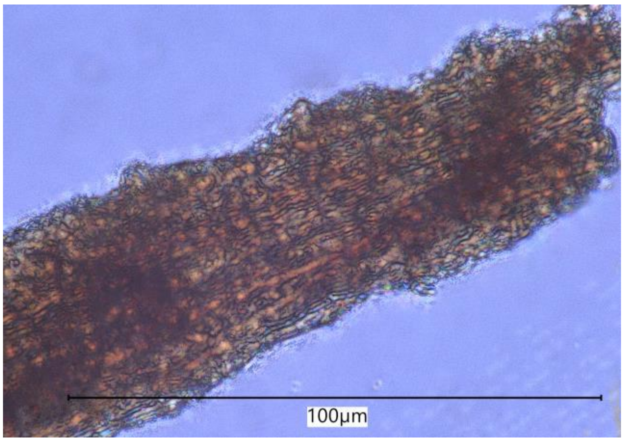

Figure 12: Fibre from the textile associated with the shoe. (x2000 magnification)

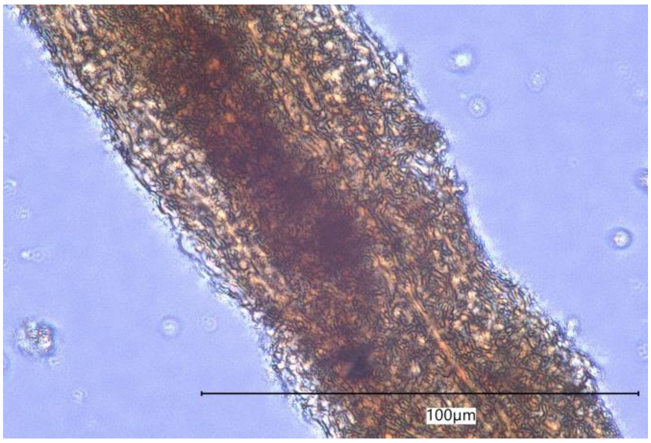

Figure 13: Modern tow flax fibre. (x2000 magnification)

Figure 14: Elizabeth Pearson, Worcestershire Archaeology, hackling (heckling) flax. The flax stems are pulled through a hackle with the teeth set successively closer together to remove any remaining stem tissue. The short fibres that are combed off are gathered to provide a lower quality product (the tow). This material can be seen on the paving stones under the hackle. Photograph by Zoë Hazell.

5. CHARACTERISATION OF SURFACE DEPOSITS BY FOURIER TRANSFORM INFRARED (FTIR) SPECTROSCOPY

Method

Grey/green and orange deposits were observed on the leather shoe. These areas were sampled and investigated by Fourier Transform Infrared (FTIR) spectroscopy to obtain qualitative chemical information. The FTIR spectra were acquired by a Spectrum 100 spectrometer (Perkin Elmer) equipped with a DTGS detector, fitted with Attenuated Total Reflection (ATR) diamond-ZnSe crystal accessory. Spectra were recorded over the range 650-4000 cm^{-1}, with a resolution of 4.00 cm^{-1}, and were averaged over 32 accumulations.

Results and discussion

The spectra collected from the grey and orange deposits show similar absorption bands (Figure 14). Spectral band of lipids were observed at about 2920 and 2851 cm^{-1} assigned to the anti-symmetric and symmetric stretching of CH_2 groups, at 1739 and 1708 cm^{-1} related to anti-symmetric stretching of C═O bonds of esters and acids, respectively, at 1458 cm^{-1} corresponding to the bending of CH_2 groups and at 1249 and 1163 cm^{-1} of anti-symmetric and symmetric stretching of C-O-C bonds. Lipids were probably found as residues of fat compounds (such as linseed oil) used to treat the leather surface.

The spectra displayed an intense peak at 1404 cm^{-1}, which corresponds to the anti-symmetric stretching mode of CO_3 groups (Figure 15), suggesting the presence of a carbonate-based compound. Calcium carbonate is often found in historical leather, as the result of the carbonation of lime (calcium hydroxide) used in the liming bath with CO_2 from the atmosphere (Vichi et al 2018). The broad band at 1040 cm^{-1} corresponds to silicate-based contaminants.

Sharp bands at 1553 and 1458 cm^{-1} (anti-symmetric stretching of COO- and bending of CH_2 groups) can be observed in the spectra and they can be assigned to metal carboxylates (metal soaps). These salts were probably formed because of the reaction of fatty acids of an oil used to treat the leather and the cations of inorganic compounds, such as calcium carbonate. Similar results were obtained on historical leather book covers, where calcium carboxylates were formed due to the saponification of calcium carbonate and gypsum (Vichi et al 2018). Metals soaps were found in leather objects, in the areas where the leather was in contact with a metal part (zinc pipe) (Robinet and Corbeil 2003). The shoe does not have any metal components close to the areas where the white and orange spots were observed, so this origin can be excluded. The formation of metal soaps on leather can be also due to the saponification of animal fat and wood ash applied to the leather during manufacturing (Püntener and Moss 2010).

