# THE ARCHAEOLOGY OF THE RENOVATION OF DUNBLANE CATHEDRAL MUSEUM

## Beverley Ballin Smith, Alastair Becket, Gavin MacGregor, David Sneddon and Bob Will

# Introduction

In June and July 2008 and January 2009, Glasgow University Archaeological Research Division (GUARD) undertook archaeological monitoring of the renovation of the existing structures and the construction of a new annexe at Dunblane Cathedral Museum, The Cross, Dunblane. This work was carried out on behalf of Dunblane Cathedral Museum as a response to conditions placed upon planning consent granted by Stirling Council (S06/00553/LBC).

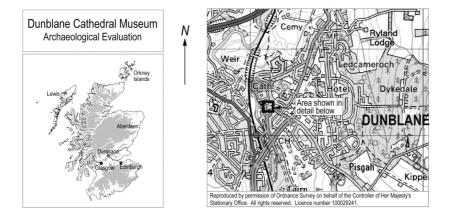
Dunblane Cathedral Museum (NGR NN 7820 0134), lies at the heart of the medieval burgh of Dunblane, opposite the Cathedral with the Allan Water approximately 100 m to the west. The museum buildings rest on glacial sands and gravels beneath which are sandstones (Geological map, Stirling Sheet 39, Drift and Solid). The site comprises the Dean's Manse and a series of terraced structures to the east, as well as an open area to the south that formerly accommodated an earlier extension to the museum that has now been demolished (Figure 1).

## Archaeological Background

GUARD had previously undertaken an archaeological evaluation and monitoring of the work of site investigation in October 2007, in the form of three trial trenches and three test pits (Will and McLellan, 2007). A series of archaeological features and deposits were identified within the evaluation trenches and within one test pit. Notable deposits at the south-west corner of an extension built in the 1970s, included the remains of a stone-capped drain, areas of cobbling, and flooring located below the topsoil and a concrete slab. The features were only recorded and not excavated to allow a mitigation strategy to be developed.

The area surrounding Dunblane Cathedral Museum, including the area of the Cross and Kirk Street, contains a wealth of archaeological material and some of the oldest standing buildings in Dunblane particularly from the medieval period being the then focus of the medieval burgh. This area was the most heavily developed part of the town, being so close to the market place and, as a result, competition for space was at its most intense with much rebuilding of properties and the expansion and contraction of streets and property boundaries (Will, 2007).

The cathedral museum building (Plate A) was constructed on the Cross



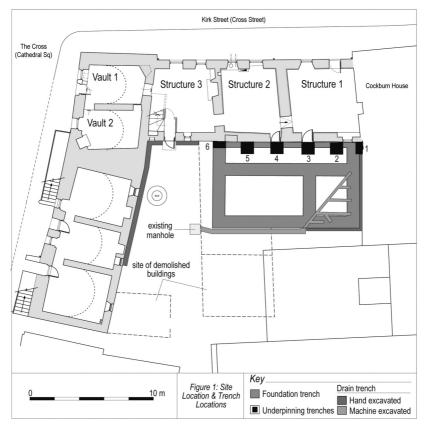


Figure 1. Site location and trench locations.

around 1624 as the Dean's Manse but there are few records available to indicate the previous usage of this site prior to this date (NMRS: NN70SE 15.06). However, the area of the annexe is known to have had a series of buildings on it over the last 150 years and the present day gardens were occupied by a 19th century weaving shop and stables.

## Aims and Objectives

The aim of the watching brief was to provide archaeological supervision for the demolition works, to ensure that any disturbance of ground, services and the existing foundations did not result in the unrecorded removal of any archaeological deposits. It also covered monitoring the excavation of foundations for the new extension and its associated services in the courtyard and the pend through to High Street. Any new openings in the fabric of the existing building were also recorded.

## Methodology

Renovations at the building involved ground disturbance works, both within and outside the buildings. All ground work was supervised by an archaeologist and excavations were undertaken either by hand or with a mechanical excavator. Archaeological features were cleaned, recorded, planned and photographed (full details of the site methodology are in the RCAHMS (Edinburgh) archive).