The spectrum collected from the grey deposits shows additional bands at 1628 and 1310 cm^{-1} (symmetric and anti-symmetric stretching of COO-), which are associated with calcium-based oxalates, in particular weddellite ($CaC_2O_4.2H_2O$), probably due to biological colonisation (fungal species) (Proietti et al 2020) (Figure 15).

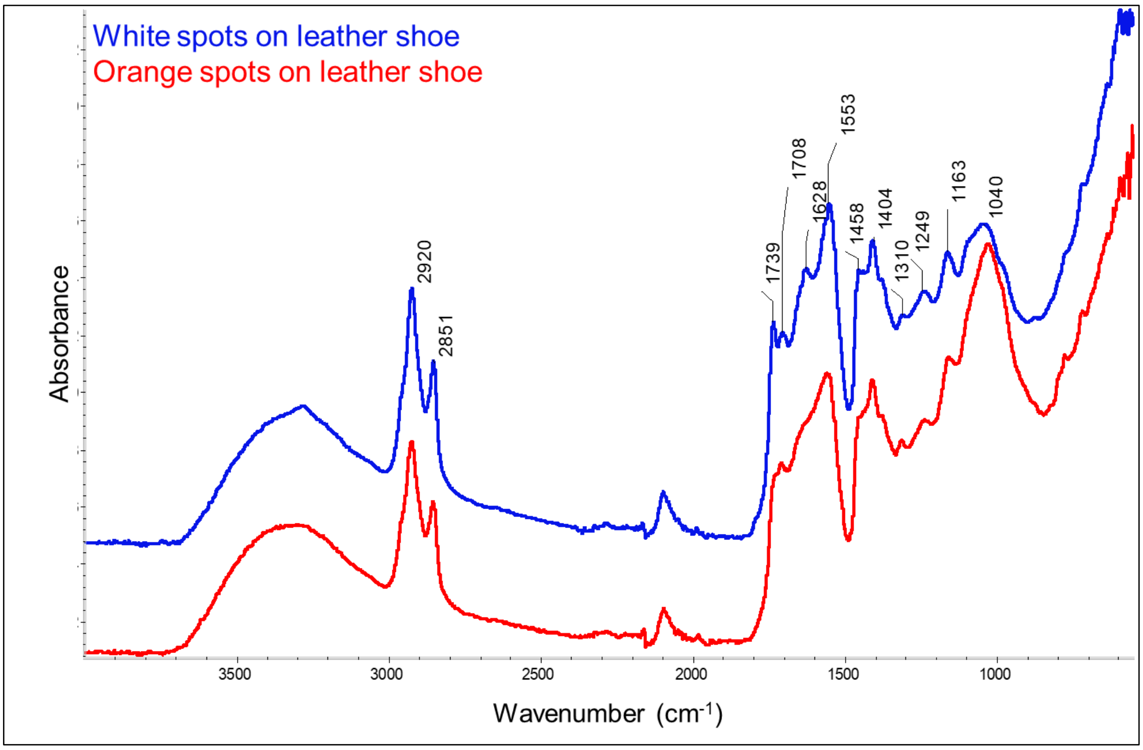

Figure 15: FTIR spectra of the white and orange spots found on the surface of the leather shoe.

6. DISCUSSION

The shoe is of small size and may represent a child's first footwear, as such it may have been retained for sentimental reasons. It appears to have been worn on the left foot, which may be of significance as a left foot shoe was often selected for deliberate deposition (van Driel-Murray 1999). It is possible that this shoe had been deliberately concealed for its supposed apotropaic (something to avert evil) properties within the fabric of one of the terraced houses a building formerly on the site.

The later Victorian or Edwardian date fits well with the time when the buildings were operating as a flax mill. This shoe adds a valuable dimension to the display at the visitor centre of the newly refurbished Shrewsbury Flaxmill Maltings. It is tangible evidence of the every-day life that once took place. Especially the identification of the tow flax allows a fascinating insight into the working life and conditions present at the flax mill. It can be speculated that workers could use this lower quality flax fibre for personal use, and this shoe might provide evidence for this practice if the textile had been subsequently placed in the shoe for the wearer's comfort rather than being part of the shoe's original manufacture.

7. RECOMMENDATIONS FOR HANDLING, STORAGE AND DISPLAY

The shoe remains in a fragile condition, especially in areas of upstanding leather and the coarse fabric. During handling, these areas should be avoided. The shoe is best moved by picking it up at the waist (middle section of the shoe, where it narrows).

For either storage or display the environmental conditions should be as stable as possible, aiming to reduce fluctuations of more than 5% in a 24h period. The relative humidity should be around 50% +/-5%. The lower/ upper limits should not exceed 45%/ 60%rH. The temperature should be between 17°-21°C. Direct sunlight should be avoided as this can raise the temperature above the upper limit.

For display an airtight showcase should be used. The use of a buffer (ie.: Artsorb©) can be advisable if airtightness is a concern.

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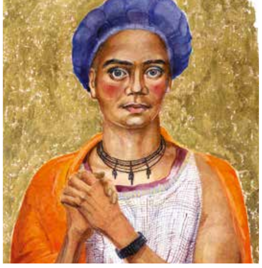



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