Owing to the number of alterations to internal and exterior spaces area codes were given to rooms and trenches (Figure 1). The terraced east wing was divided into three 'structures' (numbered 1 to 3) with an upper and lower room in each. The vaulted rooms located on the ground floor of the Dean's Manse were numbered 1 to 2. All exterior works associated with the construction of the new annexe were concentrated to the south of the east wing in the area of the former extension and within the communal garden area to the rear of the museum. A series of six trenches (UP 1-6) were excavated to under-pin the south wall of the eastern range where the new annexe joined the existing buildings.

Demolition of the 1970s extension and works within the buildings revealed several previously hidden architectural features, which were also recorded to archaeological standards. New openings in the fabric of the structures were also monitored and recorded including the creation of holes in walls to support roof steels and the replacing of rotten timber lintels. Concrete slabs forming the floors within structures 1, 2 and 3 were broken up and the floor levels reduced by c. 0.2 m. A stairway within the eastern range was also removed.

## External Works (Plate B)

Work focused on the exterior of the museum, within the footprint of the

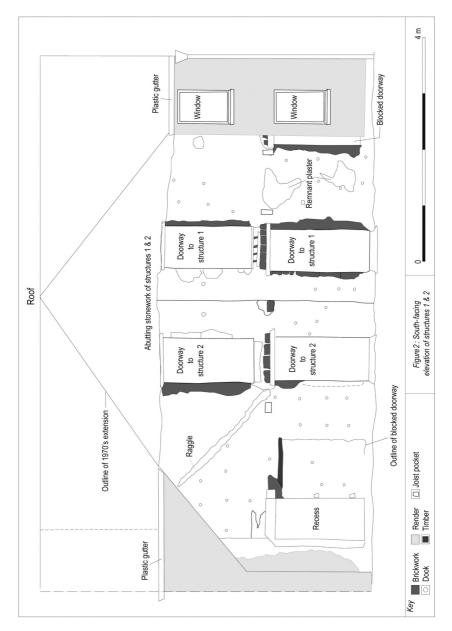


Figure 2. South-facing elevation of structures 1 and 2.

extension to the eastern range, where several archaeological deposits and features were encountered (see below). The exterior stonework of the building once exposed by the removal of the extension showed that the terrace comprised three separate abutting buildings (Figure 2). This configuration was confirmed by the northern elevation where there are clear differences in the construction of the windows (Plate C).

Four south-facing doorways in Structures 1 and 2 were all of recent origin, and had been knocked through the original walls of the building during the construction of the extension. Two blocked doorways and a recess that may have been a blocked doorway on the ground floor, also related to these structures. A raggle (evidence of a former roof alignment) within this wall and patches of horse-hair plaster plus the presence of many wooden dooks or plugs (remains of structures that adjoined the terrace.

The grubbing up of foundations of the demolished extension to the south of structures 1 to 3 did not result in any disturbance to archaeologically sensitive deposits. The foundations were of reinforced concrete, 0.35 m thick, dug into a c. 0.50 m thick deposit of mixed rubble and soil (001) which covered the entire area of the extension.

The first under-pinning trench (UP 1) was excavated in the north-east corner in the location of a test pit (Test Pit 1) excavated during the evaluation phase (Will and MacLellan, 2007). Both the digging of the test pitting and the construction of a large drainage pipe trench that runs southwards from the corner of the buildings, have significantly disturbed this area. In undisturbed areas, the mixed rubble (001) was 0.3 m thick and extended to the base of the foundations, below which was sandy subsoil (008).

In UP2, beneath the capping rubble (001) was a 0.2 m thick layer of greybrown sandy-silt (002), which ran underneath the foundations of Structure 1. This material overlay the sandy subsoil (008).

Beneath the rubble (001) and sandy-silt (002) in UP 3 (Figure 3) was a dump of loose small stones and grey sandy-silt (003). Below was another layer of sandy-silt (004), up to 0.35 m thick, which covered a partly visible oval-shaped pit (006) cut into the subsoil (008). A mixed clay deposit, with lumps of burnt clay and the occasional small stone (005) filled the upper part of the pit. The lower part contained a thin layer of charcoal (007) beneath which its base and sides were discoloured by burning or scorching. This pit (006) was thought to be the earliest feature on the site. A sample from the charcoal was analysed by Susan Ramsay and both Ericales (heather type) and *Cytisus/Ulex* (broom/gorse) was identified. This suggests that, whatever the pit was used for, the fuel had been selected to provide a fast and intense heat (Gale and Cutler, 2000). A sample of *Cytisus/Ulex* charcoal produced a radiocarbon date of 1270-1400 AD (SUERC-32841 at 2 sigma – 95.4 % probability) indicating that it pre-dated the buildings on the site.

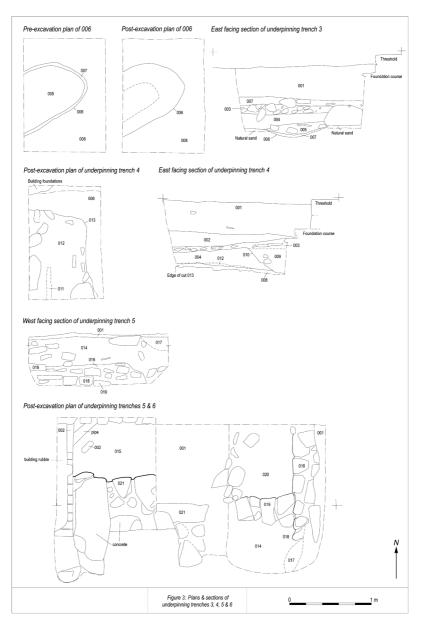


Figure 3. Plans and sections of underpinning trenches 3, 4, 5 and 6.

UP 4 (Figure 3) contained the same overlying deposits, (001, 002 and 003) seen within UP 3, as well as a linear feature (010) that ran parallel to the foundations of Structure 2. This feature had been dug into the homogenous sandy deposit (004) seen in UP 3 and was filled with grey-brown silty-sand (009). A partially visible linear feature (013) aligned north/south filled the base of the trench. It was filled with silty-clay (012) and possibly lined with stones. A single large stone slab (011) was removed from the top of the fill and it may have been a capping stone. The linear feature (013), possibly a drain, was cut into subsoil (008).

A series of walls were discovered within UP 5 (Figure 3), in places only 0.2 m beneath the ground surface but sealed beneath rubble (001), a patch of modern builder's sand (017) and a deposit of yellow-brown silty-sand (014). Two adjoining stone walls, both mortar bonded, one aligned north/south (018) and the other east/west (019) appeared to correspond to the roof raggle and wooden dooks seen on the walls of Structures 1 and 2 (Figure 2). The area between the two walls and the wall of the building was filled with a yellowy-brown deposit of silt (020).

The final trench (UP 6) had been heavily disturbed at its western end by drainage pipes relating to the 1970s extension. It revealed a continuation of east/west wall (019/021) in UP5 with a brown sandy-silt and rubble deposit (015) between it and the existing wall.

Excavations required for the foundations of the new annexe included a general reduction in ground level of 0.3 m. This disturbed the mixed rubble (001) as well as the upper sections of the walls identified within UP 5 and UP 6. Several deeper trenches, around the perimeter of the site and in the location of the annexe's internal walls, cut through the rubble (001) and exposed the brown silty-sand (002) that had been identified in the under-pinning trenches. Several artefacts were recovered from the rubble (001) during this phase of excavation, including three intact glass bottles (SF 53 – a Dutch gin bottle stamped '*P. Loopuyt & Co. Distillers Schiedam*'), several sherds of green glaze pottery (SF 29), and an intact brown glazed ceramic bottle (SF 30) (Plate H). The excavation of the foundation trenches required the partial removal of wall (018) identified in UP 5.

Several trenches were excavated at the south-eastern corner of the site to accommodate waste water pipes. As they were dug 0.2 m deeper than the foundation trenches they revealed the top of a possible sandstone wall running north/south in this area. A decorated spindle-whorl SF 32 was found within the mixed rubble (001) close to this wall (Plate D). The northern drainage channels were excavated though an area heavily disturbed by water and waste pipes from the 1970s extension and no archaeological features were encountered here.

A further series of narrow trenches, 0.3 to 0.5 m wide, were excavated to accommodate drainage pipes once the new building had been erected. These

generally ran parallel to the external walls (Figure 1) and did not contain anything of archaeological significance.

A machine excavated trench ran east/west, parallel to the southern end of the new building, to a maximum depth of 0.7 m from the ground level. The majority of the trench contained a mixture of brown silty-sand and rubble (001). At its eastern end, a concentration of large and small sandstone rubble fragments (024) and flatter stone fragments (023) were present in the base of the trench mixed with dark-brown sandy-silt and mortar (025), similar to (001). A fragment of modern glass (SF 35) and china (SF 34) were found on top of the rubble. Natural orange sand and gravel (008) was also located in the base of the trench and, although not clearly defined, sandstone rubble (024) and the darker sandy-silt (025) may have been contained within a linear feature running approximately north-east/south-west. However, this was not investigated further due to the limited width of the trench and the presence of a large sandstone boulder. The rubble concentration and possible linear feature could have been the remains of a robbed out wall.

### **Internal Works**

The removal of plaster from several interior walls revealed evidence of previous alterations to the structures and in some cases provided an insight into earlier functions prior to their incorporation into the museum. Floor levels were reduced by a maximum of 0.2 m in all three structures but not within the vaults. These excavations showed that sandy material had been brought in to form their floor levels. Several sherds of glass (SF 1), an unidentified coin (SF 15) and green glaze pottery (SF 5) were found in this material.

#### Structure 1

On removal of plaster and plasterboard from the walls of the ground floor level of Structure 1, several layers of wallpaper SF 4 were found as well as a shadow of a staircase on the eastern wall that provided access to the upper floor (Plate E). The fire-escape in the north wall may have been the original doorway to the building. Other alterations noted included the bricking-up of a doorway in the eastern wall, the eastern end of the southern wall had been significantly rebuilt and modern windows had been inserted. The western wall contained areas of inserted brickwork around the doorway to Structure 2 and the blocking of a fireplace (Plate F).

The upper floor of Structure 1 was not stripped of plaster but four holes were excavated in the eastern and western walls within the loft space to Figure 4: East-facing & west-facing elevations of structure 3, ground floor accept new roof steelwork (Plate G). The holes in the eastern wall revealed dual chimney flues running up each side of the gable.

## Structure 2

The details of construction and alteration in Structure 1 were not seen in

Structure 2 as plaster was not removed from its walls. It is unlikely that any of the doorways are original, although a blocked doorway identified in the southern exterior elevation of the structure may have been original. A small recess was noted in the north-western corner of the ground floor.

## Structure 3

Plaster was stripped from all four walls within the ground floor and a stairway to the upper floor was removed from the western wall.

The ground floor doorway between Structures 2 and 3 had been knocked through the original wall. A doorway or window with a wooden lintel in the western wall of Structure 3 to Vault 1 had been blocked with stone (see below) (Figure 4). A second blocked doorway was noted in the southern wall, which had been replaced by the current doorway to the courtyard. The westernmost window in the street-frontage may have been the original front door of this structure. Brickwork at the western end of the southern wall suggests a large blocked area possibly relating to the stairway to the upper floor.

Little plaster was removed from the upper floor of this structure but the scar of a stairway to the loft space, a bricked up doorway and small blocked window in its west wall were identified. The removal of a cupboard in the north-eastern corner of the room showed that a doorway had been knocked though this wall between Structures 2 and 3 at some stage in the past. It created a hole in the side of the chimney breast rising from the fireplace in the room below.

## Vaults

The eastern walls of Vaults 1 and 2 contained blocked doorways or windows, indicated by timber lintels. The blocking in Vault 1 was partly hidden behind the wall and the roof vaulting. The doorway between the two vaults was cut through the western end of the dividing. Fireplaces had been built into the corners of both rooms. The window recess in the western wall of Vault 2 may represent a blocked doorway.

#### Artefacts found during the building works.

## The Pottery by Bob Will

This small assemblage of 69 sherds of pottery is a good indicator of what was pottery was available in Dunblane during the medieval to modern period (Table 1). Not surprisingly the medieval and post-medieval pottery from across the site is probably of local origin.

## The medieval assemblage

The small assemblage consists of six sherds Scottish medieval redwares. In this instance the sherds date mainly to the late 14th or 15th century as they are generally thicker-walled and glazed suggesting that they are from jugs

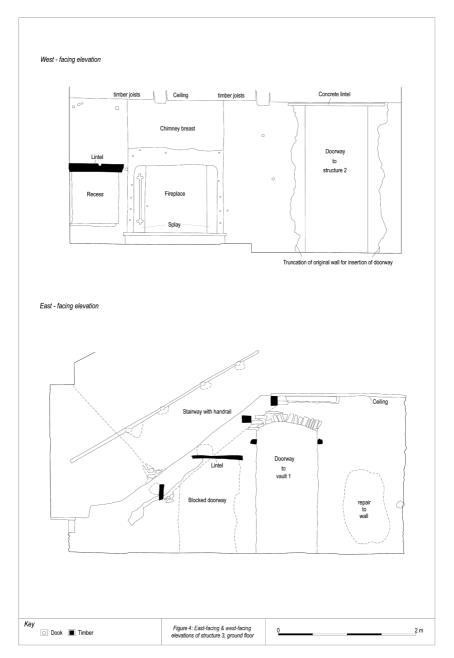


Figure 4. West-facing and east-facing elevations of structure 3, ground floor.

although a more finely made handle may be earlier (Plate H). The latter came from the foundations of the weaving shed in UP5. The term *Scottish Medieval Redware* is a general name to describe a group of similar fabrics found throughout Scotland. The largest assemblages of Scottish Medieval Redwares have been recovered from excavations in Aberdeen, Perth and other east coast burghs, which along with kiln sites at Rattray near Peterhead and Stenhouse near Falkirk have lead to the use of the fabric name East Coast Redware (Hall, 1996). Generally these fabrics date from the 13th to the 15th century.

#### Post-medieval

Twenty-nine sherds from the post-medieval period (1500-1750) were recovered. Most of the sherds (27) belong to the fabric type *Scottish post-medieval reduced wares*. These are thick-walled with a grey to black fabric and thick green glaze. One sherd SF 43, context 18 from UP5 was decorated (Plate H). One of the first assemblages of this material to be studied was from Stirling Castle (Haggarty, 1980) and a kiln site is known from Throsk near Alloa on the Forth dated to c. 1617 to c. 1750 (Caldwell and Dean, 1992). Both sites are not far from Dunblane. Many of the sherds have split or fractured (spalds) and appear to be from bowls with out-turned rims possibly cooking pots or from jugs. One sherd, from the ground floor of Structure 2, also from a bowl or skillet, was recovered in a Scottish post-medieval oxidised fabric (Plate H). This reflects conditions in the kiln and these fabrics tend to be orange/red in colour and are often partially reduced rather than fully reduced. Another thin-walled and finely made sherd was recovered which may be an import but it was too small and partially burnt for a fuller identification.

#### Modern material

The modern material (1750 onwards) consists of a mixture of white earthenwares, red earthenwares, modern stoneware and a mixture of tiles and other utility wares. Amongst the white earthenwares was one sherd of tinglazed earthenware with a blue hand – painted decoration which would date to the late 18th century and could be a product of the Delftfield factory in Glasgow (1748-1823) (Plate H). It came from the topsoil during the exterior works. There are also sherds of creamware and pearlware which again could be late 18th century although these wares continued to be made into the 19th century. The red earthenware sherds included brown glazed bowls with slip decoration and storage jars with black glaze.

A complete brown glazed industrial stoneware ink bottle with a spout was recovered from the topsoil of the exterior. It is stamped with the name of the French manufacturer *N* Antoine & Fils, encre Japonaise (Japanese ink) (Plate H) which would date to late 19th or early 20th century. While ink bottles are quite common this is the first instance known to the author of a French bottle being recovered from excavations in Scotland. Although the company was based in Paris they had outlets in other countries and cities including London.

## 124 Ballin Smith, et al.

Fabric	Sherds No	Weight (g)	Comments
Scottish Medieval Redwares	6	160	Mainly late 14th/15th century sherds from jugs but includes a ridge jug handle with an oval profile
Scottish Post-medieval reduced wares	27	422	Mainly from open bowls or skillets and jugs many of the sherds have cracked and split
Scottish post-medieval oxidised wares	1	36	Rim from a bowl or skillet, glazed on the interior
Post-medieval orange fabric	1	8	Finely made possible imported ware
Modern white earthenware	16	148	Includes tin glazed earthenware possibly Delftfield, creamware, pearlware and various forms of decoration including hand-painted and transfer printed
Modern red earthenwares	6	125	Includes slip decorated bowls and storage jars
Modern stoneware	1	308	Complete brown ink bottle from the French manufacturer ' <i>N</i> Antoine & Fils, encre Japonaise 'late 19th or early 20th century
Miscellaneous tiles etc	11	3320	Includes pan tiles, toilet fittings & chimney pots
Total number sherds	69	4527	

Table 1: Breakdown of fabrics and sherds

# The Glass by Beverley Ballin Smith

A total of 40 sherds of glass were recovered from the excavations, mainly from the topsoil. All but three sherds are from bottles. The majority of the sherds (19), including one complete bottle, are from green wine bottles. Four sherds are from brown bottles and 14 sherds from clear/pale blue bottles, the majority are handmade. Of note is SF 46 from trench 2, context 18, which is the rim and neck of a pale green bottle of early 18th century date. SF 53 is a hand blown and moulded green gin bottle with *P. Loopuyt & Co. Distillers, Schiedam*, (of late 19th century probably c. 1890, see Maunsey, 2009) (Plate I) and SF 28 a small, square, hand-blown and moulded ink bottle in clear/pale blue glass (Plate H). Both the latter two finds came from the exterior topsoil. The three pieces of window glass came from the topsoil in UP 4. A clear ridged window glass is machine produced and modern in date.

# The Stone Artefacts by Beverley Ballin Smith

Six stone artefacts were recovered from the site. Three are fragments of sandstone gravestones, with fragmentary lettering or numbering, and one piece is a perforated fragmentary roof slate. All are undated and mostly from

the topsoil. The following are noteworthy:

SF 32 from the topsoil is a fine-grained steatite/soapstone spindle whorl (Plate D) c. 42 mm in diameter decorated on both faces. It is pierced by a vertical but slightly off-centre hole, 11.1 mm diameter. One face has regularly distributed incisions radiating out from the perforation. The other face has 12 panels: half are plain and alternate with others which are decorated with horizontal lines. The edges of the whorl are smooth and slightly worn. Weight 34 g.

SF 8 from the topsoil of UP 4 is a small squared sandstone lamp hollowed on one face. The hollow measures  $50 \times 40 \times 2$  mm depth and was made by a fine chisel: marks are visible around its edge. The stone is possibly burnt and its base is flat with evidence of slight wear. Its sides have been chipped to shape but are not smoothed. It measures  $74 \times 67.5 \times 41.5$  and weighs 264 g.

#### Discussion

Since the construction of the Dean's Manse in 1624, Dunblane Cathedral Museum has undergone many phases of use including a series of alterations. A pit (006), possibly an expedient hearth located in UP 3, was excavated during the construction of the new annexe, and was dated to 1270 to 1400 AD. This single feature pre-dates not only Structures 1 to 3, but all other buildings on the site including the Dean's Manse. It is significant in that it suggests archaeological features relating to earlier periods of occupation survive beneath layers of overburden. The occurrence of medieval pottery on the site indicates contemporary uses and activities. These snapshots of evidence do not provide much of a story in themselves of what was happening in medieval Dunblane, but the potential to add to the information surviving below the foundations of the present-day buildings in the centre of the burgh is high.

A second unexcavated feature (013), a possible drain, was found in UP 4 at a similar depth to pit (006) and may be contemporary with it. It had been covered by redeposited subsoil (004), during levelling of the site prior to the construction of Structures 1-3. It is perhaps during this period of construction that the stone and silt layer (003) was deposited in the area of UP 3 and UP 4. Whether the feature within UP 4 pre-dates the Dean's manse is unclear.

The ground floor of the manse comprised a single large vault, with a front and rear entrance and windows. It was later subdivided into two separate vaults (Vaults 1 and 2), which had doors and windows to the west and possibly also to the east, and a corner fireplace in each. The most recent major alteration to the vaults involved the creation of the door- or passageway in the central vault wall between the two.

The original exterior wall of the Dean's Manse was partially revealed within Structure 3 where an east-facing window and a bricked up doorway were noted (Figure 4). It is possible that evidence of a staircase seen in the western wall of the upper floor in Structure 3 related to this blocked doorway, which may have linked the two structures.

Structures 1-3, were built as three individual buildings of two rooms (ground and first floor) with loft space, and were accessed by stairs on their west walls. They formed a small terrace although the order of their construction is unclear. The southern exterior elevation and the interior elevations revealed during the course of works show that these structures have undergone significant changes over time. Each of the original three buildings was a simple two-roomed structure most likely occupied as a house. Blocked doorways in the southern walls of all three buildings may have been rear doors. It is unclear when these buildings were linked by doorways cut through their original walls, but it could be of fairly recent date.

The recess in the southern elevation may relate to a partially blocked doorway between Structure 2 and a weaving shed to the south. This structure was shown as a single rectangular structure on the first edition Ordnance Survey map of 1863-1864, and as a sub-divided structure on later maps until the creation of the museum annexe in the 1970s. The walls of this shed were identified through excavation and its roof as the raggle line noted on the exterior elevation of Structure 2. The discovery of a lamp (SF 8) and spindle whorl (SF 32) are further evidence that these buildings were for domestic occupation.

Another southern extension to Structure 1 was noted between 1900 and 1932, when it was shown on the 3rd Edn. Ordnance Survey map. It was demolished to make way for the construction of the annexe in the 1970s but it may explain the brickwork seen in the southern elevation of Structure 1 and the fragments of wall identified within the drainage trenches.

The construction of the 1970s extension to the museum was significant in both altering the internal layout of the original buildings as well as disturbing the archaeological deposits externally. The courtyard area was landscaped prior to the construction of the extension and material relating to the demolition of the weaving shed was mixed to form the deposit (001) that overlay the entire area. This material contained finds from a variety of periods and the inclusion of complete bottles suggests that the deposit had not been significantly disturbed since its deposition.

The watching brief at Dunblane Cathedral Museum offered an opportunity to investigate the archaeology of this significant location in the heart of Dunblane. Due to the nature of the development it was possible to mitigate any significant disturbance to this cultural resource. The potential for further and earlier archaeological remains, such as feature (013), was shown to be high.

## Acknowledgements

Thanks go to the Dunblane Cathedral Museum for funding the work and especially to Janet Ainslie of the museum and Lorna Main, formerly of Stirling Council Archaeology Service for their input and assistance. Fieldwork was undertaken by Bob Will, Christine Rennie, Dave Sneddon and Alastair Becket. Susan Ramsay provided the botanical identification, illustrations were produced by Gillian McSwan and Caitlin Evans, and technical support was provided by Aileen Maule and John Kylie. Fieldwork was managed by Gavin MacGregor and the post-excavation by Beverley Ballin Smith.

## References

- Becket, A. and Sneddon, D. 2009. *Dunblane Cathedral Museum Watching Brief: Data Structure Report*. Unpublished report (GUARD 2489).
- Caldwell, D.H. and Dean, V.E. 1992. 'The pottery industry at Throsk, Stirlingshire, in the 17th and early 18th century', *Post-Medieval Archaeology* **26**, 1-46.
- Gale, R. and Cutler, D. 2000. Plants in Archaeology. Otley: Westbury Publishing.

Geological Survey of Scotland 1969. Sheet 39 – Stirling, Solid, 1 inch to 1 mile.

Geological Survey of Scotland 1969. Sheet 39 – Stirling, Drift, 1 inch to 1 mile.

Haggarty, G. 1980. 'Appendix A the pottery'. In Ewart G., Excavations at Stirling Castle 1977-78 Post-Medieval Archaeology 14, 36-45.

Hall, D.W. 1996. Blind date-Scottish medieval pottery industries, Tayside and Fife Archaeological Journal **12**, 126-9.

Munsay, C. 1970 and 2009. Gin Bottles – a history and pictoral essay. http://www.CecilMunsey.com accessed 110207.

- Ordnance Survey 1863-4. First Edition 1:2500.
- Ordnance Survey 1900. Second Edition 1:2500.

Ordnance Survey 1932. Third Edition 1:2500.

Schweingruber, F.H. 1990. Anatomy of European Woods. Stuttgart: Haupt, Berne.

Will, B. and McLellan K. 2007. Dunblane Cathedral Museum GUARD Project 2489. Unpublished Data Structure Report. 128 Forth Naturalist and Historian, volume 34